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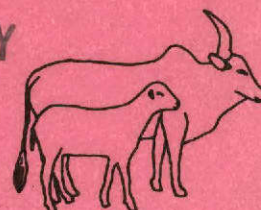
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WORLD  
BANK



# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

### FORAGE NETWORK IN ETHIOPIA

#### NEWSLETTER

May-June/83

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#### Introductory Message

The Forage Network in Ethiopia (FNE) is organized to promote more and better quality forage research in Ethiopia. It hopes to achieve this by increasing communication between scientists and encouraging the exchange of germplasm. The group's activities include meetings, field trips, this Newsletter and multilocation trials.

The Network has been in existence since October 1980 when a number of the forage research staff of IAR, ARDP, MCA and ILCA met at the ILCA headquarters and the first multilocation forage trials resulted. These were planted in 1981 at mid and high altitudes. In 1982 the planting and assessment methods were further refined and both the perennial and annual trials were replanted. A native pasture survey was also initiated. These trials are continuing in 1983 with the addition of low altitude trials in the Rift Valley.

While refining its experimental techniques the network has been expanding its membership as scientists from aid and development organizations have started to participate. At a recent meeting 13 organizations were represented.

The formation of a steering committee at a recent meeting is a further important development. Made up of a representative from each participating organization it plans the activities of the group, and publishes the Newsletter.

The Newsletter is planned to be published after the regular meetings of the Network in order to present the minutes of meetings, news of the participating organizations and any articles which may be submitted by the membership. Such news or technical articles are welcomed.

It remains, then, only to welcome any other organizations or individuals in Government Service or otherwise, who are involved or interested in forage research to participate in the Forage Network. If your name is not already on the mailing list and you wish to receive notification of meetings and the Newsletter, please fill in the slip at the end of the Newsletter.

The Editors (Alemayhu Mengistu, John Lazier)



## Minutes of FNE

In line with the recommendations of the Steering Committee to strengthen the Forage Network in Ethiopia, the following persons were selected to form the first committee.

|    | <u>NAME</u>           | <u>ADDRESSES</u>                                 | <u>TELEPHONE</u>             |
|----|-----------------------|--------------------------------------------------|------------------------------|
| 1  | Ato Hailu Kenno       | Institute of Agricultural Research - IAR         | 16 10 55                     |
| 2  | Ato Gugssa Endeshaw   | Ethiopian Seeds Corporation-ESC                  | 15 50 15                     |
| 3  | Ato Alemayhu Mengistu | Ministry of Agriculture - MOA                    | 44 46 19                     |
| 4  | Dr S Jutzi            | International Livestock Centre for Africa - ILCA | 18 32 15                     |
| 5  | Dr J Lazier           | International Livestock Centre for Africa - ILCA | "                            |
| 6  | Ato Adane Fayissa     | Ministry of State Farms-MSF                      | 15 28 81                     |
| 7  | Ato Asfaw Aleru       | Tesse Amba Training Centre-TATAC                 | -                            |
| 8  | Mr Christian Langlais | Wolleta Rural Education Programme-WREP           | 11 14 41                     |
| 9  | Ato Gashaw Shibabaw   | Arsi Rural Development Project-ARDP              | Asella 92, or<br>Kulumsa 102 |
| 10 | Ato Getinet Aklilu    | Sirinka Catchment Project-SCP                    | -                            |

On May 20, 1983, members of the Steering Committee of the Multi-location Forage Trials met for the second time at ILCA headquarters.

The Steering Committee has appointed the following persons to take responsibility for organizing and co-ordinating the Forage Network in Ethiopia (FNE).

|   |                          |            |      |
|---|--------------------------|------------|------|
| 1 | Ato Alemayhu Mengistu    | Chairman   | MOA  |
| 2 | Ato Lulseged Gebre Hiwot | D/Chairman | IAR  |
| 3 | Ato Abate Tedla          | Secretary  | ILCA |

Ato Hailu Kenno had earlier been appointed as Deputy Chairman but is replaced by Ato Lulseged Gebre Hiwot for reasons of higher education abroad. Among the Steering Committee members, Dr J Lazier, Dr S Jutzi and Ato Hailu Kenno were present. Dr S Jutzi was also selected to be a member of the Steering Committee instead of Dr M Butterworth, who declined the responsibility.

The Committee discussed how to strengthen forage research and development on a national level and chose the name for the group, "Forage Network in Ethiopia (FNE)."

The duties and responsibilities of the Steering Committee are defined as follows:

- To organize and co-ordinate the FNE.
- To review past and on going forage work.
- To initiate forage work activities such as seminars and field trips.



- To advise on forage introduction.
- To disseminate results of forage and related work.
- To keep contact through the FNE's Newsletter.
- To call meetings when necessary and to discuss issues of forage development.

At present the Committee has the task of analysing the data of the past forage network trials and to write a summary report. ILCA will assist in the data, herbage and soil analyses.

Comments are welcome as to how often the general meeting should be held.

The next Steering Committee meeting will be held on the 30 of June 1983.

Secretary (Abate Tedla)

#### The Multilocation Trials

Alemayehu Mengistu

For several years a number of research organizations were working in relative isolation screening fodder and forage species and varieties for environments representative of their areas of responsibility.

In order to draw together the information thus acquired and to encourage greater co-ordination between forage researchers a meeting was called of forage researchers of IAR, ARDP, MOA and ILCA at ILCA headquarters on October 31, 1980. It was agreed that a much better assessment of promising species and varieties could be made by incorporating them in a single trial under as near uniform management as possible, at a number of locations managed by each organization.

In 1981 a single trial was planted, but in 1982 the trial was re-designed separating the annual and perennial trials, using smaller plots and row sowing of seeds. In 1983 the annual species trial was replanted and the 1982 perennial trial was continued.

It is planned that as the trials terminate that further trials will be initiated using new promising material.

The current medium and high altitude trials are described below:

Objectives: Comparison of the performance of the most promising fodder crop species across a spectrum of sites broadly representative of the central mid-altitudes and highlands of



Ethiopia in order to compare plant performance between sites and between species. The results should provide a much clearer assessment of which species should be recommended for the various environments.

Duration : 1) Annual species planted each year for 3 years.  
2) Perennial species; 3 years.

Location : The trials locations (Table 1) are divided into two altitude groups : 1600 - 2400 m areas without frost, and 2400 - 3000 m areas which may have frost.

#### Methods and

Materials: The trials were laid out in replicated complete blocks with plots of 5 m x 2 m. Fertilizer was added at planting at 100 kg/ha diammonium phosphate (DAP 18, 46, 0) for both grasses and legumes. Planting details and the species used are given in Table 2. The grasses received a further 50 kg/ha of urea top dressed yearly. The plots are kept weeded and harvesting is done at 10% flowering for legumes, 50% heading for grasses, at 1m for elephant grass and in early December for fodder beet. Dry matter yields are obtained and nutrient analyses are done on the more successful lines.

Each organization is responsible for supply the following data for the sites under its control: Soil, pH, P and N levels, climatic data, management and other details which may affect the growth.

It is planned to publish the first two years results at the end of the 1983 growing season.

Table 1

#### Trials sites and their environmental conditions.

|   | Organizations        | Sites        | Altitude | Rainfall | Soil          | P<br>ppm |
|---|----------------------|--------------|----------|----------|---------------|----------|
| A | 1600 - 2400 m<br>IAR | Ginchi       | 2200     | 1000     | black         | 2        |
|   |                      | Bako         | 1650     | 1000     | red           | 2        |
|   | ILCA<br>ARDP         | Debre Zeit   | 1850     | 800      | black         | 5        |
|   |                      | Kulumsa      | 2200     | 900      | black         | 16       |
|   |                      | Dhera        | 1700     | 600      | sandy         | 16       |
| B | 2400 - 3000 m<br>IAR | Holetta      | 2400     | 1200     | black/<br>red | 7        |
|   |                      | Bedi         | 2800     | 1000     | black         | 6        |
|   | ILCA                 | Sheno        | 2800     | 650      | black         | 6        |
|   |                      | Debre Berhan | 2800     | 1100     | red           | 1        |
|   |                      | Shola        | 2400     | 1100     | black         | trace    |
|   | ARDP                 | Bekoji       | 2760     | 1200     | black/<br>red | 4        |
|   |                      | Meraro       | 2900     | 1000     | black         | -        |
|   |                      | Gobe         | 2670     | 1000     | black         | -        |
|   |                      | Robe         | 2400     | 900      | black         | 15       |
|   |                      |              |          |          |               |          |



Table 2

## A Annual Trials

|                                    |                                       | Between row<br>spacing<br>(cm) | Sowing<br>rate<br>(kg/ha) |
|------------------------------------|---------------------------------------|--------------------------------|---------------------------|
| 1600 - 2400 m and at 2400 - 3000 m |                                       |                                |                           |
| 1                                  | <i>Avena sativa</i> cv Lampton        | 20                             | 75                        |
| 2                                  | " " cv 8237                           | 20                             | 75                        |
| 3                                  | <i>Vicia dasycarpa</i> cv Lana        | 40                             | 25                        |
| 4                                  | Treatment 2 and 3                     | 40                             | 75/25                     |
| 5                                  | <i>Trifolium temense</i>              | 20                             | 10                        |
| 6                                  | <i>Trifolium rueppellianum</i>        | 25                             | 10                        |
| 7                                  | <i>Beta vulgaris</i> cv Aring Barres  | 40                             | 40                        |
| 8                                  | <i>Beta vulgaris</i> cv Triumph Betat | 40                             | 40                        |

## B Perennial Trials 1600 - 2400 m

|   |                                  |           |                  |
|---|----------------------------------|-----------|------------------|
| 1 | <i>Sorghum sudanense</i>         | 40        | 25               |
| 2 | <i>Sorghum alnum</i>             | 40        | 25               |
| 3 | <i>Chloris gayana</i> cv Mabrara | 40        | 25               |
| 4 | <i>Pennisetum purpureum</i>      | 1 x 0.5 m | stem<br>cuttings |
| 5 | <i>Desmodium uncinatum</i>       | 40        | 25               |
| 6 | <i>Dolichos lablab</i>           | 40        | 25               |

C Perennial Trials  
at 2400 - 3000 m

|   |                                         |    |    |
|---|-----------------------------------------|----|----|
| 1 | <i>Festuca arundinacea</i>              | 20 | 15 |
| 2 | <i>Lolium perenne</i> cv S 24           | 20 | 20 |
| 3 | <i>Lolium multiflorum</i> cv Barspectra | 20 | 25 |
| 4 | <i>Dactylus glomerata</i>               | 20 | 25 |
| 5 | <i>Phalaris aquatica</i> cv Australia   | 20 | 15 |



## Advisory Information

### The Cultivation of Fodder Beet

Alemayehu Mengistu

- Description: *Beta vulgaris*, fam. *Chenopodiaceae*. High yielding root crop for cattle feeding especially during the dry season. Closely related to Sugar beet.
- Climatic conditions: Fodder beets need a long growing season and should be grown in areas with an annual rainfall more than 750 mm. The rainfall should be distributed over 5 - 7 months. It is especially important that there is enough rainfall during the small rains to allow an even germination.
- Soils: Red clay soils, black clay soils if they are not water-logged and sandy soils in good rainfall areas.
- Fertilizer: 200 kg/ha of NP 18:46 before planting. If one can expect lack of boron in the soil (as in Arsi black soil areas) apply 10-15 kg of borax per hectare. It is also possible to apply manure to the fodder beet. If 25-30 tons per hectare of manure is applied before planting there is no need for additional fertilizer.
- Soil cultivation: The fodder beet needs a fine and firm seedbed. After ploughing the land should be harrowed three times with a spike harrow. Roll the field with a roller after planting or compact the soil by walking on the planted rows.
- Planting: The fodder beet has to be planted in the small rain not later than early April, around 6 - 7 kg/ha of PGS (pure germinated seed) are used. The seeds should be planted at a depth of about 2 cm. If planted deeper the seedlings cannot penetrate the soil and if planted too shallow they will not germinate if the weather conditions are dry after planting. Try to plant the beets when there is sufficient moisture in the soil. The seeds are planted in rows by hand or with a planter. The distance between rows should be 40 - 45 cm.
- Cultivation: When the plants have developed 2 real leaves they are ready for thinning. The distance between plants in the rows should be 20 - 25 cm. If the stand is uneven some transplanting can be done in connection with the thinning. Later on the beets have to be hoed between the rows at least twice to control the weeds. Some complementary hand weeding in rows might be necessary, especially after the first hoeing.



- Harvest : The beets can stay in the field during the whole dry season without any loss of dry matter. They can be harvested when needed for feeding. The roots have to be chopped before being given to the cattle.
- Yield: At high altitude 100 - 130 ton of fresh roots per hectare.  
At medium altitude 70 - 80 tons of fresh roots per hectare.  
Dry matter content is roughly 17 - 18% with 8 - 10% crude protein.
- (Note): A series of articles on the cultivation of fodder crops and the establishment of pasture land will be presented in future issues.

#### Steering Committee Meeting

June 27 1983, ILCA

Members present: S. Jutzi, A. Mengistu, H. Kerno, J. Lazier

- Business:
- 1 The Newsletter is about to go to press. Over 80 names are on the mailing list.
  - 2 A field trip is planned for September 16, (Friday) and 17 (Saturday) which will be to Bako, Ginchi and Holetta. Transportation will leave ILCA at 6:30 A M and will arrive at Bako by noon. The Bako trials will be viewed that afternoon and the group will overnight in Bako. The Network meeting will be held in the evening, with each organization giving a brief verbal description of the progress of its network or related work. On September 17 the group will return to Addis viewing Ginchi and Holetta on the way.

All those wishing to attend must inform Dr Samuel Jutzi (extension 113) or Hiruth Mekonnen (extension 226) at ILCA (13-32-15) or Alemayehu Mengistu, Ministry of Agriculture (44-46-10) before September 6 so that transport and accommodation can be arranged.

- 3 The next meeting of the steering committee will be at ILCA on September 7 at 1:30 P M. Dr Jutzi will arrange a meeting room.
- 4 Queries were raised about the trials in progress. The following points were made a) the soil should be sampled each time a trial is planted b) all of the 1982 trial soil and herbage samples, and data should be in the hands of the members responsible for handling them.



The Committee wishes to express its thanks, bon voyage and best of luck to Ato Hailu Kenno of IAR Holetta who will be shortly leaving for the United States to continue his studies. Hailu has been an enthusiastic and valuable member of the Forage Network since its inception.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA P O Box 5689, Addis Ababa, Ethiopia.

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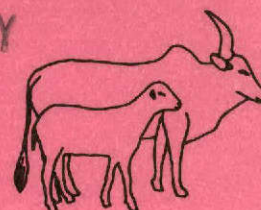
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# Forage Network in Ethiopia Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No 2

Date September-October, 1983

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## INTRODUCTORY MESSAGE

As the second issue of the FNE newsletter goes to press, a little late due to the demands of planting and harvesting, the editors are pleased to announce that there has been a very positive response to the first issue of the newsletter. Many thanks to those who wrote in expressing their support for the project. The newsletter may we remind you, is available to all who are interested as is membership in the Network.

The next meeting of the Network will be held at ILCA Headquarters on January 20, 1984 at 9 A.M. in the small auditorium. Besides regular members, all of those who are interested in forage research and development are welcome to attend. The meeting will be mainly concerned with the presentation and discussion of results of the 1983 trials, and in particular the various multilocation trials (see the notes section following, number 7). We will have an invited lecture as well. The Steering Committee will be preparing the formal agenda.

We have received an experimental outline and results from Alemayehu Dejene of Gore. A summary of the results has been presented in the notes section of this issue of the Newsletter. We would be pleased to publicize any other work which is being currently undertaken in forage research.

(The Editors: Alemayehu Mengistu, John Lazier)



## ELEVENTH FNE GROUP FIELD TOUR AND MEETING

Abate Tedla, Secretary

The Forage Network in Ethiopia's annual field trip was made to stations of the Institute of Agricultural Research (IAR) on the 16th and 17th of September, 1983. Last year a similar field trip was arranged to ILCA's Debre Berhan Station and IAR's Sheno and Melka Worer Research Stations.

These field trips provide an opportunity for development and research personnel to gain an appreciation of the various environmental constraints in the production of forage crops and to exchange experiences and practical information.

ILCA provided transport for the trip and IAR prepared the field research demonstrations at Bako, Ginchi and Holleta. Thanks are due to both organisations for making the two day visit such a success.

### Participants in the trip to Bako

People who attended were from six Governmental and International Institutes with an interest in forage production.

|     |                         |      |                        |
|-----|-------------------------|------|------------------------|
| IAR | Ato Lulseged Gabrehiwot | MOA  | Ato Alemayehu Mengistu |
|     | W/t Zemam Tekele        |      | Dr. P. A. Chadhokar    |
|     | Ato Girma Berhane       |      |                        |
|     | Ato Alemu Tadesse       | MSF  | Ato Adane Feyissa      |
|     | Ato Gebre Medhen Hagose |      | Ato Belete Adnew       |
|     | Ato Tadesse Tekletadik  |      |                        |
|     | Ato Girma Chemed        | ARDP | Ato Gashaw Shibabaw    |
|     | Ato Liyusew             |      |                        |
|     | Ato Eshetu Begna        | ILCA | Dr. S. Jutzi           |
|     |                         |      | Dr. I. Haque           |
|     |                         |      | Mr. P. Haines          |
|     |                         |      | Ato Abate Tedla        |

### Forage work issues covered during the trip

|         |   |                                                                                 |
|---------|---|---------------------------------------------------------------------------------|
| 16/9/83 | - | Bako IAR field visit                                                            |
|         | - | Brief presentation of experimental work by researchers                          |
|         | - | Report on Steering Committee meeting held on the 7th September, 1983 at ILCA HQ |
|         | - | Discussion on the future work of FNE                                            |
| 17/9/83 | - | Ginichi IAR field visit                                                         |
|         | - | Holleta IAR field visit                                                         |

### Bako IAR field visit

The group left Addis at 6:30 A.M., reached Bako at 1:00 P.M. and had lunch in town. A brief description of the Bako station and its work was given by the Officer-in-Charge before the field visit started. Detailed



- 5 -

discussions and comments were made during the three hour tour of the forage work.

The group noted that Bako has very favorable environmental conditions for growing and producing seed of tropical forage species.

Field research at Bako includes:

- Evaluation of exotic perennial and annual grass and legume species
- Forage trials specific to various production constraints such as
  - Seed rate and spacing
  - Seed production methods
  - Fertilizer rate
  - Varietal comparisons
  - Evaluation of leguminous shrubs
- FNE annual and perennial multilocation trials
- Improvement of native pasture by oversowing legumes with minimum technical input at establishment

After seeing the agronomy trials the group visited the Livestock Research Section at Bako station where the work was described by the Section Head. The group then held a meeting from 5:00 P.M. to 7:00 P.M.

Three main issues were addressed at the meeting:

- 1) Report of the previous Steering Committee meeting
- 2) Brief presentation of each participant's research work
- 3) Discussion on the future work of FNE

It was reported that the members of the Steering Committee had held a meeting on the 7th September, 1983 at 1:30 P.M. at ILCA HQ.

Points raised for discussion at the meeting were:

- The delayed analyses of the herbage samples (2 years backlog)
- Data processing and statistical analysis of the multilocation trials
- Concern that certain members of FNE were not attending the meetings

Because of the large number of herbage samples to be analysed Dr. Butterworth, the Head of ILCA's nutrition laboratory suggested a reduction in the number of samples coming in. He further advised the Steering Committee meeting that analyses should be done only for those species that proved to be agronomically successful.

Some members suggested that plant analyses be eliminated, as they are very expensive, and that evaluation be done on the basis of dry matter production and soil analyses instead. Another suggestion was to group similar sites and soil types and then to analyse a few representative samples from each so as to reduce the number of analyses.



### Decisions

- ILCA's nutrition lab and members of the Steering Committee will decide which analyses will be done on which samples from the multilocation trials.
- IAR will be responsible for doing the soil analyses until ILCA's lab starts to function.
- Data processing and analyses of the multilocation trials will be delayed until a person is assigned for the job by the FLAG programme.

After brief presentation of each participant's work, questions and comments were made in great detail. Towards the end of the meeting, the Chairman of FNE asked for suggestions on future FNE activities.

The following suggestions were made:

- To make recommendations on the basis of the results of the present trials;
- To put more emphasis on native pasture work;
- To look seriously at forage seed production;
- To become involved with development work with the peasant sector;

Participants were urged to think about the future of FNE and to come up with more ideas for the next meeting.

On the following day, the group left Bako at 6:30 A.M. for Addis. A stop was made at Ambo for breakfast and the Ginchi IAR forage trials were visited. Later, in the afternoon, the group looked at the forage trials at Holleta IAR station.

After a very valuable field tour, the group concluded its mission and reached Addis at 5:00 P.M.

### LETTERS TO THE EDITORS

11/10/83

Dear Sirs,

May I take this opportunity to congratulate you on enlightening those of us interested on the contemporary pasture and forage situation in Ethiopia through your newsletter.

I have found it to be very brief and comprehensive in its content and providing interesting information on trials and experiments carried out both by national and international experts.



Your newsletter is also playing a vital role in creating harmony and cooperation between the National Staffs and ILCA.

Once again I wish to express my full support to the editors for undertaking this task and wish to assure you that we in the Veterinary Services are very much interested in your newsletter.

Solomon Haile-Mariam(Dr.)  
Head, Animal Health Team  
Ministry of Agriculture

#### NOTES

1. Alemayehu Dejene of Gore, Illubabor has done an intake trial on 5 cows using a variety of feeds both fresh and as hay. As fresh material the order of acceptability was native pasture (65%), Colombus grass (54%), Vicia and Oats (48%), Sudan grass (45%), Oats (43%). As hay the order was Oats (60%), Vicia and Oats (57%), Colombus grass (37%), native pasture (20%), Sudan grass (20%). The order of green matter yields (largest to smallest) was Oats, Oats and Vicia, Sudan grass, Colombus grass, natural pasture. The editors will be sending comments on the trial to Ato Dejene.
2. A two week training course was held at ILCA on "Tropical rangeland management and methodology" sponsored by the Commonwealth Secretariat, UNESCO, FAO and ILCA. It was attended by 15 participants from 13 countries. Ato Alemayehu Redda of MOA's regional office in Sidamo and Ato Betru Nedessa of the MOA's Soil and Water Conservation Department were the official Ethiopian participants. Observers at the course included Ato Aschalew Tsegahuen of IAR, Melka Worror, Ato Getinet Aklilu of the Sirinka Catchment Project and W/z Elizabeth Mekonnen of the MDA. Staff members of WRBP, Soil and Water Conservation and ILCA attended from time to time.  
Alemayehu Mengistu of MOA was one of the lecturers. Other lecturers included 3 from Australia, 4 from FAO and 3 from ILCA. The course was given in French and English. Besides lectures, field work was done at the ILCA Headquarters in Addis and at the MOA's ranch at Abernossa in the Rift Valley.
3. Anthracnose, a serious fungal disease of Stylosanthes has many different strains. Dr. Barry Walker, of the Department of Primary Industries in Queensland, Australia advised at the course on 'Tropical rangeland management and methodology' that all Stylosanthes seed introduced to Africa receive treatment with a fungicide or sulphuric acid in order to prevent the introduction of new strains of the disease to Africa.



The fungicides Benlate (benomyl) or 0.6% difolitan dust are recommended as seed treatments. Infected plants can be sprayed with benomyl at 280 g active ingredient/ha with sprays each 2 weeks over a period of 8 weeks (4 times) from the first appearance of the disease followed by monthly sprays until the dry season.

Sulphuric acid treatment while dangerous to the user is advantageous in that it scarifies the seed at the same time.

4. Ato Tegnetwork Haile, Junior Pasture and Forage Expert from Wello, has just returned from Aleppo Syria where he attended a 7 month forage course at ICARDA (the International Centre for Agricultural Research in Dry Areas, a sister institute of ILCA). We will look forward to an article from Ato Tegnetwork about the course for our next issue of the FNE Newsletter.
5. The Soil and Water Conservation Department and the Feeds and Nutrition Team of the MOA held a seminar on October 26 at Nazareth entitled The Utilization of Pasture and Forage Crops from Catchment Areas. The thirty participants were mainly from Wello, Shoa, Harrar and Genu Gofa Administrative Regions. The lecturers were Dr. P. Chandokar and Ato Alemayehu Mengistu. A visit was made to the grass and legume seed production area of the Soil and Conservation Dept. at Sodere.
6. The FLAG programme at ILCA is currently in the process of hiring an Agriculture graduate whose job it will be to analyze the multilocation trial data.
7. The next meeting of the FNE will be on January 20 at 9 A.M. at ILCA Headquarters in the small auditorium. As was mentioned in the Editors Notes the meeting will be largely taken up with presentations of the 1983 forage trial results, both FNE multilocation and pasture survey trials and the separate work of each group.

In order to reduce the amount of information which will need to be read participants are urged to get all the data for their trials to ILCA (John Lazier) as soon as possible. This will allow duplication of results and summaries to be made. Each participant will then be allowed a limited time (about 5 minutes) to speak of the best species and the problems encountered in the trials. We would also hope that some groups would be able to make poster displays of their results. This will encourage discussion.

Please don't forget - rainfall, soil, management details and results to John Lazier as soon as possible.



### Advisory Information

#### 1. The Cultivation of "Alfalfa" in Ethiopia, Alemayehu Mengistu

Description - Medicago sativa, fam, Leguminosae. A long lived perennial legume it is considered to be one of the most productive and nutritious forage crops.

Climatic conditions - Alfalfa grows at elevations between 1500 meters and 2500 meters where annual rainfall is from 600 - 1000 mm. It is adapted to a wide range of temperatures.

Soils - It grows on a range of soils varying from sandy to fine textured clay. The best yields of alfalfa are obtained on well drained and fertile soils. It does not grow on wet areas although it does grow on cambered beds on a vertisol (black clay) at ILCA. Alfalfa is sensitive to soil acidity. In most cases a pH between 6.5 and 7.5 appears ideal for maximum alfalfa production. Results from different research stations in the country showed fertilizer application is very important for obtaining high yields.

a) Medium altitude areas - during the planting year use 150 kg/ha NP 18:46. In the second year around 100 kg/ha TSP (46%  $P_2O_5$ ) can be applied as top dressing in March.

b) Low altitude areas - apply 100 kg/ha NP 18:46 for the planting year and in the second year around 50 kg/ha TSP (46%  $P_2O_5$ ) can be applied once in June or July, when the rain starts. ILCA however, has had reasonable alfalfa production on soils with a low P status.

Cultivation - The seed bed of alfalfa should be moist and firm at seeding. The soil surface should be finely granular. Normal ploughing and harrowing techniques are used.

Planting - Hand sowing is a simple and effective method. Following ploughing the seed is broadcast and immediately covered.

As the seed is larger than most grass seed it can therefore be safely covered to depths of 0.6 to 1.2 cm on heavy soils and 1 to 2 cm on sandy soils. A sowing rate of 8 kg/ha is optimum for the medium altitude and 5 kg/ha for low land areas when seeded in rows. The optimal date of planting varies from place to place. At medium altitudes it can be planted in March and April depending on the amount and duration of rain, whereas in lowland areas it is planted in late June or at the beginning of July, when the rain starts. Early weeding is essential at the seedling stage. From research studies done in Ethiopia varieties Hunter River and Hairy Peruvian are recommended for medium and lowland altitudes respectively.



New varieties from South Australia are available at ILCA and are currently being tested there. These are pest and disease resistant and include the aphid resistant cultivars Hunterfield, Siriver, Springfield, Wakefield, Schoffield and the fungal and aphid resistant cultivar Trifecta.

(Editor's note: There has been much discussion on the problems of alfalfa production in Ethiopia. This could be the topic of another advisory article. Other topics could include diseases and pests, and the differences between hay and grazing cultivars of alfalfa. Any submissions will be gratefully received. John Lazier).

## 2. Vetches: Successful Legumes in the Highlands

Lulseged Gebrehiwot

### 1.1 Introduction

Vetches (*Vicia* sp) are leguminous annual forage crops. Most species are viny and weak-stemmed having numerous leaves and leaflets terminating with tendrils. Vetches grow best on fertile well drained soil and in regions having mild temperatures. In Ethiopia, several species and lines have been tried at various locations ranging in altitude from 1600 to 2800 m above sea level. Generally vetches seem to be adapted to this altitudinal range. However, at higher elevations, especially where there are drainage problems and frost occurrence growth is very much stunted resulting in poor yields.

### 1.2 Promising Species

Among those species/lines tried the following are most promising.

Woolypod vetch  
Purple vetch  
Hairy vetch

*Vicia dasycarpa*  
*Vicia atropurpurea*  
*Vicia villosa*

Dry matter forage yield of these species is over 6 t/ha. When harvested at full flowering stage they have a crude protein content of no less than 21%. Purple vetch requires a relatively long growing period. It usually flowers in October and hence can hardly escape frost before seed setting. So, it is recommended for frost free areas. On the other hand woolypod and hairy vetch have better chance of escaping frost. Vetch seed production is generally difficult because of uneven maturity, shattering and frost problems. In good year seed yields of up to 15 qu/ha can be obtained. There is a good indication that higher seed yields can be achieved by using fences or poles to support the vetch.



### 1.3 Production Technology

Land preparation requires at least one ploughing and harrowing. Depending on the soil type more than one harrowing may be necessary for good establishment. The seeding rate is 20 kg/ha broadcast, and the normal fertilizer practice is to apply 100 kg/ha DAP during planting. Vetches can be dry planted and the seeds emerge when conditions are favourable. In order to minimize competition from weeds early planting i.e. during the onset of the big rains, is recommended. Since vetch seedlings are susceptible to excess water, use of drainage ditches help establishment. Initial seedling growth is very slow in June, July and August and it is more so in regions where the temperature is relatively cold. Hence it is desirable to pull out the major weeds by hand. Once the vetches resume active growth they can suppress most of the weed flora.

### 1.4 Uses

Vetches can be fed to animals while green or as hay or silage when mixed with oats. They are highly compatible with fodder oats and can be planted at a seeding rate of 20 and 80 kg/ha for vetch and oats respectively.

Vetches have good potential for pasture improvement programmes. They can easily be introduced into natural or cultivated perennial pastures by oversowing. The vetch seeds can be broadcast into the pasture during the short rains (March, April) or early during the onset of the main rains. However, the grass has to be as short as possible by either mowing or heavy grazing. If the sod is dense and allows no seed-soil contact, then it is essential to disturb it (the sod) by discing or using an ox-drawn local plough. Once the vetches establish they can regenerate year after year. This is made possible from a reserve of hard seeds from previous years as well as seed produced in the current year.

Elsewhere in the world vetches are widely used as cover crops and green manures when ploughed under before seed setting. Their matting type of growth besides protecting the soil from erosion can improve the physical and fertility status of the soil by adding organic matter and plant foods, especially nitrogen. In the highlands of Ethiopia vetches can play a great role in crop rotation schemes and in replacing fallows.

(Editors Note: There is said to be a problem in producing Vetch seed in Ethiopia. Would anyone like to contribute an article on this subject? John Lazier).



# Steering Committee Members

Executive sub-committee : Ato Alemayehu Mengistu, Chairman, MOA  
Ato Lulseged Gebre Hiwot, D/Chairman, IAR  
Ato Abate Tedla, Secretary, ILCA

## Members:

|                        |                                          |          |
|------------------------|------------------------------------------|----------|
| Ato Gugssa Endeshaw    | ESC                                      | 15-50-15 |
| Dr. Samuel Jutei       | ILCA                                     | 18-32-15 |
| Dr. John Lazier        | ILCA                                     | 18-32-15 |
| Ato Adane Fayissa      | MSF                                      | 15-28-81 |
| Ato Asfaw Alemu Tesse  | Amba Training Centre                     |          |
| Mr. Christian Langlais | - Wolleta Rural Education Programme WREP | 11-14-41 |
| Ato Gashaw Shibabaw    | ARDP Asella                              | 92       |
|                        | or Kulumsa                               | 102      |
| Ato Getinet Aklilu     | Sirinka Catchment Project                |          |

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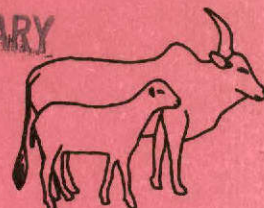
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# Forage Network in Ethiopia Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No 3

Date December 1983

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(The Editors: Alemayehu Mengistu, John Lazier)



Steering Committee Meeting

13/12/83

The Steering Committee met at ILCA to discuss the business at hand of the FNE. The members present were:

|                          |                   |
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| Ato Lulseged Gebre Hiwot | - Deputy Chairman |
| Dr. John Lazier and      |                   |
| Dr. Samuel Jutzi         | - both of ILCA    |

Ato Alemayhu Mengistu (Chairman) and Ato Abate Tadla (Secretary) were both unable to attend.

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2. The minutes were accepted as presented in the September - October issue of the Newsletter.
3. John Lazier reported that a graduate has been hired to deal with the accumulated FNE research data.
4. The Steering Committee agreed that after three years research that the adapted species and lines tested were obvious for each altitude. It was decided to make a preliminary list of the best lines and species for each environmental zone at the next meeting, rather than awaiting the detailed analysis of the data.
5. As the next development step in the extension of these species and their agronomy is the responsibility of the Ministry of State Farms for Government lands and the Ministry of Agriculture for peasant farms it was deemed appropriate to ask the FNE representatives of these organizations to explain to the January General Meeting how they proposed to make use of the knowledge gained in the FNE multi-location trials.
6. Seed production was discussed as a necessary preliminary to commercial introduction of forage plants - it was decided to ask the representatives of the Ministry of State Farms and of the Ministry of Agriculture how they proposed to go about this.
7. Work on native pasture was discussed and it was agreed that Alemayhu Mengistu should chair a discussion on native pasture at the meeting, encouraging those who would like to participate in this study. Lulseged agreed to chair a discussion at the general meeting on oversowing of native pasture. He will get opinions on successful ways of doing it, what seed is available for 1984 trials and if a trial should be designed to test methods and species.



8. The present annual multilocation trial was discussed and it was suggested that it had been run long enough and that subject to the agreement of the FNE January General Meeting the annual trial should be terminated.
9. The present perennial multilocation trials were discussed and it was decided that at least 1 further year of work should be put into these trials. The use of a legume or legumes as a source of N for the grasses was discussed. It was agreed to discuss this topic at the January meeting.
10. Future trials
  - a) It was agreed that primary centres of screening should be identified in the country. These should represent particular environmental zones, and have personnel interested in participating.
  - b) Lines of forages could be tested simply at these locations, perhaps in unreplicated strips or plots. Successful lines could then be tested at secondary sites which would broaden the area in which testing is done.
  - c) It was suggested that the key personnel at each primary site see the range of introductions each year at IAR and ILCA in order to be able to choose which lines they wished to test the following season.
  - d) Annual trials: Lulseged said that IAR has new lines of oats which need to be more broadly tested. John said that ILCA has some better lines of native annual Trifolium species which should also be tested.
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  - a) There are apparently more productive lines of alfalfa available than are currently planted and these are currently freely seeding.
  - b) Phalaris aquatica is the most productive grass in ILCA plots.
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  - a) plant special trials to measure seed production
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1. Ato Hailu Kenno of IAR, staunch member of the FNE, left for the USA in August 1983. He will be studying Range Science for two years.
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ILCA by the way is doing agroforestry research in Ibadan Nigeria where *Gliricidia* and *Leucaena* are grown in rows 4 m apart and crops and grazing are done between. The trees are used as a source of N (as they are leguminous), mulch, and fodder.

5. The FNE steering committee has information on sources of commercial forage seed in East Africa (NR = new release).
  - a) Kenya Seed Company, P O Box 553, Kitale, Kenya, *Chloris gayana* cvs Masaba, Mbarara, Pokot, Emba (NR), Boma (NR), *Panicum coloratum*, *Setaria anceps* cv Nandi, Nasiwa (NR), *Brachiaria brizantha*, *Sorghum alnum*, Oats cv sure grain, *Trifolium semipilosum*, *Desmodium uncinatum*, *Medicago sativa* cv Hunter River, and Siratro. They also have durum wheat (3 lines), bread wheat (16 lines), Triticale (3 lines), barley (3 lines), sunflower (6 lines), maize (12 lines).
  - b) Farm Seeds (Pvt) Ltd., P O Box 653, Harare, Zimbabwe. *Chloris gayana* cv Katanbora, *Eragrostis curvula* (Ugeni Love Grass), Siratro, Oxley fine stem stylo, *Desmodium uncinatum*.



### FLAG Research Results

The work of the Forage Legume Agronomy Group in the Highlands of Ethiopia has concentrated on screening of annual and perennial forage species. Some of the most interesting work has been done on the native Trifolium species by Levi Akundabweni, a Kenyan who is doing his PhD for South Dakota State University. The native species Trifolium temense, one of the more vigorous and productive species has been found to vary in plant form, date of flowering and longevity. The native annual Trifolium species were found to respond markedly to the addition of P where the soil had a low P status, though the response varied with the P applied and the species tested. T. schimperii, T. decorum, and T. steineri responded well to rates of P as low as 10 kg/ha while the other native lines T. temense and T. quartinianum(?) tended to respond at 20 kg P/ha. The native species responded to lower rates of P than the exotic species tested (T. subterraneum, T. resupinatum, T. alexandrinum).

Linear growth for the Trifolium species ranged as high as 86 kg/ha/day of dry matter production with T. quartinianum(?) as the most productive. Seed yields ranged from 200 to over 800 kg/ha. There was less variation in CP level between species when comparing plant parts than between plant parts within species.

The proportion of plant parts varied markedly between species (stem 38 to 64%, head 18 to 46%, leaf 12 to 24%). Leaf-stem ratios varied from 2:1 to 6:1 depending on the species. Growth in the clovers appeared to cease at 15% soil moisture content. The most promising species in terms of dry matter and seed production were T. quartinianum(?) 6 t/ha and T. temense.

In the Rift Valley of Ethiopia cooperative screening trials with the MOA at Abernosa Ranch (1700 m, 800 mm) have shown the following species to be the most promising after two rainy seasons: Stylosanthes guianensis (cvs Cook, Endeavour), S. seca, S. fruticosa (native), S. hamata, Centrosema brazilianum, C. pascuorum, Desmodium distortum and Dolichos lablab.

Some seeds of most experimental lines mentioned, and of all commercial lines are available from ILCA.



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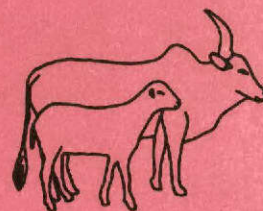
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SPR 22/10/83 09:50

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4. Abate Tedla (ILCA) attended an 8 day training course "Agroforestry Research for Development, Practices and Methods" organized by ICRAF (the International Council for Research in Agroforestry) in the ICRAF Headquarters, Nairobi, in November. The course was designed to provide African researchers with a background in agroforestry and to interest them in initiating research relevant to their own areas. The course described existing agroforestry systems used world wide. These involve trees alone, with livestock, crops or crops and livestock. The multiple uses of trees were emphasised (fuel, fodder, fruit, mulch etc). The participants were encouraged to think of designing systems involving livestock, crops and trees relevant to their own areas. Abate is already designing work for next planting season and has promised us an article on this.

ILCA by the way is doing agroforestry research in Ibadan Nigeria where *Gliricidia* and *Leucaena* are grown in rows 4 m apart and crops and grazing are done between. The trees are used as a source of N (as they are leguminous), mulch, and fodder.

5. The FNE steering committee has information on sources of commercial forage seed in East Africa (NR = new release).

a) Kenya Seed Company, P O Box 553, Kitale, Kenya, *Chloris gayana* cvs Masaba, Mbarara, Pokot, Emba (NR), Boma (NR), *Panicum coloratum*, *Setaria anceps* cv Nandi, Nasiwa (NR), *Brachiaria brizantha*, *Sorghum aluum*, Oats cv sure grain, *Trifolium semipilosum*, *Desmodium uncinatum*, *Medicago sativa* cv Hunter River, and Siratro. They also have durum wheat (3 lines), bread wheat (16 lines), Triticale (3 lines), barley (3 lines), sunflower (6 lines), maize (12 lines).

b) Farm Seeds (Pvt) Ltd., P O Box 653, Harare, Zimbabwe. *Chloris gayana* cv Katambora, *Eragrostis curvula* (Ungeni Love Grass), Siratro, Oxley fine stem stylo, *Desmodium uncinatum*.



### FLAG Research Results

The work of the Forage Legume Agronomy Group in the Highlands of Ethiopia has concentrated on screening of annual and perennial forage species. Some of the most interesting work has been done on the native Trifolium species by Levi Akundabweni, a Kenyan who is doing his PhD for South Dakota State University. The native species Trifolium tembense, one of the more vigorous and productive species has been found to vary in plant form, date of flowering and longevity. The native annual Trifolium species were found to respond markedly to the addition of P where the soil had a low P status, though the response varied with the P applied and the species tested. T. schimperii, T. decorum, and T. steudneri responded well to rates of P as low as 10 kg/ha while the other native lines T. tembense and T. quartinianum(?) tended to respond at 20 kg P/ha. The native species responded to lower rates of P than the exotic species tested (T. subterraneum, T. resupinatum, T. alexandrinum).

Linear growth for the Trifolium species ranged as high as 86 kg/ha/day of dry matter production with T. quartinianum(?) as the most productive. Seed yields ranged from 200 to over 800 kg/ha. There was less variation in CP level between species when comparing plant parts than between plant parts within species.

The proportion of plant parts varied markedly between species (stem 38 to 64%, head 18 to 46%, leaf 12 to 24%). Leaf-stem ratios varied from 2:1 to 6:1 depending on the species. Growth in the clovers appeared to cease at 15% soil moisture content. The most promising species in terms of dry matter and seed production were T. quartinianum(?) 6 t/ha and T. tembense.

In the Rift Valley of Ethiopia cooperative screening trials with the MOA at Abernosa Ranch (1700 m, 800 mm) have shown the following species to be the most promising after two rainy seasons: Stylosanthes guianensis (cvs Cook, Endeavour), S. seca, S. fruticosa (native), S. hamata, Centrosema brazilianum, C. pascuorum, Desmodium distortum and Dolichos lablab.

Some seeds of most experimental lines mentioned, and of all commercial lines are available from ILCA.



### Steering Committee Members

Executive sub-committee :   Ato Alemayhu Mengistu, Chairman, MOA  
                                  Ato Lulseged Gebre Hiwot, D/Chairman, IAR  
                                  Ato Abate Tedla, Secretary, ILCA

### Members:

|                        |                                                 |          |
|------------------------|-------------------------------------------------|----------|
| Ato Gugssa Endeshaw    | ESC                                             | 15 50 15 |
| Dr. Samuel Jutzi       | ILCA                                            | 18 32 15 |
| Dr. John Lazier        | ILCA                                            | 18 32 15 |
| Ato Adane Fayissa      | MSF                                             | 15 28 81 |
| Ato Asfaw Alemu        | Tesse Amba Training Centre                      |          |
| Mr. Christian Langlais | Wolleta Rural Education Programme WREP 11 14 41 |          |
| Ato Gashaw Shibabew    | ARDP - Asela                                    | 92       |
|                        | or Kulumsa                                      | 102      |
| Ato Getinet Aklilu     | Sirinka Catchment Project                       |          |

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia.

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**International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15**

Date January-February 1984

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The 12th meeting of the Forage Network of Ethiopia at ILCA Headquarters in Addis Ababa on January 27 was a considerable success. Representatives of 8 organizations attended the meeting, which along with 8 other organizations whose representatives were unable to attend give a total of 16 participating organizations in the FNE.

The participants reviewed their organizations' 1983 forage research results, summarized the results of 3 years cooperative FNE multilocation trials, designed new trials for 1984, heard talks on forage research and production in South America, and on strip trials. They went on a tour of ILCA library facilities and of ILCA forage plots. It was a most interesting and useful meeting with all members participating fully in the discussions.

The participating researchers' were briefed by the representative of the Ministry of Agriculture as to how the results of the FNE trials are being taken to the peasant sector. No representative of the Ministry of State Farms was present to indicate how the results would be used on State lands.

The chairman would like to express his appreciation to the staff of ILCA and the FNE members who made the meeting such a successful one.

The day following the meeting some participants joined an FNE field trip to the ILCA seed multiplication and trial sites in the Rift Valley. The trip was said to be an educational one. An account is given (page 9) in this Newsletter.

The General Meeting was followed by a Steering Committee Meeting on February 7 which decided the details of the 1984 trials and initiated planning on 1985 trials. The details of the new trial are given on page 12.



The regular participants in the Network trials are urged to be certain to get their seeds in time for planting. Any researchers who would like to join the multilocation trial group are welcome to do so, but should inform the editors of this Newsletter as soon as possible in order that seed can be made available for them.

This issue of the Newsletter is gratifyingly thick. One of the reasons is that the research results of the Jigiga Project has been included. We would like to include the results of all organizations which are involved in forage research - so please send copies of your annual reports to the editors.

Editors: (Alemayehu Mengistu, John Lazier)

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## 2. 12th FNE General Meeting - January 27 1984

### 2.1 Introduction

The Chairman of the FNE, Ato Alemayehu Mengistu, welcomed all of the participants to the 12th meeting of the FNE. He noted the increase in participating organizations and the FNE Newsletter as signs of the success of the network. The FNE Newsletter he noted, is of great importance to the development of forage production in Ethiopia as it disseminates research information and helps to put new ideas across to researchers and to farmers through extension agents.

He then invited Dr. P. Brumby, Director General of the International Livestock Center for Africa (ILCA) to open the meeting.

### 2.2 Opening talk by Dr. Brumby

After welcoming the participants to ILCA Headquarters Dr. Brumby spoke of the agricultural problems of Africa. The current food situation is unsatisfactory. The yearly increase in both food grains and livestock is about 1.3% whereas population growth is near 3%. The annual cost of livestock imports is now at 2 billion dollars, more than the total foreign aid inflow over the last 20 years. The livestock sector has shown growth only in numbers and not in productivity. Livestock are particularly important in smallholder farming as a source of food, manure, draught, and cash.

The dependency of the estimated 150 million livestock units in Africa on crop residues is high. The food value of such residues can be improved by chemical treatments, but these are rarely practical under African conditions. The use of forage legumes as a fodder supplement holds much more promise and ILCA is committed to research on forage legumes in the major ecological zones of Africa.



Work is underway on native legumes in the Ethiopian Highlands. ILCA has obtained a dramatic response to P by native legumes in its trials this year at Shola, and the potential impact of this knowledge on local agriculture is tremendous. Since legumes supply nitrogen to the soil they allow the replacement of fertilizers containing both nitrogen and phosphorous (DAP) by pure phosphate fertilizers.

In Nigeria ILCA is involved in both alley cropping and fodder bank research. The alley cropping system grows crops of food between rows of leguminous browse species such as Leucaena leucocephala and Gliricidia sepium. Such cropping systems appear to do much to solve a major West African problem, that of preserving soil structure and fertility as well as enabling livestock to be integrated into the cropping system.

Fodder banks of Stylosanthes species serve a similar function. They enable an extension of the crop area cultivated, improve crop yields and provide high quality, dry season feed supplements for livestock.

ILCA has had excellent cooperation with national organizations in its role of complementing and assisting them. As national problems are best tackled by national organizations ILCA tries not to undertake work which they are doing or which they can do. ILCA's role is one of research in those areas that go beyond national boundaries and capabilities. It also involves providing library, documentation, computer, laboratory and training facilities.

Dr. Brumby concluded by requesting that the participants concentrate on practical recommendations for the development of forage production.

Ato Alemayehu Mengistu outlined ILCA's assistance to the FNE and thanked Dr. Brumby for his advice and support.

- 2.3 The minutes of the 11th FNE meeting and of the Steering Committee meetings were passed as presented in the Newsletter issues 1, 2 and 3.

#### 2.4 1983 Forage Research Summaries

Each organization presented a brief summary of the results of their forage research in 1983.

##### 2.4.1 ILCA - FLAG

Trifolium temense ILCA 8501 produced the highest dry matter yields (6.8 t/ha) followed by T. quartinianum and T. decorum. The addition of P fertilizer at 41 kg/ha produced yield increases of up to 900% compared to no P. Considerable phenotypic differences were found within the species T. temense. Rust resistant lines of Lolium perenne and higher yielding lines of alfalfa have been identified.

Good growth and seed production were obtained at Mulo Farm from T. alexandrinum, T. resupinatum and Vicia species.



In the Rift Valley under 800 mm rainfall, the best adapted species were Stylosanthes scabra, S. hamata, S. fruticosa and Lablab purpureus (various speakers).

#### 2.4.2 ILCA - Highlands Programme

The best legume at Debre Zeit was Lablab purpureus (10 t/ha) (Ato Abate Tedla).

2.4.3 IAR work at Holleta concentrated mainly on screening of alfalfa and studies on native pasture. At Awassa the emphasis was on legume - wheat and maize combinations. There was also a stocking rate trial on native pasture. Vetch was reported to have produced 20 t/ha (Ato Lulseged Gebre Hiwot).

2.4.4 At Bako IAR work included nursery evaluation of grasses and legumes, a fertilizer response study, response of Leucaena to pruning and legumes intercropped with maize (Ato Alemu Taddesse).

2.4.5 At IAR Melka Werer DM yields of 40 t/ha/year were achieved by Leucaena under irrigation (Ato Aschalew Tseghuen).

2.4.6 ARDU work included cultural practice trials on forage crops, seeding rates of Sudan grass and oats, a variety trial of oats and seed production of vetch (Ato Gashaw Shibebaw).

#### 2.4.7 Serinka Catchment Project

The work mainly involved evaluation of exotic species and intercropping trials (Ato Getinet Alemu).

#### 2.4.8 Third Livestock Development Project

Screening of grasses and legumes were emphasised (Ato Menwyelet Atsedu). (See the summary of their work on page 13).

#### 2.4.9 Ministry of Agriculture

Forage work is extension oriented with 117 extension demonstration sites, and 65 other sites on peasant farms (Ato Alemayehu Mengistu).

#### 2.5 Library Visit

All participants visited the ILCA Library where Ato Michael Hailu, Head of the Library, described the services which the Library can offer. These include the provision of abstracts to scientists on specific research topics. The Library facilities are open to all researchers.

#### 2.6 Results of the 1983 FNE Trials

Over the past 3 years ILCA, IAR and ARDU have conducted identical forage trials in the medium and high altitude regions of Ethiopia. In 1983 low altitude trials were initiated in the Rift Valley. The number of sites per organization are as follows: IAR 4, ILCA 7, Nomadep 1, WREP 6 sites.



2. 6. 1. Summary of the best yielding species in 1983-FNE trials, yields in t DM/ha.

1. High altitude areas ( 2400 m<sup>+</sup> )

| Species                | Debre Berhan | Shola | Holleta | Sheno Bedi | Robi | Bekoji |
|------------------------|--------------|-------|---------|------------|------|--------|
| Oats Lampton           | 6.1          |       |         |            |      | 7.0    |
| Oats 8237              |              | 9.3   |         | 4.5        | 10.6 | 4.3    |
| Oats 8237/Vetch        |              |       | 12.3    |            |      |        |
| L. perenne cv s24      | 2.3          |       |         |            |      |        |
| F. arundinacea         |              | 6.9   | 13.0    | 3.7        |      |        |
| P. tuberosa cv Sirocco |              |       | 13.0    | 3.7        |      | 5.9    |
| F. beet cv T. betat    | 6.8          |       | 12.4    |            |      | 5.6    |
| F. beet cv A. barres   |              | 7.2   |         | 5.1        |      |        |
| Native pasture         | 6.3          | 5.9   |         |            |      |        |

2. Medium altitude areas ( 1600-2400 m )

| Species              | Debre Zeit | Ginchi | Dherra | Kulumsa | Meraro |
|----------------------|------------|--------|--------|---------|--------|
| Lab lab purpureus    | 10.2       |        |        |         |        |
| Oats Lampton         |            | 5.4    |        |         |        |
| Sudan grass          |            |        | 5.0    |         |        |
| Oats 8237/vetch      |            |        |        | 8.0     | 15.0   |
| C. gayana            | 4.2        |        |        |         |        |
| F. beet cv. T. betat |            |        |        | 10.0    |        |

2. 6. 2. Data Analysis

Regarding the data analysis of the results of the multilocation trials, Dr. J. Lazier said that as in 1982 the analyses will be done at ILCA.

2. 7. Recommended species

In order to make the research results available for the 1984 planting season, the following recommendations were made on the basis of the 3 years of FNE trials.



2. 7. 1. For Highland regions

Annual Cereals: Oats 8237  
Oats Lampton  
Legume : Vicia dasycarpa

Fodder crops : Fodder beet cv. Aring barres  
Fodder beet cv. T. betat

Perennial Grasses : Phalaris aquatica cv. Sirocco  
Phalaris aquatica cv. Australia  
Festuca arundinacea  
Lolium multiflorum cv. Barspectra

2. 7. 2. For medium regions

Annual Cereals : Oats 8237  
Oats Lampton

Legumes : Vicia dasycarpa  
Lablab purpureus

Perennial Grasses : Chloris gayana  
Panicum coloratum  
Pennisetum purpureum

Legume : Desmodium uncinatum

2.8. 1984 FNE Trials

2. 8. 1. A lively discussion ensued on this topic. The following decisions were made:

1. to terminate the present annual high altitude and medium altitude species trials and to replace by new promising species;
2. to continue the high and medium altitude perennial species trials for one more year;
3. to continue the native pasture inventory work;
4. to continue the present lowland perennial trials for at least a further year;
5. to have the Steering Committee design the new annual high and medium altitude trials for 1984 ;

2. 8. 2. The following suggestions for trials were made for the consideration of the Steering Committee:-

- 1) a P response trial (Dr. S. Jutzi)
- 2) an intercropping trial (Ato Asfaw Yemegnuhal)
- 3) Rhizobium response trial (Ato Amare Abebe)



2.9 The transfer of results of farmers

As the Network had chosen the species recommended for planting for various altitudes, the Ministry of Agriculture's representative Ato Alemayehu Mengistu was asked how the Ministry intended to transfer this knowledge to the farmers.

Ato Alemayehu replied that by means of the Ministry's demonstrations plots that oats, vetch and fodder beet have become quite popular in the peasant associations particularly those involved in dairy farming which have been supplied with improved heifers. Tropical grasses and alfalfa have been demonstrated on 1 ha fields in peasant associations. Once their productivity has been demonstrated seed will be distributed to peasant associations. Planning is under-way to multiply seed on Ministry of Agriculture ranches, and in the future it may be done in the fields of peasant associations.

Unfortunately the meeting did not hear how the Ministry of State Farms proposed to use these recommended species as the Ministry was not represented at the meeting.

2.10 Field Tour

The participants were shown ILCA's high altitude forage plots. The emphasis in the tour was on showing new improved lines of Lolium perenne, L. multiflorum, alfalfa, and Vicia species. Some time was spent explaining the simple strip trial designs used.

2.11 Forage research in Brazil and Bolivia

Dr. S. Jutzi, the ILCA Highlands Programme forage agronomist gave an interesting and educational talk on forage research and production in Brazil and Bolivia. The simultaneous use of 2 slide projectors helped make the presentation an excellent one.

2.12 Strip Trials

Dr. J. Lazier, of ILCA's FLAG programme discussed the design and uses of strip trials, and promised to produce detailed procedures for those interested.

2.13 Forage Seed Supply

This has been a topic for discussion at all FNE meetings. As demand for forage seeds is growing the question is, how will they be supplied? It was concluded that for the 1984 season requests should be addressed to IAR, ARDU and ILCA.

The meeting closed at 16:20



2. 14. Participants of FNE Meeting

| No.                        | Names                   | Position                    |
|----------------------------|-------------------------|-----------------------------|
| <u>IAR</u>                 |                         |                             |
| 1.                         | Lulseged Gebrehiwot     | Pasture Forage Agronomist   |
| 2.                         | Amare Abebe             | Research Officer            |
| 3.                         | G. Medhin Hagos         | Tech. Asst.                 |
| 4.                         | Assefa Haileselassie    | " "                         |
| 5.                         | Aschalew Tsegahun       | Asst. Research Officer      |
| 6.                         | Alemu Taddese           | Research Officer            |
| 7.                         | Taddese Teklestadik     | Asst. Research Officer      |
| <u>MOA</u>                 |                         |                             |
| 8.                         | Alemayehu Mengistu      | Pasture & Forage Agronomist |
| 9.                         | Debebe Dessalgen        | G. Manager                  |
| 10.                        | Mengistu Zewge          | Expert                      |
| 11.                        | Garry Smith             | Advisor                     |
| <u>ARDU</u>                |                         |                             |
| 12.                        | Gashaw Shibabaw         | Agronomist                  |
| 13.                        | Getachew Wondimagegnehu | -                           |
| 14.                        | Tegene Alemayehu        | Animal Ext. Expert          |
| <u>Ambo Junior College</u> |                         |                             |
| 15.                        | Fikre Aberra            | Lecturer                    |
| 16.                        | Girma Fikresellassie    | "                           |
| <u>TATC</u>                |                         |                             |
| 17.                        | Asfaw Yemegnuhal        | Project Manager             |
| <u>TLDP</u>                |                         |                             |
| 18.                        | Menwyelet Atsedu        | Head of Trials & Studies    |
| <u>SCP</u>                 |                         |                             |
| 19.                        | Getinet Aklilu          | Section Head                |
| 20.                        | Amakeletch Atlaw        | -                           |
| <u>ILCA</u>                |                         |                             |
| 21.                        | John Lazier             | Agronomist                  |
| 22.                        | James Kahurananga       | Plant Ecologist             |
| 23.                        | Samuel Jutzi            | Forage Agronomist           |
| 24.                        | I. Hague                | Soil Scientist              |
| 25.                        | Abate Tedla             | Forage Agronomist           |
| 26.                        | Taye W/Mariam           | Sen. Tech. Asst.            |
| 27.                        | James O'Chang           | Research Assistant          |



|     |                    |                    |
|-----|--------------------|--------------------|
| 28. | Asres Tsehay       | Research Assistant |
| 29. | Abayneh Wudineh    | " "                |
| 30. | Yimer Assen        | " "                |
| 31. | Solomon Mengistu   | " "                |
| 32. | Girma Getachew     | " "                |
| 33. | Zenam Tekle        | " "                |
| 34. | Nigist Wagaye      | Technical Asst.    |
| 35. | Nancy Akundabweni  | Lab. Asst.         |
| 36. | Levi Akundabweni   | PhD. student       |
| 37. | Tony Russell-Smith | Agronomist         |
| 38. | Worqu Mekasha      | Extension Officer  |

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### FNE RIFT VALLEY FIELD TRIP

Asres Tsehay

On Saturday January 28, the day following the FNE meeting a field trip was taken to the ILCA sites at Zwai Horticulture Farm and Abernosa Ranch. The purpose of the trip was to demonstrate the layout of strip trials and the range of species and varieties available for forage research.

An ILCA minibus took eight participants, and myself and Dr. Lazier of ILCA down to the Rift Valley. There was considerable discussion about our experiences with forages on the way down. After breakfast at Zwai at 9:45 A. M. we first went to the Ministry of State Farms-ILCA Cooperative Seed Multiplication Site at the Zwai Horticulture Farm. Several hundred lines of forage legumes and a few lines of grasses are being multiplied here under irrigation in about 330 plots. The plots were growing very well in contrast to the dry, dusty surroundings where only the Acacia sp and some weeds were green.

Ato Girma Getachew, of the ILCA FLAG programme explained about the location, the genera present and the type and rate of fertilizers applied. Dr. Lazier then showed us the simply designed field office and lead the group into the plots. He explained the reason for the visit was to demonstrate the range of available species and to give the opportunity to those present to request the seed of any line which they thought might be of use for their areas. Dr. Lazier then explained the native environments, potential and management of a large number of species and lines. This prolonged discussion which resembled a school lecture, took almost 2 hours, but the time was not noticed by the participants.



The group had lunch and then proceeded the Ministry of Agriculture-ILCA Cooperative Programme at Abernosa Ranch (670 mm) which was also dusty and dry with little green vegetation apparent. Dr. Lazier first demonstrated the simple thatch roofed, wooden office - nursery and then James Ochang, the ILCA staff member responsible for the programme explained the programme at the site. A number of small plots held native and exotic lines of forage legumes for initial evaluation and multiplication under rain-fed conditions. These were almost all dried up.

Dr. Lazier pointed out that the plots were minimal input, with grass in the plots and pathways. Regular observations were taken. One perenniating Lablab purpureus line ILCA 6536 was pointed out as being promising for cut and carry. It was still green. A replicated trial with 8 lines of Stylosanthes had recently been grazed very hard. Dr. Lazier said that as the trial had been planted with grass, and with grass in the pathways it was easy to maintain. S. scabra cv. Seca was the outstanding line in the trial, with S. hamata cv. Verano, and a S. fruticosa line next in vigour.

We looked at a strip trial site on the Ranch. Dr. Lazier explained the simple planting and observation procedures required to run the trial. It too looked very dry. Stylosanthes lines appeared to have done the best.

We drove up a hill on the ranch for a view of the area. We could only see lakes Abiata and Langanjo as it was too dusty to see further. We then returned to Addis arriving at 6:30 P. M.

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4

FNE Steering Committee Meeting  
February 7, 1984, ILCA Headquarters

Members present: Ato Alemayehu Mengistu, Ato Lulseged Gebre Hiwot, Dr. Samuel Jutzi, Dr. John Lazier and Ato Abate Tedla.

The meeting was called in response to the decision of the 12th FNE General Meeting that a new annual forage trial was to be planned by the Steering Committee.

- 1 Oat varieties from IAR were first suggested for the trial. Ato Alemayehu indicated that work had already been done in different regions using these same varieties. The Committee however noted the importance of screening for rust resistant oat varieties. Dr. Samuel Jutzi said that ILCA had been screening oat and triticale lines and had selected some 15 lines of each of these two cereals. It was decided that ILCA should multiply these varieties for an FNE trial in the 1985 planting season. Dr. Jutzi suggested that triticale warrants further study in Ethiopia as it is a valuable crop due to its resistance to drought and good performance on fertile soils.



2. It was decided to have the 1984 annual trial based on Trifolium species. Dr. J. Kahurananga from ILCA was invited to the meeting to explain the potential of the Trifolium species and to recommend lines for the trial.

He recommended :-

T. tembense , ILCA 5774      T. decorum, ILCA 6264 and  
T. quartinianum , ILCA 6301 for high altitude areas.

After some discussion it was agreed that 3 levels of P fertilizer should be additional treatments in the trial. The Committee then designed the trial. The trial outline is presented on page 12.

3. The Vicia sativa lines from ICARDA screened by ILCA in 1982 and 1983 have shown considerable promise. It was agreed by the Committee that these lines should be multiplied (initially at Zwai and if not successful, at a higher altitude during the long rains) in order that an FNE trial could be planted in 1985.
4. For the low altitude trials in the Rift Valley Dr. J. Lazier will prepare a new experimental outline describing the replanting with new lines which will be done before the short rains begin.
5. Dr. Lazier was also asked to prepare an outline for grass-legume replicated trials for IAR and ILCA/MOA and other sites in the Rift Valley.
6. Ato Lulseged raised the issue of attracting more individuals and organizations to the FNE. The consensus was that the Network will attract interested individuals by its Newsletter and by developing and maintaining good quality, relevant research.

#### Notices

1. For Trifolium seeds, Dr. J. Kahurananga of ILCA should be contacted.
2. Any organization which wishes to, may plant an FNE trial. An early request for seed would be adviseable.
3. For other forage seeds, requests should be made to Dr. J. Lazier (ILCA).
4. If the trial procedures are not clear, researchers should contact any of the members of the Steering Committee which attended this meeting.



## 5. Experimental Protocol

FNE Annual Trial 1984

- Locations : 1. Debre Berhan  
2. Robe  
3. Holleta  
4. Shola  
5. Mulo (if land is available)
- Title : Evaluation of 3 annual Trifolium species under three levels of phosphorous fertilizer.
- Objectives: 1. To determine seed yield and production potential of the most promising highland Trifolium species.  
2. To compare their performance under different levels of P application.  
3. To compare their performance in different regions of Ethiopia.

## Experimental design and treatments:

Randomized complete block design with 3 blocks. Each block will contain 9 plots, three P treatments (0, 10 and 30 kg P/ha) on each of the three Trifolium species (T. tumbense ILCA 5774, T. decorum ILCA 6264 and T. quartinianum ILCA 6301).

- Seeding rate : 10 kg/ha for all species  
Planting time : before the rains  
Planting method: in rows 20 cm apart, the seed should be weighed for each row before planting.
- Plot size : 2 m x 5 m
- Fertilizer application: broadcast before making rows. Note that the fertilizer rates are given as P, (not as  $P_2O_5$  or TSP).
- Nodulation : Researchers are requested to observe the size and colour of the nodules on plants taken from the guard rows.
- Harvest method 1) DM production
- The plots will be harvested at full flower. One half of each plot will be harvested leaving a 20 cm border. The harvested area will thus be 1.6 m x 2.3 m. The plants will be cut at ground level.
- 2) Seed production
- At maturity. The remaining half of each plot will be harvested at ground level in the same manner as for dry matter production. A 20 cm border will be left and an area of 1.6 x 2.3 m harvested.



Ato Menwyelet Atsedu of the Third Livestock Development Project attended the January FNE meeting and left a copy of his project's recent research results. The project has its main agronomy site at Jijiga (1650 m, 600 mm) where forages are multiplied, with a subsite at Fafem (1450 m). The best grass yields at Fafem were given by Setaria anceps, Chloris gayana cv Masaba and cv Pokot and Sorghum alnum. Medicago sativa cv Hairy Peruvian was by far the best legume tested.

At Jijiga S. alnum produced good yields, substantially better than Panicum coloratum, the only other grass tested. Lablab purpureus (Dolichos lablab), M. sativa cv Hairy Peruvian and D. uniflorus were the best legumes.

Various grass-legume combinations were successfully grown at both sites. No information was given as to when the dry matter yields were taken or whether the plants perenniated or not.

Browse lines established at Jijiga included Atriplex balanitides, Acacia species, and spineless cactus. Only the spineless cactus grew.

Present activities include the planting of 17 grasses and 15 legumes, Leucaena and fodder beet at Jijiga and Gursum (2000 m).

x x x x

## Advisory Notes

### 7.1 Stylosanthes humilis H. B. and K

S. humilis, commonly called Townsville Stylo is native to N. E. South America, Central America and the Caribbean. It became naturalized in Australia and was developed there as the first tropical forage legume.

The plant is a self regenerating, self-fertile annual or short-lived perennial which can be prostrate or upright, reaching a height of 70 cm. Each loment contains 1 seed which is characterized by a long hook. Under heavy grazing or when the plant stems rest on moist soil, adventitious roots can be formed on the stems.

The plant requires warm temperatures, growth being inhibited below day/night temperatures of 30°C/25°C. Native to the Americas between 23°N and 14°S it has been grown from sea level to 1500 m in Burma and 1650 m in Ethiopia.

It is said to require more than 550 mm to 640 mm rainfall and has been reported growing in areas with rainfall as high as

2500 mm. The three commercial cultivars do best in the following environments cv. Paterson 800 mm, cv. Lawson 900 mm, cv. Gordon 1000 mm rainfall.

It can stand some intermittent waterlogging but generally prefers well drained soils. It survives drought by its ability to seed heavily.

Nodulation is not a problem as it associates readily with native cowpea rhizobia.

The plant establishes readily and spreads rapidly by seed. Generally, the better the seed-bed preparation and the less the competition from other plants, the better the stand which will result. The seed can be broadcast on burnt-over areas, or lightly raked into prepared seed beds. It is best scarified mechanically or by sulphuric acid before planting to reduce the amount of hard seed. Acid scarification is preferable if feasible as this will reduce the chance of introducing new strains of the fungal disease, anthracnose, with exotic seed.

The plant can grow on soils low in P, but does better with P fertilizer added. It can tolerate low pH levels (4) and grows well at pH 6.5 (at Abernosa Ranch). It grows relatively poorly at pH 8 at Zwai however.

The plant combines poorly with vigorous grasses, and is normally found on sites with little grass or weed competition. Once the fertility of soils rise after P applications and N added by the legume, grasses become more vigorous and commonly shade out the plant. Heavy grazing is required to reduce the effect of weed and grass competition.

The plant survives long dry seasons and fires as seed. Its real value is as standing hay for it is not very palatable as a young plant, but with maturity and when dried it is much more so. Any rain showers during the dry season will lower the feed value and palatability of the hay by causing fungus to grow on the leaves. Seeds and what leaves have fallen are licked from the ground by cattle.

Townsville stylo is naturalized over much of Northern Australia and the beef industry in the area benefited greatly from its presence. It has also been successfully introduced to Burma. However, in both places the plant was suddenly and severely attacked by a fungal disease commonly called anthracnose (*Colletotrichum gloeosporoides*) which has much reduced its productivity and persistence. An anthracnose resistant line is said to have been developed in Thailand.

In recent years S. humilis is no longer sown commercially as it has been replaced by more competitive, productive and persistent Stylosanthes lines (S. scabra cv. Seca, S. hamata cv. Verano).



Paterson stylo has been planted by ILCA on Abernosa ranch, where it showed very good vigour in the first year. However, though the plants seeded heavily few seedlings appeared in the second year and these were not vigorous due to competition from grass. It is thought that ants removed the seeds from the plots. No anthracnose was noted on the plants.

Townsville stylo may yet have a place in Ethiopian fodder production. It could be a good annual legume crop for lowland fallows, and it may persist under range conditions. ILCA is currently testing it in a series of strip trials in cooperation with the MOA and IAR in the Rift Valley. Seed is available from ILCA for those who would like to test it.

x x x x

## 7. 2 Advisory Notes

### Strip Trials

Strip trials are a simple method of testing the adaptation of forage or other genoplasm in a given environment.

Their advantages are:

- 1) Very little seed is required of each line. This allows their adaptation to be tested in many environments without having to multiply the seed to large quantities.
- 2) Little effort is required to prepare the land for planting.
- 3) Minimal management is needed during the period of the trial.
- 4) Data on adaptability is obtained by simple, infrequent observations.
- 5) Treatments (fertilizer, grazing, cutting) can be easily applied.
- 6) The same site can be used for successive trials if fine differences are not sought.

### Design

The trial consists of a series of cultivated strips which we shall call plots (A in the accompanying diagram), which are usually 50 cm wide and as long as is required. Where rainfall is high and where weed or grass growth in the untilled areas between the plots may be vigorous, then a wider cultivated plot may be better, 1 m is usually sufficient.

The plot may be from 1 or 1.5 m to 10 m or more long, the length depending on the amount of seed available, expected soil variation and treatments applied.

The plots are spaced from centre to centre at a distance which depends on the expected growth (B): for vigorous viney plants such as Desmodium intortum or Siratro in areas of high rainfall or under irrigation, 5 m, in low rainfall areas such as Abernosa 1.5 m, for annual Trifolium species 1 m.

In order to have the trial rectangular rather than long and narrow, the strips are usually arranged in two or more rows. The distance C between the rows of plots may be the same as B if B is small. If B is large it may be any convenient size from 0 m to 4 or 5 m.

As unexpected variations may occur in the soil, particularly where the site has been previously cropped, a control may be planted in a 50 cm wide prepared strip around the trial. The distance of this strip E from the ends of the plots may be from 0.5 m to the same distance as B. Its distance F from the side of the trial plots is usually the same as B. The perimeter of the trial site (G) is a minimum of 1.5 to 2 m from the control strip. All of the area within the trial perimeter receives the same treatment.

#### Replication

The trial may be planted without replications or may be replicated one or more times. If the soil is uniform and the genoplasm to be tested is expected to show large differences then no replication is usually planted. In fact one of the main advantages of the trial is that it is normally not replicated.

Such trials are usually planted simultaneously in a number of environments, and this in itself is a type of replication. Of course such widely spaced replications under different environmental conditions cannot be statistically analyzed, however the environments are usually not so different as to preclude the more vigorous plants from showing up at several sites.

Such trials are planted in a range of common soil types, rainfall regimes, altitudes and in different biotic environments, (such as several different types of established pastures).

#### The Control

The most successful forage plant known for the environment being tested is chosen as the control. Observation values for the lines being tested in the trial are obtained by comparing the performance of each plot with that of the nearest control plot.

If the trial site is expected to be variable then the control is planted in each 5th plot (H) and a line of control can be planted between the rows of plots (I)



Longer plots make the replication of the control lines less necessary. Ten metre plots may only require the planting of the control about the margin. It may not be necessary to plant a margin control plot where the trial site is uniform and/or where longer plots are sown. Long established fallows of uniform soil type, level surface and plant composition, and land which has been cropped just previous to the planting of the trial in which there were no variations in growth are two examples of sites which may not require the planting of a control plot about the trial perimeter. Of course the best line known should be included in the trial in one plot for comparison.

#### Planting Rate

The plots are considered for planting purposes to be 0.5 m wide x the length of the plot no matter how wide the tilled area. Where the seeding rate for small and large seeded legumes is 5 and 10 kg/ha respectively then the seeding rate per m of plot will be 0.25 and 0.5 g respectively.

Where several lines of unknown or doubtful value are being planted or if seed and plots are in short supply, mixtures of several lines can be sown in one plot. The lines in the mixture should be easily distinguishable. The sowing rate is reduced for each line to one-half or less of the normal sowing rate depending on the amount of seed, number of lines and viability of the seed.

#### Plot Preparation and Planting

A trial diagram should be prepared for each site with the locations of the lines to be planted assigned at random separately for each trial site. Pegs are put in to mark each end of the plots, on the centre line. The accession number to be planted should be marked on one peg of each plot before planting.

The boundaries of each plot are marked and the area hoed, grass and weeds removed, and a fine tilth established down the centre of the plot, about 10 to 15 cm wide.

After checking the seed packet against the peg label the seeds are planted in a single line down the centre of the plot from one end to the other.

For uniform sowing of such small amounts of seed it may be mixed with sand or soil. The seed should be applied at least two and preferably 3 times down the length of the plot for uniformity. The empty seed bag should be checked a final time against the number on the peg before discarding. Good compaction of the soil is required for good seed germination.

#### Fertilizer

Fertilizer, when applied is usually applied over the entire trial including the boundary surrounding the perimeter control plot. Care must be taken when applying the fertilizer that it is applied uniformly. Thus at least 3 passes over the area to be fertilized should be made, each in a different direction.



## Treatments

Fertilizer may be added as a treatment, in which case the plots are divided into two (or more) sections, and the fertilizer broadcast over the entire section of the trial from the boundary. To avoid confusion when several trial sites are receiving the same treatment the same side of the plots should receive the fertilizer.

For perennial forages some sort of clipping or grazing treatment is normally applied after the plants are well established to see how the plants would respond to pasture or cut and carry conditions. For grazing, a large number of animals are put in after the observations have been completed and it is grazed down in a few hours. Such rapid, heavy grazing makes the management of the trial much easier and eliminates the need for watering points. Grazing is continued at 6 weekly intervals except in the dry season when the trial is well grazed down and there is no regrowth.

Where there are no animals available for grazing, a cut and carry treatment (simulated grazing) can be imposed by cutting the plants back. Of course clipping is not at all like grazing, particularly for woody or bushy legumes. It is however, better than no treatment. Each line should be cut at a height suitable for good regrowth.

Tropical prostrate woody and viney legumes can be cut at 10 to 15 cm, 30 cm if upright, and 50 cm or more if tall bushes and herbs. The grass between the plots is normally cut back at the same time if necessary, whether planted or not, at 30 cm for tall clumpy tropical grasses such as Guinea grass, 15 cm for more prostrate rhizomatous tropical grasses such as Pangola and 2.5 cm for temperate grasses. The cut material is then removed.

## Management

The planted lines are normally weeded until the plants are well established, then only the taller weeds are removed, for neatness. If the pasture is not grazed, the grass is normally cut over by hand or mower periodically, if necessary. Fencing is done with particular care as it must keep out animals between observations. Where rabbits are a problem, chicken wire or some other such fencing should be used as well. At each visit to the trial, maintenance should be done on the wire, pegs, and any moles or other pests removed. Where the legumes are very vigorous they may have to be cut about their plot perimeters to prevent them from growing into adjacent plots.

## Observations

Observations should be done by one person, or team for the duration of a trial to ensure uniform ratings. If trials are to be compared the same people should observe all of the trials.

When learning to do the observations more than one person should be involved. One character at a time should be observed and rated, and the observers should then argue as to which is the best rating.



It is useful to have a team of two persons observing strip trials. They should practice together until their ratings are identical. They then observe the trials together, one doing the high fertilizer rate the other the low. Having a pair of individuals responsible means that when one is sick or on leave the observations can be continued, with no change in the ratings.

If junior staff are doing the observations. Care must be taken to check that the forms are properly filled in, and are legible and sensible.

The observations on strip trials are commonly done at 6 weekly intervals for perennial trials and 3 weekly intervals for trials on annual species.

#### The 0 - 10 rating method

This is a percentage, a summary of 0 to 100%. It has been shortened to 0 to 10 as observational ratings cannot be accurate to 1%. The temptation must be resisted to record decimals ie 4.5 as it would have to be changed to 4 or 5 anyway.

0 also means none, 10 means fully, all, or completely. Where there is an insignificant occurrence, and you wish to record it, and 1 is too large, then use "n" indicating negligible.

When filling the forms, all the spaces must be filled. Where there is nothing to be observed put zeros otherwise it is not known whether or not the observation was actually taken.

As an example, a trial has been chosen which has 16 separate lines of perennial legumes and 10 lines in a mixture planted in a grass sward. There are two fertilizer rates applied (high and low). Detailed observations are taken on the legumes and the grass. The trial is grazed after each six weekly observation, thus there are forms required for the regular observation before grazing, and for the post grazing observation. These forms are attached. Refer to them when reading the following discussion:

|             |                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exp :       | Experiment number, name, or other identifier;                                                                                                                                                                                                                                                         |
| High Low :  | The fertilizer rate being observed;<br>One is crossed out;                                                                                                                                                                                                                                            |
| Date :      | Day/month/year;                                                                                                                                                                                                                                                                                       |
| Number :    | The number of the observation (first (1), second (2), third (3), etc.)                                                                                                                                                                                                                                |
| Weather:    | The weather generally since the last observation.<br>This is <u>not</u> the weather on the day the observation is taken;                                                                                                                                                                              |
| Observer :  | The name of the person taking the observations;                                                                                                                                                                                                                                                       |
| Mixture :   | Right of the double vertical line the individual accessions in the mixture are observed;                                                                                                                                                                                                              |
| Accession : | The top line on the sheet is filled in with the accession numbers or symbols for each treatment in the trial. Those in the mixture go to the right of the double lines. It is simplest if the accessions are always put in the same order on the sheet, and put on before the observations are taken. |



Plot cover : In this section we observe as a percentage ground cover the legume cover in the tilled strip, and in the grass which lies between the tilled strips. The true plot of any planted line is considered to extend half way to the next strip. Thus if the sown lines are 4 m apart, the plot will extend 2 m on either side of the sown lines. The amount of grass, weed and bare ground are also observed both in the tilled strip and in the untilled part of each plot. This will give an indication of the competition which the sown plants are facing. It also will indicate the speed with which the tilled area is invaded by other plants.

Spread and height : Are measured as maximum and averages both for the legume and for the grass.

Leafy : Is measured as a percentage. The plants are compared to a theoretical plant completely covered in leaves. This allows the leafiness of the plants to be compared, even if of different species.

Vigour : Is the rate of growth. Look for new leaves, newly formed growing tips.

Chewing and sucking refer to insect pests. These headings have 2 sections.

Leaf : Refers to the percentage of leaves affected by the pest.

Damage : Refers to the percentage of each affected leaf damaged.

Fungus and Virus disease : Are recorded in the same way.

Leaf drop : Loss of leaves due to drought or pest or disease, damage is measured as a percentage of the leaves. It can be estimated by examining the leaves which have fallen from the plant. Damage in this case would refer to any fallen leaves.

Grass "Disease" and "Pest" : As the legumes are the main consideration in this trial the grasses receive less attention.

Flowers present: A percentage, considering a theoretical plant completely covered in flowers.

Seed : A percentage measure of the flowers which have produced seed.

green : Percentage of seed present which are not ripe.

ripe : Percentage of ripe seeds present.

Seedlings : A percentage ground cover, or a count if preferred, of the number of seedlings self sown by the plant.

Plants alive/ in Strip : Where survival of the plants is a consideration, then the numbers are recorded in this section. If the line which was planted is covered then C may be put in here. Plants may be tagged to determine their survival. This number may also be put in this box ie C/5.



- Plant deficiency symptoms : Any discoloration or distortion of the plants which is believed to be caused by a nutrient deficiency should be given an estimate of severity between 0 and 10.
- Detail/notes : On the back of the sheet the best lines in the trial should be listed, any further comments or observations, plus details of whatever deficiency symptoms, or symptoms of water - logging etc. are seen.
- If there is damage by birds, rabbits, moles etc, some estimation (0 - 10) should be given of the damage to any plants.

### The Post Grazing Observation Sheet

This form is used for strip trials which are grazed and is done immediately after grazing. The observations on this, compared to the observations done immediately before grazing will give a good indication of relative palatability and the degree of grazing done.

Many of the observations are the same as on the regular strip trial form. A few are different and warrant some explanation.

- Amount grazed : Is the percentage of the plot area which has been grazed.
- Extent grazed : Has a special 1 to 5 scale of, on average, what plant parts in a particular plot were removed by the animals.. (amount grazed x extent grazed gives a nice graphable grazing index).
- Trampled : Is a percentage measurement, area of the grass and legume which have been flattened by the feeding cattle. This has an effect on regrowth, particularly in wet weather when the plants may be covered in mud.

### Simplified Observations

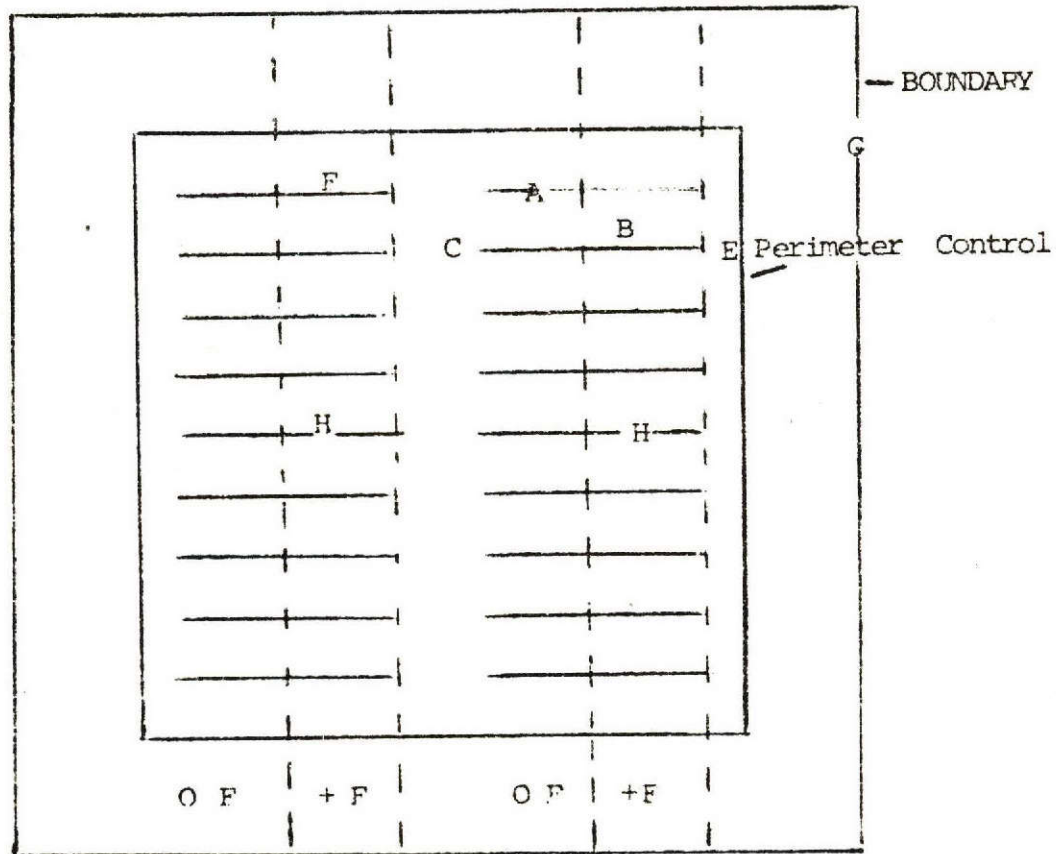
In the trial given as an example , if desired, the observations could be much simplified by not observing the grass and by observing the legume only once and not separately in the strip and in the grass.

This would then eliminate all grass, weed and bare soil observations.

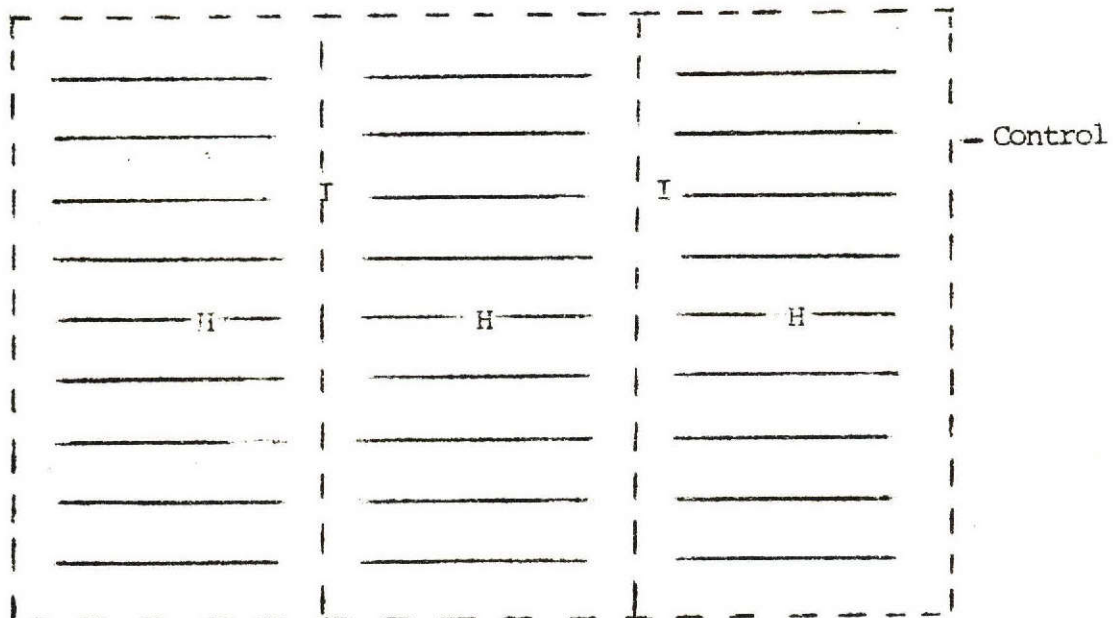


# STRIP TRIAL DIAGRAMS

1. Two rows of plots



2. Three rows of plots with the control planted between rows



EXP

High

## Strip Trial Observation Form

OBSERVER

\*(rate 0-10)

Low

DATE

NUMBER

WEATHER

Mixture

|                           |                  |  |
|---------------------------|------------------|--|
|                           | Accession        |  |
| Plot                      | Legume Strip     |  |
| Cover*                    | Grass            |  |
|                           | Grass Strip      |  |
|                           | Grass            |  |
|                           | Weed Strip       |  |
|                           | Grass            |  |
|                           | Bare Strip       |  |
|                           | Grass            |  |
| Spread                    | Legume maximum   |  |
| cm                        | average          |  |
| Height                    | Legume Strip max |  |
| cm                        | av               |  |
|                           | Grass max        |  |
|                           | av               |  |
|                           | Grass Strip max  |  |
|                           | av               |  |
|                           | Grass max        |  |
|                           | av               |  |
| Leafy*                    | Legume           |  |
|                           | Grass            |  |
| Vigour*                   | Legume           |  |
|                           | Grass            |  |
| Chewing*                  | Legume Leaf      |  |
|                           | Dam              |  |
| Sucking*                  | Legume Leaf      |  |
|                           | Dam              |  |
| Fungus*                   | Legume Leaf      |  |
|                           | Dam              |  |
| Leaf Drop*                | Legume Leaf      |  |
|                           | Dam              |  |
| Virus*                    | Legume Leaf      |  |
|                           | Dam              |  |
| Grass* "Disease"          | Leaf             |  |
|                           | Dam              |  |
| "Pest"                    | Leaf             |  |
|                           | Dam              |  |
| Flowers present*          |                  |  |
| Seed*                     |                  |  |
| green*                    |                  |  |
| ripe*                     |                  |  |
| Seedlings*                |                  |  |
| Plants alive/in Strip     |                  |  |
| " Deficiency Symptoms*    |                  |  |
| " Detail/notes (and over) |                  |  |





### Steering Committee Members

Executive members                      Ato Alemayhu Mengistu, Chairman, MOA - 44-75-32  
                                         Ato Iulseged Gebre Hiwot, D/Chairman, IAR  
                                         Ato Abate Tedla, Secretary, ILCA        - 18 32 - 15

### Members :

|                        |                            |            |
|------------------------|----------------------------|------------|
| Dr. Chadokar           | Soil & Water (MOA)         | - 44-40-80 |
| Ato Gugssa Endeshaw    | ESC                        | - 15-50-15 |
| Dr. Samuel Jutzi       | ILCA                       | - 18-32-15 |
| Dr. John Lazier        | ILCA                       | - 18-32-15 |
| Ato Adane Fayissa      | MSF                        | - 15-28-81 |
| Ato Asfaw Yemegnuhal   | Tesse Amba Training Centre |            |
| Mr. Christian Langlais | Wolleta Rural Education    |            |
|                        | Programme WREP             | - 11-14-41 |
| Ato Gashaw Shibahew    | ARDP - Asela               | - 92       |
|                        | or Kylymsa                 | - 102      |
| Ato Getinet Aklilu     | Sirinka Catchment Project  |            |
| Ato Fikre Aberra       | Ambo Junior College        |            |
| Ato Kidane W/Yohannes  | TLDP                       | - 15-10-88 |
| Ato Berhanu Hiko       | Forestry & Wildlife (MOA)  | 18-29-81   |

The forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter itself is obtained by writing to "The Editors".

Any news, notes, notices research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia.

If your address is not correct or you do not receive The Newsletter and wish to, please fill in the attached form:

To        The Editors  
          FNE Newsletter  
          P. O. Box 5689  
          Addis Ababa

Date \_\_\_\_\_

Please include/change my address to

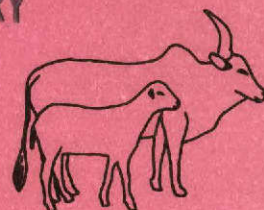
Name : \_\_\_\_\_  
Address : \_\_\_\_\_  
          \_\_\_\_\_  
          \_\_\_\_\_  
          \_\_\_\_\_





# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 5

AUGUST 1984

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### 1. INTRODUCTORY MESSAGE

The Steering Committee in its latest meeting planned the 1984 FNE field trip. The trip will visit FLAG (ILCA) lowland trial and seed multiplication sites. Participants will leave ILCA on Friday October 26 at 7 A.M. and visit sites at the Zwai State Horticulture Farm and the MOA's Abernosa Ranch. The night will be spent at the Bekele Mola Hotel at Shashamane. On Saturday the group will travel to the new ILCA site at WADU in Soddo and then return to spend the night at Shashamane. On the way back to Addis on Sunday ILCA Highland Programme trials at Debre Zeit will be visited.

ILCA will provide the transport and make the hotel reservations. All research and development workers interested in forages are welcome to join the trip. Please inform Tony Russell-Smith or the Secretary (Hiruth) of FLAG at ILCA as soon as possible of your intention to come.

The FNE Newsletter needs the results of your research from 1983, or your plans for 1984. Let other researchers hear of your work.

Editors Alemayehu Mengistu, John Lazier.

\* \* \* \*



## 2. MINUTES OF THE FNE STEERING COMMITTEE MEETING 10/5/84

A meeting of the FNE Steering Committee was held on 10/5/84 at ILCA Headquarters, from 9:30 to 11:00 A.M. The members who participated were Dr. J. Lazier, Ato Alemayehu Mengistu and Ato Abate Tedla.

### Issues discussed:

#### a) Newsletter release

The committee agreed to release the FNE Newsletter about four times a year in September, December, February and June.

#### b) FNE 1983 trials results

Data analysis for individual experiments and combined locations has been completed. Abate Tedla will produce a draft of the 1983 FNE trials in the high and medium altitude regions. Thereafter, the draft will be circulated among the FNE Steering Committee members for comments in order to produce the final report. The 1983 Bako data was not available for the report.

#### c) Articles, research briefs and annual reports for FNE Newsletter

The committee decided to request researchers and development personnel in ILCA, State Farms, IAR, ARDU, Ministry of Agriculture, and aid programmes for their annual reports, research briefs and articles related to forage work for publication in the coming FNE Newsletters.

#### d) Future field trip on forage work

It was decided to arrange a field trip on the 26th October, 1984 to visit the FLAG forage work in the Rift Valley specifically at Zwai, Wolayta, Abernosa, and on the way back Debre Zeit Research Station (ILCA). A detailed time table for the trip will be available and all interested forage researcher are invited. ILCA will be responsible for organizing the trip make transport arrangements.

#### e) Write up of low altitude FNE forage project

Dr. J. Lazier will write up the results of the first year's replicated low altitude FNE strip trials.



**Other points:**

FNE Newsletter goes to 300 interested researchers and development personnel. Requests to be included on the mailing list are being continually received.

Researchers doing FNE multilocation trials are reminded that the steering committee had previously decided that there would be no quality analyses done on forage samples from the 1983 trials. Those researchers who sent samples to ILCA should retrieve them, or instruct ILCA to discard them.

\* \* \* \*

**3a) RESULTS OF 1983 FORAGE NETWORK TRIALS**

Compiled by Abate Tedla

**Introduction**

Over the past two decades, research on pasture and forage crops has been done by various organizations in Ethiopia, (IAR, Institute of Agricultural Research, ARDU, Arsi Rural Development Unit, MOA, Ministry of Agriculture, MSF, Ministry of State Farms, ILCA, International Livestock Centre for Africa). In late 1980, all the researchers involved viewed it as important to set up and implement coordinated, joint forage trials on a national level. Since 1981 trials have been carried out in various ecosystems of Ethiopia, subjecting promising forage species to a wide range of environments (soil, temperature, rainfall and drainage). The species which proved to be doing well under these conditions were likely to be adopted by farmers. The trials were grouped according to the species' longevity (annual or perennial), altitude requirement (high or medium), and ease of management. Evaluation was made under uniform management at all test locations.

The organizations which set up the Forage Network trials were IAR, ARDU and ILCA.

**Methods and Materials**

Five network trials on forage crops were carried out in different ecological zones of Ethiopia to determine and compare yields. The sites selected for the trials were representative of high altitude

(above 2400 m) and medium altitude (1600-2400 m) environments. Detailed information on test locations, soil and altitude are given in Table 1.

Rainfall and temperature data are shown in appendices 1 and 2 respectively. However, data for some locations (Merraro, Dherra, and Bedi) were not available, and hence they have not been included in this report.

Annual, and perennial forages were planted in separate trials, and different species were planted in each altitude zone. The fodder beet trial was only planted at the higher altitudes. The species chosen for comparison in the five network trials are listed in Table 2. Cereal-legume mixtures were also included and compared with pure stands of cereal and legume.

At planting time, DAP fertilizer was broadcast at 100 kg/ha and 200 kg/ha for forage crops and fodder beet respectively. Urea was applied at 50 kg/ha on the pure grass plots about a month after planting. Forage seeds were sown in rows. Table 2 shows the seed rates and spacings used.

All experiments had three replicates in a complete randomised block design with plots of 2 x 5 m with one meter paths between plots and replicates.

Dry matter yields were obtained by harvesting at the optimum growth stage (grass about 50% heading and legume 10% bloom) at ground level, drying in an oven and weighing. A combined analysis of variance for all locations was done using the MBDP computer software package at ILCA headquarters.



**TABLE 1. FORAGE NETWORK TEST LOCATIONS, SOIL AND ALTITUDE**

| TEST LOCATION                    | S O I L |            | Altitude |
|----------------------------------|---------|------------|----------|
|                                  | PH      | Texture    | (m)      |
| 1. Debre Berhan <sup>x</sup> (a) | 5.0     | Clay loam  | 2800     |
| 2. Shola <sup>x</sup> (a)        | 6.0     | Black clay | 2400     |
| 3. Debre Zeit <sup>x</sup> (b)   | 6.2     | Clay loam  | 1800     |
| 4. Holetta <sup>+</sup> (a)      | 5.0     | Red clay   | 2400     |
| 5. Sheno <sup>+</sup> (a)        | 6.6     | Clay       | 2800     |
| 6. Bedi <sup>+</sup> (a)         | 4.9     | Clay       | 2800     |
| 7. Ginchi <sup>+</sup> (b)       | 6.5     | Clay       | 2200     |
| 8. Bako <sup>+</sup> (b)         | 5.7     | Clay       | 1650     |
| 9. Robe <sup>y</sup> (a)         | 6.0     | Clay       | 2450     |
| 10. Bekoji <sup>y</sup> (a)      | 5.2     | Red clay   | 2760     |
| 11. Kulumsa <sup>y</sup>         | 5.8     | Clay       | 2200     |
| 12. Dherra <sup>y</sup> (b)      | 7.1     | Sandy loam | 1700     |
| 13. Merraro <sup>y</sup> (a)     | 5.7     | Clay       | 2980     |

a = high altitude location (2400 - 3000 m)

b = medium altitude location (1600- 2400 m)

+ IAR

x ILCA

y ARDU

TABLE 2. Forage network test locations, species, seed rate and spacing.

| Trial                                 | Number of Locations | Species/Cultivar                                       | Seed rate Kg/ha | Spacing cm |
|---------------------------------------|---------------------|--------------------------------------------------------|-----------------|------------|
| I. High altitude annual species       | 7                   | 1. <u>Avena sativa</u> (oats)<br>Cl 8237               | 75              | 20         |
|                                       |                     | 2. <u>Avena sativa</u> Lampton                         | 75              | 20         |
|                                       |                     | 3. <u>Vicia dasycarpa</u> (vetch)<br>cv Lana           | 25              | 40         |
|                                       |                     | 4. Cl 8237/cv Lana                                     | 75/25           | 40         |
|                                       |                     | 5. Lampton/cv Lana                                     | 75/25           | 40         |
|                                       |                     | 6. <u>Trifolium tembense</u>                           | 10              | 20         |
|                                       |                     | 7. <u>Trifolium rueppellianum</u>                      | 10              | 25         |
| II. Medium altitude annual species    | 5                   | 1. <u>Avena sativa</u> Cl 8237                         | 75              | 20         |
|                                       |                     | 2. <u>Avena sativa</u> cv Lampton                      | 75              | 20         |
|                                       |                     | 3. <u>Vicia dasycarpa</u> cv Lana                      | 25              | 40         |
|                                       |                     | 4. Cl 8237/cv Lana                                     | 75/25           | 40         |
|                                       |                     | 5. Lampton/cv Lana                                     | 75/25           | 40         |
|                                       |                     | 6. <u>Sorghum sudanense</u> (Sudan grass)              | 25              | 40         |
|                                       |                     | 7. <u>Sorghum alnum</u> (Colombus grass)               | 25              | 40         |
|                                       |                     | 8. <u>Lablab purpureus</u>                             | 25              | 40         |
| III. High altitude perennial species  | 5                   | 1. <u>Festuca arundinacea</u> (Tall fescue)            | 15              | 20         |
|                                       |                     | 2. <u>Dactylis glomerata</u> (Cocksfoot)               | 25              | 20         |
|                                       |                     | 3. <u>Lolium perenne</u> S 24                          | 20              | 20         |
|                                       |                     | 4. <u>Phalaris tuberosa</u> cv Australia               | 15              | 20         |
|                                       |                     | 5. <u>Lolium multiflorum</u> cv Barspectra             | 25              | 20         |
| IV. Medium altitude perennial species | 4                   | 1. <u>Chloris gayana</u> (Rhodes grass)                | 12              | 20         |
|                                       |                     | 2. <u>Panicum coloratum</u>                            | 12              | 20         |
|                                       |                     | 3. <u>Pennisetum purpureum</u> (Elephant grass)        | *               | 100 x 50   |
|                                       |                     | 4. <u>Desmodium uncinatum</u> silver leaf Desmodium    | 10              | 40         |
| V. High altitude fodder beet          | 6                   | 1. <u>Beta vulgaris</u> (fodder beet) var Aring barres | 10              | 40         |
|                                       |                     | 2. <u>Beta vulgaris</u> var Triumph betat              | 10              | 40         |

\* Root splits or stem cuttings used



# I. Results for high altitude annual species (Table 3)

Two cereals, two cereal-legume mixtures and three legume species were evaluated at seven locations.

On the black soil at Shola oats 8237, oats Lampton and their mixtures with Vicia dasycarpa gave significantly higher yields than the pure stands of Trifolium and Vicia. Among the seven locations Shola (followed by Holetta) was the most suitable for dry matter production of Trifolium tembense and T. rueppellianum (4.36 and 2.95 t/ha respectively). Unlike the Trifolium species, V. dasycarpa did well at Merraro, Holetta and Bekoji. The performance of oats 8237, oats Lampton and their mixtures with Vicia dasycarpa at Merraro, Holetta, Bekoji and Bedi was in general good and comparable to that at Shola.

Low yields were observed at Sheno and Robe for all the species planted, this could be due to poor soil drainage.

TABLE 3. Average yields (t/ha) of high altitude annual species by site, 1982/83 multilocal trials.

| Location     | Average yield (t/ha) |              |                     |                                   |                                           |                          |                               | Location mean |
|--------------|----------------------|--------------|---------------------|-----------------------------------|-------------------------------------------|--------------------------|-------------------------------|---------------|
|              | Oats 8237            | Oats Lampton | <u>V. dasycarpa</u> | Oats 8237/<br><u>V. dasycarpa</u> | Oats lamp-<br>ton/<br><u>V. dasycarpa</u> | <u>T. tem-<br/>bense</u> | <u>T. ruep-<br/>pellianum</u> |               |
| Shola        | 9.31                 | 7.99         | 3.07                | 8.14                              | 8.78                                      | 4.36                     | 2.95                          | 6.37          |
| Robe         | 0.95                 | 1.00         | 0.20                | 1.40                              | 1.11                                      | 1.37                     | 1.14                          | 1.02          |
| Bekoji       | 5.93                 | 6.94         | 5.21                | 6.78                              | 5.80                                      | 0.10                     | 0.05                          | 4.40          |
| Merraro      | 14.70                | 12.95        | 9.92                | 15.06                             | 12.18                                     | 1.57                     | 0.57                          | 9.56          |
| Bedi         | 10.61                | 7.17         | 0.47                | 9.56                              | 6.41                                      | 0.59                     | 0.89                          | 5.10          |
| Holetta      | 11.77                | 11.01        | 7.13                | 12.27                             | 9.47                                      | 2.22                     | 1.82                          | 7.95          |
| Sheno        | 3.57                 | 4.03         | 2.99                | 4.54                              | 4.18                                      | 0.39                     | 0.65                          | 2.91          |
| Species mean | 8.12                 | 7.30         | 4.14                | 8.25                              | 6.85                                      | 1.52                     | 1.15                          |               |

S. E. of species mean = 0.59

LSD (0.05) of species mean = 1.79

## II. Results for high altitude perennial species

(Table 4)

Five perennial species were evaluated at four locations

The overall performance of the five perennial grasses tested at Debre Berhan and Robe was low, with no significant differences in yields being observed among species at either location.

At Holetta, tall fescue (Festuca arundinacea) was the best dry matter producer; its yield of 13.7 t/ha was significantly higher than the yields of the other species tested. Phalaris tuberosa cv Australia ranked second (6.97 t/ha), significantly outyielding Lolium perenne S 24, Lolium multiflorum cv Barspectra and Dactylis glomerata.

At Shola, tall fescue was again the top yielder with 6.87 t DM/ha. Lolium multiflorum cv Barspectra, Lolium perenne S 24 and Dactylis glomerata showed no significant differences while the yield of P. tuberosa cv Australia was significantly lower than that of D. glomerata but comparable with those of L. multiflorum cv Barspectra and L. perenne S 24.

It has been suggested that the low cutting height of Phalaris tuberosa contributed to its low yield.

TABLE 4. Average DM yields (t/ha) of five perennial grasses evaluated during the 1982/83 multi-localational trials (second year of establishment).

| Location     | Average DM yield (t/ha) |                                |                                             |                        |                           | Location mean |
|--------------|-------------------------|--------------------------------|---------------------------------------------|------------------------|---------------------------|---------------|
|              | <u>F. arundinacea</u>   | <u>P. tuberosa</u> cv Austral. | <u>L. multi</u> <u>florum</u> cv Barspectra | <u>L. perenne</u> S 24 | <u>Dactylis glomerata</u> |               |
| Debre Berhan | 1.69                    | 2.08                           | 2.32                                        | 1.65                   | 2.12                      | 1.97          |
| Robe         | 3.65                    | 3.73                           | 3.99                                        | 4.09                   | 3.72                      | 3.84          |
| Holetta      | 13.07                   | 6.97                           | 3.95                                        | 2.74                   | 2.67                      | 5.88          |
| Shola        | 6.87                    | 4.27                           | 5.03                                        | 5.33                   | 5.40                      | 5.42          |
| Species mean | 6.32                    | 3.18                           | 3.52                                        | 4.56                   | 3.80                      |               |

S.E. of species mean = 0.38

LSD (0.05) of species mean = 1.11



### III. Results for Medium altitude annual species (Table 5)

Two cereals, two cereal legume mixtures, two grasses and two legumes were evaluated at five locations.

At Debre Zeit, Lablab purpureus was found to be the best yielder (10.73 t DM/ha) among all the species tested. Second in rank were oats Lampton and Lampton/vetch and oats 8237/vetch mixtures, which did not show any significant yield differences. Vetch and Columbus grass gave the lowest yields (4.78 and 4.29 t/ha).

At Kulumsa the top yielders were oats 8237/vetch, Sudan grass, vetch, and no significant difference was found among these species. It is also interesting to note that Kulumsa proved to be the best location for the production of vetch (7.03 t/ha).

At Dhera and Ginchi, the performance of all the species was low compared to the other locations (Bako, Debre Zeit and Kulumsa).

The overall performance of species at Bako was excellent, which could be attributed to ideal environmental factors such as long rainfall combined with good temperature and soil status. Outstanding yields were obtained from Sudan grass and Columbus grass (13.88 and 12.74 t/ha respectively), whereas the performance of vetch was very poor (2.93 t/ha).

TABLE 5.

Dry matter yields (t/ha) of eight annual forage species at five medium altitude test locations, 1983/84 season.

| Location      | DM YIELDS (t/ha) |              |       |                  |                |                |             |                         | Location mean |
|---------------|------------------|--------------|-------|------------------|----------------|----------------|-------------|-------------------------|---------------|
|               | Oats 8237        | Oats Lampton | Vetch | Oats 8237/ vetch | Lampton/ vetch | Colombus grass | Sudan grass | <u>Lablab purpureus</u> |               |
| 1. Debre Zeit | 5.50             | 7.76         | 4.78  | 7.13             | 7.56           | 4.29           | 5.46        | 10.73                   | 6.65          |
| 2. Kulumsa    | 5.48             | 4.90         | 7.03  | 8.02             | 4.89           | 6.46           | 7.97        | 2.96                    | 5.96          |
| 3. Dherra     | 3.39             | 3.11         | 2.20  | 4.13             | 4.60           | 3.54           | 4.95        | 1.84                    | 3.47          |
| 4. Ginchi     | 5.04             | 5.35         | 1.34  | 3.89             | 3.59           | 1.41           | 0.99        | 0.44                    | 2.76          |
| 5. Bako       | 8.04             | 6.61         | 2.93  | 8.57             | 6.31           | 12.74          | 13.88       | 11.47                   | 8.82          |
| Species mean  | 5.49             | 5.55         | 3.65  | 6.35             | 5.39           | 5.69           | 6.65        | 5.49                    |               |

S. E. of species mean = 0.67

LSD (0.05) of species mean = 1.91



## V. Results for medium altitude perennial species

(Table 6)

Three perennial grasses and one legume species were planted at three locations. No significant yield differences were found among these species at Debre Zeit and Ginchi. Compared to the three grass species tested Desmodium uncinatum (the legume) appeared to be poorly established at these two sites. The lower performance of medium altitude perennial species at Debre Zeit and Ginchi was due mainly to the short growing season which resulted in only one harvest.

At Bako, however, the performance of these species was outstanding. Four harvests were taken for all species except Panicum coloratum, which was harvested two times. Chloris gayana and Pennisetum purpureum were the top DM producers (25.25 t/ha respectively) yielding significantly higher than Panicum coloratum and Desmodium uncinatum. No significant yield difference was detected between P. coloratum and D. uncinatum.

TABLE 6. Average DM yields (t/ha) of four medium altitude perennial species 1983/84 growing season.

| Location     | Average DM Yields (t/ha) |                          |                             |                            | Location mean |
|--------------|--------------------------|--------------------------|-----------------------------|----------------------------|---------------|
|              | <u>Chloris gayana</u>    | <u>Panicum coloratum</u> | <u>Pennisetum purpureum</u> | <u>Desmodium uncinatum</u> |               |
| Debre Zeit   | 4.83                     | 3.70                     | 4.53                        | 1.28                       | 3.59          |
| Ginchi       | 4.95                     | 2.72                     | 5.30                        | 2.78                       | 3.94          |
| Bako         | 25.25                    | 18.00                    | 25.60                       | 14.71                      | 20.97         |
| Species mean | 11.78                    | 8.14                     | 11.81                       | 6.29                       |               |

S. E. of species mean = 2.00

LSD (0.05) of species mean = 5.95

#### IV. Results for fodder beet at high altitude locations

(Table 7)

Two cultivars of fodder beet were evaluated at six locations.

The two cultivars of fodder beet tested (cv Aring barres and Triumph betat) were harvested 8 to 9 months after planting to determine dry matter production. The yields obtained are shown in Table 7. The yield of fodder beet cv Triumph betat was slightly higher than that of cv Aring barres in all locations except Shola, where it suffered from porcupine damage. Nevertheless, the yields, did not differ significantly at any of the test locations.

TABLE 7. Average DM Yields\* (t/ha) of two high altitude fodder beet cultivars, 1982/83 multilocal trials.

| Location     | Average DM yields (t/ha)              |                                        | Locations mean |
|--------------|---------------------------------------|----------------------------------------|----------------|
|              | Fodder beet cv<br><u>Aring barres</u> | Fodder beet cv<br><u>Triumph betat</u> |                |
| Debre Berhan | 1.54                                  | 3.30                                   | 1.92           |
| Shola        | 7.24                                  | 6.19                                   | 6.72           |
| Sheno        | 4.22                                  | 4.32                                   | 4.27           |
| Kulumsa      | 6.67                                  | 9.78                                   | 8.22           |
| Robe         | 3.51                                  | 5.59                                   | 4.55           |
| Holetta      | 8.93                                  | 10.82                                  | 9.88           |
| Species mean | 5.35                                  | 6.50                                   |                |

S.E. of species mean = 0.98

\* combined root and leaf dry matter yield



# APPENDIX 1

Monthly rainfall (mm) recorded at the network's test locations for 1983 crop season

| Month     | D. Berhan | Shola  | D. Zeit | Holetta | Sheno  | Ginchi | Robe   | Bekoji  | Kulumsa | Bako   |
|-----------|-----------|--------|---------|---------|--------|--------|--------|---------|---------|--------|
| January   | 12.6      | 22.2   | 0.0     | 19.9    | 3.24   | 13.5   | 4.7    | 58.5    | 5.6     | 5.5    |
| February  | 5.3       | 20.4   | 0.5     | 49.4    | 11.84  | 36.2   | 73.0   | 100.5   | 16.0    | 29.2   |
| March     | 103.0     | 108.2  | 26.7    | 120.4   | 63.24  | 74.7   | 82.4   | 124.0   | 128.4   | 84.7   |
| April     | 48.8      | 144.3  | 31.4    | 126.3   | 70.67  | 90.8   | 107.6  | 139.4   | 99.3    | 55.6   |
| May       | 95.9      | 255.4  | 107.2   | 219.1   | 26.50  | 179.7  | 144.1  | 242.3   | 239.4   | 133.9  |
| June      | 23.7      | 68.9   | 128.7   | 87.5    | 58.64  | 142.4  | 45.0   | 68.1    | 64.8    | 108.3  |
| July      | 158.3     | 233.5  | 213.5   | 241.2   | 266.27 | 253.1  | 105.4  | 122.9   | 161.7   | 227.4  |
| August    | 381.8     | 305.1  | 405.2   | 241.2   | 213.54 | 156.5  | 195.8  | 166.9   | 183.1   | 235.5  |
| September | 82.6      | 144.3  | 72.8    | 284.0   | 89.24  | 205.1  | 122.1  | 122.0   | 104.9   | 146.9  |
| October   | 3.7       | 25.5   | 11.0    | 101.9   | 27.64  | 34.5   | 62.7   | 42.5    | 12.5    | 137.8  |
| November  | 0.0       | 0.0    | 0.0     | 3.9     | 3.84   | 16.9   | 21.9   | 26.8    | 4.3     | 54.1   |
| December  | 0.0       | 0.2    | 0.0     | 22.7    | 0.0    | 17.4   | 0.0    | 14.5    | 0.0     | 0.0    |
| Total     | 915.7     | 1328.0 | 996.5   | 1517.50 | 834.66 | 1220.8 | 964.70 | 1228.40 | 1020.00 | 1218.9 |

# APPENDIX 2

Monthly average temperature (°C) recorded at the network's test locations for the 1983/84 crop season

| Month              | D. Berhan |      | Shola |      | Bako |      | Holetta |      | Ginchi |      | Robe |      | Bekoji |      | Kulumsa |      | D. Zeit |      |
|--------------------|-----------|------|-------|------|------|------|---------|------|--------|------|------|------|--------|------|---------|------|---------|------|
|                    | min       | max  | min   | max  | min  | max  | min     | max  | min    | max  | min  | max  | min    | max  | min     | max  | min     | max  |
| January            | 6.9       | 18.7 | 7.8   | 21.9 | 11.1 | 20.7 | 3.0     | 22.7 | 6.0    | 24.8 | 4.2  | 23.2 | 5.6    | 20.6 | 6.8     | 22.6 | x       | x    |
| February           | 7.8       | 20.3 | 11.2  | 23.1 | 11.3 | 30.7 | 7.4     | 23.6 | 9.5    | 26.2 | 6.3  | 23.1 | 7.5    | 20.3 | 9.2     | 24.1 | x       | x    |
| March              | 9.5       | 20.5 | 12.6  | 24.2 | 16.1 | 30.4 | 9.0     | 24.2 | 10.9   | 26.9 | 8.5  | 25.1 | 8.8    | 21.0 | 10.9    | 25.0 | x       | x    |
| April              | 8.7       | 19.0 | 11.9  | 23.1 | 15.7 | 30.4 | 9.6     | 23.1 | 11.4   | 25.7 | 9.9  | 22.3 | 9.1    | 19.4 | 11.2    | 24.4 | x       | x    |
| May                | 8.8       | 20.1 | 12.1  | 23.2 | 16.5 | 29.2 | 10.3    | 22.7 | 11.4   | 24.8 | 1.6  | 22.3 | 8.5    | 18.9 | 11.4    | 24.5 | x       | x    |
| June               | 6.9       | 21.6 | 11.3  | 22.5 | 15.2 | 27.0 | 8.4     | 22.4 | 10.0   | 24.2 | 8.2  | 23.3 | 6.6    | 18.8 | 10.4    | 24.0 | x       | x    |
| July               | 7.7       | 20.6 | 11.4  | 21.5 | 15.3 | 25.1 | 9.7     | 21.2 | 10.6   | 22.7 | 9.8  | 22.7 | 7.1    | 17.5 | 10.9    | 22.9 | 11.0    | 25.5 |
| August             | 9.2       | 16.8 | 11.9  | 19.0 | 15.5 | 23.3 | 10.7    | 19.0 | 11.2   | 21.0 | 10.3 | 20.8 | 7.9    | 15.9 | 9.8     | 21.5 | 11.0    | 24.0 |
| September          | 6.8       | 18.0 | 10.9  | 20.3 | 14.9 | 24.3 | 8.8     | 20.1 | 9.9    | 22.3 | 9.3  | 21.0 | 7.6    | 17.9 | 8.3     | 21.1 | 11.0    | 25.0 |
| October            | 4.2       | 17.6 | 8.9   | 21.1 | 13.3 | 26.0 | 6.3     | 21.3 | 7.7    | 23.2 | 7.7  | 20.8 | 6.8    | 17.4 | 8.6     | 22.3 | 8.0     | 25.0 |
| November           | 3.2       | 18.1 | 7.5   | 21.8 | 11.6 | 27.5 | 4.4     | 22.2 | 5.5    | 24.2 | 5.0  | 21.6 | 6.7    | 18.8 | 7.9     | 23.0 | 7.0     | 26.0 |
| December           | 3.3       | 17.8 | 6.1   | 22.1 | 8.9  | 28.5 | 4.0     | 22.4 | 4.7    | 24.2 | 4.0  | 22.3 | 6.0    | 18.9 | 7.8     | 23.2 | 6.0     | 25.0 |
| Mean               | 6.9       | 19.1 | 10.3  | 22.0 | 14.7 | 27.0 | 7.6     | 22.1 | 9.1    | 24.2 | 7.7  | 22.4 | 6.7    | 18.8 | 9.4     | 23.2 | 9.0     | 25.0 |
| Mean (max and min) | 13.0      |      | 16.2  |      | 20.6 |      | 15.0    |      | 16.7   |      | 15.1 |      | 12.8   |      | 16.3    |      | 17.0    |      |



### 3b) FNE LOWLAND TRIAL RESULTS

Strip trials were initiated in the lowlands of Ethiopia in 1983 in order to test the range of adaptability of promising forage species and lines. These trials have been established in cooperation with a number of organizations as part of the Forage Network in Ethiopia and their results are attracting considerable interest as very little work has been done in Ethiopia on forages for the low altitudes.

It is apparent from the work of 1982 and 1983 that tropical legumes are also adapted to the medium altitudes of Ethiopia, particularly the areas with more acid soils and with higher rainfall which are found in western Ethiopia. Again little research has been done in this region and the results so far are very promising.

The 21 strip trial sites (Table 8) in the Rift Valley were planted towards the middle of the rainy season. Thus, although all trials except the rainfed sites at Melke Werer and Aware Melke established themselves, growth was minimal and many of the lines did not survive the following dry season. It should be remembered, however that most commercial lines have low productivity below 800 mm annual rainfall. Due to late planting and low rainfall (most of the sites have less than 800 mm) it is not surprising that many lines performed poorly.

In terms of survival of the dry season and growth rates, Stylosanthes hamata cv Verano and S. scabra cv Seca and cv Fitzroy were the most promising lines in the drier areas although many other lines survived or have regenerated from seed. In the wetter sites the same Stylosanthes lines performed well and alfalfa was particularly promising but was selectively attacked by rabbits and porcupines. The latter completely eliminated the alfalfa lines at the Adami Tulu site.

Due to the termination of the agronomy programme of WREP, most of these strip trials have been abandoned. ILCA plans to re-initiate them in the next growing season. All of the trials, except those at Soddo, were replanted in February and March, either with new lines where it was apparent the original material was not adapted, or with the same lines where it seemed likely that they were (Table 9). As more drought tolerant plants are identified in screening in the ILCA site at Abernosa they will be introduced to the strip trials in future seasons. The trials will continue to be observed at six weekly intervals and the established lines either cut or grazed as appropriate.

TABLE 8  
STRIP TRIAL SITES

1983

|     |                            |                           |
|-----|----------------------------|---------------------------|
| 1   | Sirinka <sup>+</sup>       | Sirinka Catchment Project |
| 2*  | Gimbe                      | Adventist College         |
| 3*  | Melka Werer A, dryland     | IAR                       |
| 4*  | Melka Werer B, irrigated   | IAR                       |
| 5*  | Aware Melke <sup>+</sup>   | Nomadep                   |
| 6*  | Melkassa                   | IAR                       |
| 7*  | Alementena A, dryland      | Peasant Association       |
| 8*  | Alementena B, wetland      | Peasant Association       |
| 9*  | Meki                       | Peasant Association       |
| 10* | Adami Tulu                 | IAR                       |
| 11* | Tuluba (Abernosa)          | MOA                       |
| 12* | Negele Arussi A, (dryland) | Adventist College         |
| 13* | Negele Arussi B, (wetland) | Adventist College         |
| 14* | Awassa                     | IAR                       |
| 15* | Soddo <sup>+</sup>         |                           |
|     | A) eroded area (2)         | WREP                      |
|     | B) pasture (2)             | WREP                      |
|     | C) wetland                 | WREP                      |
|     | D) under coffee            | WREP                      |
|     | E) under ensete            | WREP                      |

1984

|    |        |              |
|----|--------|--------------|
| 16 | Ambo   |              |
|    | A) dry | Ambo College |
|    | B) wet | Ambo College |

<sup>+</sup>Sites may be terminated due to re-organization or termination of programme.



TABLE 9

Replanting of strip trials  
February, March, 1984

| D R Y   S I T E S        |                          |                               |                                     |    |   |
|--------------------------|--------------------------|-------------------------------|-------------------------------------|----|---|
|                          | Original<br>plot<br>ILCA | New Seeding                   | Accession Sites <sup>+</sup> g/site |    |   |
| <u>S. capitata</u>       | 159                      | <u>L. purpureus</u>           | 6356                                | ab | 4 |
| <u>Oxley stylo</u>       | 1                        | <u>D. distortum</u>           | 7263                                | ab | 3 |
| <u>C. brazilianbm</u>    | 155                      | <u>D. discolor</u>            | 6988                                | ab | 3 |
| <u>C. brazilianum</u>    | 6773                     | <u>Cajanus cajan</u>          | 6755                                | ab | 4 |
| <u>D. heterococarpon</u> | 6766                     | <u>Sesbania aculeata</u>      | 10865                               | ab | 2 |
| <u>C. gyroides</u>       | 124                      | <u>S. scabra</u> *            | 6855                                | ab | 3 |
| <u>M. uniflorum</u>      | 6503                     | <u>S. hamata</u>              | 167                                 | ab | 3 |
| Empty plot 1             |                          | <u>Phaseolus acutifolius</u>  | 7380                                | a  | 4 |
|                          |                          | <u>D. intortum</u> cv.        |                                     |    |   |
|                          |                          | Greenleaf                     | 6968                                | b  | 3 |
|                          |                          | Katamani maize                | 9228                                | ab | 4 |
|                          |                          | <u>Medicago arborea</u>       | 7053                                | ab | 3 |
| Empty plot 2             |                          | <u>Macrotyloma axillaries</u> | 6756                                | ab | 3 |
| Empty plot 3             |                          | <u>M. lathyroides</u> cv      |                                     |    |   |
|                          |                          | Murray                        | 6955                                | ab | 3 |
|                          |                          | <u>D. sandwicense</u>         | 6990                                | b  | 3 |
|                          |                          | <u>Vigna sinensis</u>         | 9362                                | a  | 4 |
| <u>L. leucocephala</u>   |                          |                               |                                     |    |   |
| cv Peru                  |                          | resow                         |                                     | ab | 4 |
| W E T   S I T E S        |                          |                               |                                     |    |   |
| <u>Adventist College</u> |                          |                               |                                     |    |   |
| Empty plot 1             |                          | <u>D. discolor</u>            | 6988                                |    | 3 |
|                          |                          | <u>C. pubescens</u>           | 6953                                |    | 4 |
| <u>Alemtena</u>          |                          |                               |                                     |    |   |
| <u>S. capitata</u>       |                          | <u>D. discolor</u>            | 6988                                |    | 3 |
| Empty plot 1             |                          | <u>C. pubescens</u>           | 6953                                |    | 4 |
| 2                        |                          | <u>S. scabra</u> cv Seca      | 143                                 |    | 3 |
| 3                        |                          | <u>S. hamata</u>              | 167                                 |    | 3 |

+ a) low rainfall sites  
b) higher rainfall sites

\* C. gyroides not removed where alive.

## ACKNOWLEDGEMENTS

I wish to thank Ato Lulseged G/Hiwot (IAR), Ato Alemu Tadesse (IAR), Ato Gashaw Shibabaw (ARDU), Ato Taye W/Mariam and Ato Abayneh Woudneh (ILCA) who were responsible for the execution of the forage trials in their respective research sites. My thanks also go to Mr. Robin Sayers for his guidance in undertaking statistical analysis at ILCA.

\* \* \* \*

## 4. IAR FORAGE RESEARCH HIGHLIGHT

### Lulseged Gebrehiwot

The 1984/85 Project review Meeting of IAR was held at Nazareth from 23 to 28 April, 1984. Various research project proposals were presented by crop team leaders and department coordinators. Animal Science and Forage projects were discussed on April 27.

In the 1983/84 season there were a total of 34 research activities on forages, out of which eight have been completed and twenty-six are ongoing. For the 1984/85 season seven new research activities have been proposed, and approved by IAR Management, raising the current activities to thirty-three. These activities are grouped into six major headings or projects.

|                                                      |               |
|------------------------------------------------------|---------------|
| 1. Plant Introduction and Variety Trials             | 10 activities |
| 2. Selection of forage species for specific problems | 3 "           |
| 3. Studies on <u>Leucanea</u>                        | 4 "           |
| 4. Intercropping and Rotational Studies              | 3 "           |
| 5. Seed production study                             | 5 "           |
| 6. Pasture management and improvement study          | 8 "           |

During the review meeting the Animal Science and Forage Department strongly suggested the formation of a forage research team similar to those formed for research on other crops. It was felt that the formation of a forage team will allow best use to be made of existing manpower and scarce resources. Furthermore forage research projects will be better coordinated, documented and comprehensive information could be gathered. Because of the complex problems encountered in forage production a team approach is logical.



It was suggested and agreed that the forage research team will be composed of experts from the following disciplines; forage production, general agronomy, soil fertility, soil microbiology, soil and water conservation, weed science, entomology, plant pathology, animal nutrition, animal production and socio-economics. A further meeting will be held with IAR Management when Crop Team Leaders and Department Coordinators will finalize the formation of the team.

\* \* \* \*

## 5. THE PRODUCTIVITY AND PERSISTENCE OF FORAGE LEGUMES WITH CHLORIS GAYANA IN MEDIUM RAINFALL, MEDIUM ALTITUDE AREAS OF ETHIOPIA

### Introduction

Initial plantings of a range of perennial tropical forage legumes has indicated that there are several which may prove to be of value for the medium altitude (1500-2000 m) and medium rainfall (900-1400 mm) areas of Ethiopia. At Awassa there has been research on tropical forages over several years and the most promising in small plots have been Medicago sativa, Desmodium intortum, D. uncinatum and Chloris gayana which is native). Recently however, a much larger range of forage legumes have been tested and several have shown promise in plantings by IAR at Awassa and by WREP in Soddo.

Western Ethiopia, which is similar to Soddo in particular, is an agriculturally productive region which has areas of high population density and a considerable dependence on milk as a source of human nutrition. There is good potential for increasing the productivity of livestock in the region by the introduction of leguminous forage plants to fallows, wastelands and field boundaries. The Forage Network in Ethiopia has decided to establish a number of replicated trials in these environments to determine in more detail the adaptation, productivity and persistence of the most promising lines.

### Methods and Materials

The trial will be laid out on a randomized complete block design with 3 replicates. The plots will be 4x4m with pathways of 1 m between plots and a 2 m trial border. There will be 12 legume treatments plus one control per plot which will be organized in rows of 6 and 7 plots in each replicate. The trial will thus be 33 m x 38 m.



The controls in the trial will be Medicago sativa cv Hairy Peruvian and Desmodium intortum cv Silver leaf. There will be 10 species and cultivar treatments in the trial. All treatments and the control plot will be planted with Chloris gayana, cv Pioneer.

The trials will be planted in March 1984 and will last for three and a half years.

The sites chosen for the trials are in the Rift Valley of Ethiopia, at medium altitudes. One site will be at the WADU station in Soddo with a rainfall of about 1300 mm, 3 to 4 months dry season, 1850 m altitude and red, moderately well drained acid soils. The other site will be at the IAR station at Awassa which has about 950 mm rainfall, 5 to 6 months dry season and an altitude of 1675 m and soils which are basic fluvisols. The mean maximum and average temperature for Awassa and Soddo are similar at 25°C, 12°C and 18°C. The fluvial, basic, well drained soils of Awassa are representative of large areas of the Rift Valley while the Nitosols of WADU at Soddo are representative of the mildly acid soils (pH 5.5-6.0) of the medium altitude plateau of Western Ethiopia.

The soils at both sites will be sampled at 30 locations at random at depths of 0-15 and 15-30 cm and at 15 locations at depths of 30-45 and 45-60 cm. The soils will be analyzed for pH, electrical conductivity, C.E.C., T.E.B, Ca, Mg, K, Na, C, N, and P as well as being physically analyzed.

Site preparation will involve the preparation of a good tilth, at Soddo by oxen. The plots will be hoed and raked to provide a good seed bed.

All seeds will be mechanically scarified except for the Stylosanthes lines which will be treated with conc H<sub>2</sub>SO<sub>4</sub>, and Leucaena which will be soaked overnight in water which had been heated to the boiling point. All lines will be appropriately inoculated and sown at appropriate seeding rates (table 1). The seed will be planted in alternating rows of grass and legume spaced at 25 cm, the seed for each row being weighed and planted separately. The Chloris gayana control plot will have the grass seed planted in rows 25 cm apart, at the same rate per hectare.

Fertilizer will be applied initially at 10 kg P/ha by broadcasting and further applications will be made at the same annual rate in split applications after alternate harvests. P was chosen as the critical fertilizer to be applied as the soils throughout the region are known to be very low in P. It was determined that a minimal level of P should be added to ensure the trial did not fail through lack of an element which was known to be in short supply. The rate chosen has proven adequate in other trials in the Rift Valley and in other similar edaphic conditions.

The germinating rows of legumes and grasses will be hand weeded if necessary until the plants are established. Thereafter only the taller weeds will be removed. The pathways and plot perimeters will be mowed as necessary. Observations will include germination counts and regular six weekly observations of plot cover, vigour, height, spread, flowering, seeding, insect pests, diseases and deficiency symptoms.

Harvesting on a hay basis to determine the growth cycle will be done on a six week cycle, starting when the plants



have grown to a harvesting height appropriate to the structure of each plant (table 1). A six weekly harvesting cycle has been chosen due to its convenience and the ability of the legumes involved to recover and regrow over that period.

Sampling of the plots will be done using three quadrats of 0.5 x 0.5 m on legs of the appropriate height. The quadrats will be located randomly within a 0.5 m plot border. Samples will be cut by hand using sheep shears, placed in paper bags sealed within plastic bags and as soon as possible transported to the laboratory. The plots will be cut over at their harvesting level and the cut material removed.

Samples will be stored in a refrigerator until they can be handled. They will then be weighed, separated into grass, weed grass, legume, weed, legume, and other weeds. The weight of these components will then be taken before and after drying at 65°C for 24 hours in a forced draught oven.

The forage components of the more successful treatments will be analyzed for N, P, crude fibre and in vitro digestibility for critical harvests in the second year of the trial (early wet season, late wet season, early dry season, late dry season).

The dry matter yields will be analyzed by analysis of variance for all of the sward components and for the total yields. There will be the following degrees of freedom: blocks 2, treatments 11, error 22 total 35.

After the trial has been harvested for over one year, that is after the first harvest of the third wet season, the trial will be grazed on a six weekly cycle. Regular six weekly observations will be done before grazing and a similar set of observations will be done immediately after grazing. This second set of observations will also include amount of plot (area) grazed, an observation on the mean amount that each plant is grazed and the plot area trampled.

The trial will be continued under grazing into the fourth wet season when a final harvest will be taken at the original harvesting height, and at ground level, both before and after grazing in order to quantify the total amount and type of forage present, and the amount actually consumed. The figures can be compared with those from the last of the clipping part of the trial in order to determine how the sward components have changed under grazing. This final harvest should be done at the same time of year as the final clipping had been done.

The observational data can be statistically analyzed in the same manner as the dry matter yields of the clipping part of the trial.



TABLE 1

Species chosen for the trial, inoculant type,  
sowing rate and cutting height

|                                                   | ILCA | Inoculant<br>group | Sowing<br>rate<br>kg/ha | Harvest<br>height<br>cm |
|---------------------------------------------------|------|--------------------|-------------------------|-------------------------|
| 1 <u>Desmodium intortum</u> cv Greenleaf          | 6968 | <u>Desmodium</u>   | 4                       | 20                      |
| 2 <u>Desmodium sandwicens</u>                     | 6990 | <u>Desmodium</u>   | 4                       | 15                      |
| 3 <u>Leucaena leucocephala</u> cv Peru            | 6956 | <u>Leucaena</u>    | 10                      | 50                      |
| 4 <u>Macroptilium atropurpureum</u><br>cv Siratro | 7280 | I                  | 4                       | 20                      |
| 5 <u>Medicago sativa</u> cv Hairy<br>Peruvian     | 6752 | A                  | 4                       | 25                      |
| 6 <u>Stylosanthes guianensis</u> cv Cook          | 4    | I                  | 4                       | 30                      |
| 7 <u>Stylosanthes guianensis</u> cv<br>Endeavour  | 6960 | I                  | 4                       | 30                      |
| 8 <u>Stylosanthes guianensis</u> cv<br>Graham     | 73   | I                  | 4                       | 30                      |
| 9 <u>Stylosanthes hamata</u> cv Verano            | 75   |                    | 4                       | 15                      |
| 10 <u>Stylosanthes humilis</u>                    | 9287 | I                  |                         |                         |
| 11 <u>Stylosanthes scabra</u> cv Seca             | 140  | I                  | 4                       | 30                      |
| 12 <u>Stylosanthes scabra</u> cv Fitzroy          | 141  | I                  | 4                       | 30                      |
| 13 <u>Chloris gayana</u> cv Poiner                | 9206 |                    | 6                       | 15+                     |

+ in all plots

\* \* \* \*

## 6. NEWS OF MEMBERS

1) Wt. Zemam Tekle, in charge of the FLAG forage gene bank at ILCA, is attending a 3 week course on seed physiology in the United Kingdom, July 14-August 14, sponsored by IBPGR (International Board of Plant Genetic Resources).

2) Ato Alemayehu Mengistu, Forage Officer of the Ministry of Agriculture is attending a 3 month course, July 9 to September 28, on the uses of trees and shrubs in Perth, Australia sponsored by the Australian Government. After the course he will visit, CSIRO forage research stations at Brisbane and Townsville in Queensland and Darwin and Katherine in the Northern Territory (all in Australia) and the Kenyan - FAO forage project at Kitale, Kenya, sponsored by ILCA. Ato Alemayehu will return to Addis on October 20.

3) Mr. James Ochang, Manager of ILCA's FLAG, research operations in the Rift Valley was in Queensland Australia



on a two month seed production course over May and June. He also visited the CSIRO Davies Pastoral Research Laboratory at Townsville Queensland.

### Correction

In the FNE Newsletter No 4, page 5 the ARDU research site Merraro is listed under medium altitude sites. As it is at 2980 m altitude it should have appeared under high altitude.

\* \* \* \*

## 7. DESMODIUM INTORTUM

Desmodium intortum (Mill.) Urb. is a forage legume of potential for Ethiopia at altitudes up to about 2000m, with good rainfall. It has received considerable agronomic attention in Ethiopia by research groups and has been found to be one of the more successful legumes at medium altitudes.

A commercial cultivar cv Greenleaf has been developed in Australia from three D. intortum introductions; the plant is commonly called greenleaf Desmodium. A large vigorous, self-fertile plant, it has a deep taproot, pubescent stems, leaflets with red-brown to purplish flecking on the upper surface and stem nodes which can produce roots.

Native to parts of Central America, northern South America and Brazil as far south as 25° it has become naturalized in many areas of the tropics through its use as a fodder.

Tolerant of hot weather but the most cold tolerant of the tropical species it performs best in higher, cooler zones of the tropics. Growth rates were found to decline above 30°/25°C and below 27°/22°C day/night temperatures. A 50 percent drop in growth rate occurs between 18°/13° and 15°/10°. It is somewhat resistant to frosts and the taproot is resistant to fire.

Recorded as growing as high as 2400 m in Kenya and Ethiopia, it produces poorly at such extreme altitudes. In its native environment it occurs from 600 m to 2500 m altitude, but in the subtropics it occurs at lower elevations. In Ethiopia at about 8°N it grows very well under irrigation at 1700 m in the Rift Valley.

Preferring environments with higher rainfall (greater than 1000 mm) and short dry seasons, it can be very productive during rainy periods, but grows poorly or becomes deciduous in dry seasons. It has been recorded as producing reasonable growth under 800 mm rainfall (1800m) at Debre Zeit on a bottom land soil. At very high rainfall levels disease and insects can inhibit production. Where soils are deep and fertile it tolerates drought though it sheds its leaves. While sensitive to extended periods of waterlogging it can tolerate short periods.



Best growth is achieved in deep fertile soils with a pH above 5.0 and which are not saline. Nodulating well in Ethiopia with native strains of soil Rhizobium, the Desmodium strain of inoculum (CB 622) is recommended in areas where nodulation is poor. As much as 375 kg N/ha has been recorded as being fixed, with 5 percent transferred to the associated grass.

Propagated by seed or transplanted cuttings, it can be sown in a prepared bed or sown from the air. Seeding rates are normally 1 to 2 kg/ha. If not already scarified by machine threshing it should be scarified by using fine grade sandpaper or strong sulphuric acid for 5 minutes to reduce the proportion of hard seed.

High levels of fertility are required for high productivity. Elements required in abundance are P, K, Mo and Zn.

Seedling growth is slow and a major cause of planting failures. Lenient grazing is recommended until the plants are well established. Once established under fertile conditions it can combine well with most tropical and subtropical pasture grasses and competes well with weeds.

As it is tolerant of some herbicides these can be used to control weeds. At 3-5 weeks it is tolerant to 2-4-D at 1.65 kg acid equivalent/ha and Diquat at 140 and 280 g of cation/ha from 6 weeks and when established, respectively.

Five to twelve weeks cutting intervals and 7.5 to 15 cm cutting heights give good yields, and persistence. Persistence is best under light continuous grazing which allows retention of bud sites and some leaves. Yields of up to 19 DM/ha have been recorded. It makes good hay and reasonable silage without molasses although better silage can be made with the addition of 2 to 8 percent molasses.

Palatable to cattle and a good source of protein, riboflavine and vitamin A for chickens, the crude protein content of the leaves has been reported as 23.6 percent with a digestability of 54 percent. No bloat or toxicity from tannins (7 percent) has been reported though there have been suggestions of lower digestability.

The seed is difficult to harvest as it ripens unevenly. It is mown when 30 to 50 percent ripe and left to mature in the swath for 10 to 14 days. As it flowers in the dry season in Ethiopia, it produces little seed in drier areas. Under irrigation it produces very well.

Greenleaf desmodium is thus well adapted to the mildly arid, medium altitude, good rainfall western plateau area of Ethiopia. Though it can be grazed it is probably most productive for Ethiopian conditions under cut and carry. Likely areas for small farmer sowing include small, patches on plot margins and undersown in crops such as maize to provide a catch crop after the maize is harvested. It must be remembered however, that unlike less vigorous forage legumes such as Stylosanthes and Zornia, it requires a moderate level of fertility to be productive.

\* \* \* \*



## STEERING COMMITTEE MEMBERS

### Executive memers

|                           |      |          |
|---------------------------|------|----------|
| Ato Alemayehu Mengistu,   |      |          |
| Chairman                  | MOA  | 44-75-32 |
| Ato Lulseged Gebre Hiwot, |      |          |
| D/Chairman                | IAR  |          |
| Ato Abate Tedla           |      |          |
| Secretary                 | ILCA | 18-32-15 |

### Members

|                       |                                 |          |
|-----------------------|---------------------------------|----------|
| Dr. Chadokar          | Soil & water<br>(MOA)           | 44-40-80 |
| Ato Gugssa Endesahw   | ESC                             | 15-50-15 |
| Dr. Samuel Jutzi      | ILCA                            | 18-32-15 |
| Ato Adane Fayissa     | MSF                             | 15-28-81 |
| Ato Asfaw Yemeghual   | Tesse Amba Train-<br>ing Centre |          |
| Ato Gashaw Shibabew   | ARDP, Asela                     | 92       |
|                       | or Kulumsa                      | 102      |
| Ato Getinet Aklilu    | Sirinka Catch-<br>ment Project  |          |
| Ato Fikre Aberra      | Ambo Junior<br>College          |          |
| Ato Kidane W/Yohannes | TLDP                            | 15-10-88 |
| Ato Berhanu Hiko      | Forestry & Wild-<br>life (MOA)  | 18-29-81 |

The forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter itself is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia.

If your address is not correct or you do not receive The Newsletter and wish to, please fill in the attached form:

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FNE Newsletter  
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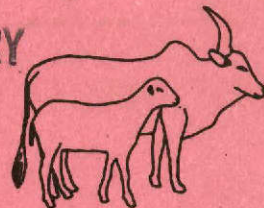
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# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 6

December 1984

### FORAGE NETWORK IN ETHIOPIA

### NEWSLETTER

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#### 1. INTRODUCTORY MESSAGE

With the present drought there has been increasing awareness of the need for good dry season feed reserves for livestock in order that there be milk to aid human nutrition and strong oxen at the end of the dry period in order to prepare the land for planting. Not only crop residues of small farmers can be used but residues of larger scale state enterprises are now being organized to maintain or fatten cattle. These include the seeds and stalks of broom sorghum, molasses, and sugar cane tops. State Farm Managers should look carefully at their wastes to see if there is potential fodder which is not being utilized.

There is need as well to develop areas of managed fodder reserves particularly of high quality legumes for the dry season. These may be harvested and stored as hay or silage or planted in wetter areas, such as river or lake margins where deeper rooted plants can retain their leaves in the dry season and be grazed for a period each day.



The FNE is tackling these problems and the article on page 2 describes its successes to date in the Rift Valley.

The Annual General Meeting will be held at ILCA Headquarters on February 1 1985 at 8:30 AM. All those interested in forages are welcome, and urged to attend. Details of the programme are given on page 3.

Editors: Alemayehu Mengistu,  
John Lazier,

\* \* \* \*

## 2. EARLY PROGRESS IN FNE LOWLAND RESEARCH

The work of the FNE in the Rift Valley, now only one and a half years old, is already beginning to bear fruit. The success of the FNE-IAR strip trial at Melke Were under the management of Ato Aschalew Tsegahun has stimulated an interest in irrigated production of high protein tropical forage legumes by the Meat Development Board in its holding areas in the Rift Valley. It has also prompted the Ministry of Agriculture to initiate irrigated production of tropical grass and legume seeds.

In Soddo both 1983 and 1984 FNE plantings have produced outstanding growth of tropical forage legumes in pure and mixed stands. The 1984 growth has been particularly surprising as the area has received less than half of its normal rainfall (500 mm instead of 1100 mm). Initial trials with small farmers have been very successful with very good growth of Desmodium intortum cv Greenleaf under ensete and coffee and S. guianensis cv Cook under maize. The farmers have been enthusiastically cutting these legumes several times a year and feeding them to their cattle.

\* \* \* \*

### 3. THE 1985 FNE GENERAL MEETING

The Annual General Meeting of the FNE will be held February 1 at ILCA Headquarters at 8:30 AM. All who are interested in forage research and development are welcome to attend. The meeting will consist of brief summary presentations (no details) of the forage work done, and planned by all of the organizations present. Members will be asked to submit, if possible, their annual report or a brief written summary of their work for presentation in the next issue of the Newsletter.

Members participating in the FNE Network trials (strip trials, replicated trials and grassland inventory) are reminded that their detailed results are expected to be received by the FNE Secretary by January 20, before the meeting. These should be presented in the usual form and include meteorological data, results and discussion.

The multilocation perennial grass trial will be terminated, and the final results presented by the participants. New multilocation trials will be planned on the basis of the 1984 results and new sites chosen for on-going trials.

Other topics which will be discussed will include the Pasture Network for Eastern and Southern Africa, a proposed project on Vertisol management, the National Forage and Livestock Meeting, drought feeding of draft animals and ILCA's new seed unit.

There will be an illustrated talk on forage research and production in another part of the world and the opportunity to see the ILCA facilities for those who have not already done so.

The meeting will select officers for the coming year, plan the 1985 programme and discuss its relationships to the Pasture Network of Eastern and Southern Africa (PANESA). There will be plenty of opportunity for discussion, exchange of ideas and to get to know others in the field.

Members are reminded that the verbal presentations of their 1984 and future research must be brief as there are many organizations which will be presenting their data. Five to ten minutes is all that can be allowed. Practice



your presentation to see that it falls within the time limit. A handout is a convenient way of getting more information across. Those handouts received by the FNE Secretary or John Lazier at ILCA before the meeting will be photocopied for handing out.

\* \* \* \*

#### 4 MINUTES OF THE FNE MEETING 27/10/84

Bekle Mola Hotel

20:30 - 22:10 hrs

J. Lazier ,FLAG, ILCA

The minutes were reviewed of the FNE General Meeting of January 1984 and of the Steering Committee meetings held since then. The minutes were adopted as read except it was noted that an error was present in the FNE trial results (FNE No 5, page 8, Table 4). The Shola results are incorrect. A corrected table will be presented in the next issue of the FNE Newsletter.

Representatives of the organizations present at the meeting each gave a brief summary of their involvement with forage research, development and utilization.

Each organization with network trials then reviewed their growth in 1984. These results will be presented in greater detail at the January General Meeting so will not be presented here. The MOA reported that they have planted demonstration plots of FNE selected forages throughout the country.

The presentation of the Meat Development Enterprise stimulated a discussion on the replacement of concentrates, which are currently being used for fattening, with legume based fodders. The FNE agreed to help advise the Meat Development Enterprise on the initiation of a legume based feeding strategy.

Other issues raised and discussed included 1) the problems of harvesting seed of Chloris gayana, and 2) the transfer of information from researchers to the Ministry of State Farms, and to small farmers via the MOA. Short training courses in forages for new graduates were also discussed and it was agreed to bring this topic up at the General Meeting in January.

\* \* \* \*

## 5. MINUTES OF STEERING COMMITTEE MEETING 11/12/84

J. Lazier

A Steering Committee Meeting was held at 9 AM at ILCA with Alemayehu Mengistu, Chairman, Ato Lulseged Gebre Hiwot, Deputy Chairman, Dr. Samuel Jutzi and Dr. John Lazier present. The Secretary Ato Abate Tedla was absent and Dr. Lazier performed his duties.

1) The minutes of the FNE meeting of 27/10/84 held during the field trip were accepted as written in this edition of the Newsletter.

2) The date, venue and general programme of the January General meeting was settled.

3) Dr. Lazier presented a summary of the November meeting of the Pasture Network for Eastern and Southern Africa. It was agreed that if the PANESA Working Committee were to visit ILCA in early 1985 it would be valuable for them to come, if possible during the week of the FNE General Meeting. Failing that the Chairman and Deputy Chairman agreed that they would be pleased to meet with the Committee, whenever they appeared.

4) The forth-coming National Workshop on Livestock and Forage Research (8-10 January 1985) was discussed and it was agreed to advertize it in the Newsletter.

5) The Chairman and Deputy-Chairman agreed to meet with the ILCA Director of Training in order to arrange for participation of FNE members in ILCA training courses. As there was no further business the meeting was closed at 10:45 AM.

\* \* \* \*

## 6. FNE 1984 FIELD TRIP

The 1984 Field Trip to ILCA research sites in the Rift Valley was undertaken on 26 - 28 October, nineteen teachers, managers, and researchers participated. On Friday the group had a careful look at the over 600 experimental



and commercial lines of legumes, browse and grasses being multiplied at the Ministry of State Farms-ILCA seed multiplication site at the Zwai Horticulture Farm. Their potential and environmental requirements were discussed. The participants were encouraged to ask the FLAG programme for seed of these, and other lines for their own experimental or development uses.

At the Ministry of Agriculture - ILCA research site at Abernosa Ranch the group were shown the simply constructed facilities, the pregermination and nursery seed production procedures were explained, and evaluation trials on herbaceous legumes, including Stylosanthes scabra, and Lablab purpureus were viewed. The very long 1983-84 dry season had killed most of the earlier planted herbaceous legumes. Some Stylosanthes, Neonotonia and Lablab lines had survived however, with S. hamata cv Verano being particularly vigorous in its regeneration from seed. Two new trials were shown including browse evaluation (165 lines) and the oversowing of herbaceous legumes into natural pasture. These trials and the FNE strip trial had all grown poorly due to the brief rains in 1984.

The night was spent at the Bekele Mola Hotel at Lake Langano and the group had a most enjoyable barbecue by the lake. The vocal talents of the FNE members were well demonstrated by the singing which followed.

An early start on Saturday took the group to Soddo where the new FNE-FLAG replicated tropical herbaceous legume trial was seen. Cook stylo was outstanding both in this trial combined with Chloris gayana and in a 0.25 ha seed production area. A strip trial was growing well and a browse trial which had poor germination were also seen. A Lablab - maize intercrop trial had already been harvested. The group was told that unfortunately, the Lablab line available for the trial was not well adapted to the area.

The FNE meeting was held at the Bekele Mola Hotel, Lake Langano, that evening. The minutes are presented on page 3.

Another 6 AM start allowed the group to see the ILCA Highlands Programme inter-cropping (Lablab and maize), alley cropping (Sesbania and oats), Triticale and other cereal evaluation plots and fertility trials. The tired but jolly group reached Addis after lunch on Sunday. All felt it had been a worthwhile trip.

## Participants

### Meat development Enterprise

1. Ato Zeynu Nur Hussien
2. Ato Yohannes Cherie
3. Ato Gedelu Dabe
4. W/t Yeshwareg W/Meskel
5. Ato Yacob
6. Ato Mersha Haile
7. Ato Bezuneh Zenebe
8. Ato Wubishet Debebe
9. Ato Lema Lendedo

### Ministry of Agriculture

1. Ato Alemayehu Mengistu

### Ambo Junior College

1. Ato Fikre Aberra

### IAR

1. Ato Lulseged Gebre Hiwot
2. Ato Aschalew Tsegahun

### ILCA

1. Ato Taye W/Mariam
2. Ato Asfaw Yemeguhail
3. Dr. John R. Lazier
4. Ato Tafesse Akle

### ARDU

1. Ato Hailu Abebe
2. Ato Getachew Wondimagne

7

\* \* \* \*

## **7. HIGHLIGHTS ON EASTERN AND SOUTHERN AFRICA PASTURE WORKSHOP**

Lulseged Gebrehiwot-IAR

An international workshop on Eastern and Southern Africa pastures was held at Harare, Zimbabwe from 17 to 21 September, 1984. The workshop was sponsored by the International Development Research Centre (IDRC) and Southern Africa Development Co-ordination Conference (SADCC). A total of 17 countries participated at the workshop out of which 14 were from Eastern and Southern Africa. About 40 scientists attended the workshop and 5 of these were from Ethiopia. These were:

Ato Lulseged G/Hiwot  
Ato Alemu Tadesse

Dr. J. Kahurananga

Dr. J. Lazier

Dr. A. Krauss

IAR - Forage research and development in Ethiopia.

ILCA - The collection and evaluation of Ethiopian Trifolium species.

ILCA - Theory and practice in forage germplasm collection.

PGRC - Germplasm storage and dissemination.



The main objectives of the workshop were a) to bring together forage scientists from Eastern and Southern Africa to review the present state of knowledge on pasture research and development b) to review appropriate research methodologies and draw up research priority areas and c) to establish a mechanism for exchange of information and germplasm among interested scientists and institutions.

The first two days were devoted to country papers. Delegates from various Eastern and Southern Africa countries described the state of pasture research and development. In all cases the livestock industry is based on natural forage resources which at present do not provide enough feed on a year-round basis. Cultivated pasture and fodder species have an important role in livestock improvement. Research on forages is underway in all countries, however, the strength and magnitude of programmes varies from country to country.

On the third day workshop participants visited an agricultural experiment station, an extension site and a commercial farm simultaneously dealing with citrus, and cattle fattening. The last two days were devoted to papers on methodology and to group meetings. Methodology papers dealt with pasture establishment and utilization, seed production, and germplasm collection and evaluation.

At the end of the workshop in a plenary session group reports were received and recommendations made. One of the most important outcomes of the workshop was the concern of the participants for strong and co-ordinated research on pastures. Hence it was agreed that a Forage Network should be establishment for the Eastern and Southern Africa region and a committee was set up to facilitate the formation of the Network. We all hope to see the African Forage Network operating in the near future.

\* \* \* \*

## **8. THE NEW PASTURE NETWORK FOR EASTERN AND SOUTHERN AFRICA (PANESA)**

John Lazier, FLAG, ILCA

As a follow-up to the Workshop on Pastures in Harare, Zimbabwe described by Lulseged in the previous article, the Network Steering Committee elected

at the Workshop met in Nairobi for 3 days (November 26 - 28) to organize the Network and its funding. The committee has 5 regular members (Prof. A. B. Lwoga, chairman, Tanzania; Dr. B. H. Dzowela, Malawi; Dr. J. N. Clatworthy, Zimbabwe; Mr. D. R. Chandler, Botswana; Dr. A. N. Said, Kenya and two co-opted members (Prof. J. A. Kategile, IDRC; and myself, (J. Lazier), ILCA). The co-opted members are those invited by the general meeting to be part of the Steering Committee due to their ability to give financial support (IDRC) and technical support (ILCA).

The steering committee drew up the organization of the Pasture Network for Eastern and Southern Africa (PANESA) and became, in the process, the "Working Committee."

The objectives of the Pasture Network are to improve effectiveness in pasture research in participating countries and to expedite the application of improved technology by farmers and graziers at all levels of management.

PANESA will operate at both the national and regional levels. Established national organizations such as FNE, and the Grassland Society of Zimbabwe will form the basis of the national networks in those countries, while in other countries national networks will have to be stimulated. IDRC agreed to fund a Network Co-ordinator, the annual workshop/meeting in 1985 and a training workshop.

The next annual workshop/meeting is planned to be held in Kenya in October on the theme "Feed Resources for the Small-Scale Livestock Producer." It is planned to have at least one representative attend from each national network.

The training workshop will be held in July 1985 in Zimbabwe. It is planned to have it at the technician level and for it to be on "Introduction and Preliminary Evaluation of Germplasm." Nominees for the course will be sought from the national networks.

A newsletter is planned which may be produced with the help of ILCA. ILCA will be involved with PANESA in providing technical support, germplasm and a possible base for the network co-ordinator at ILCA in Addis.

PANESA will be seeking financial support from other organizations besides IDRC, such as USAID, ACIAR and CIDA.



The establishment of PANESA is a great boost to regional co-operation and the exchange of forage information. It will give FNE members greater opportunities to learn about forage research and development in other countries in the region and will help our network with training and identifying funding opportunities.

Copies of a draft of the minutes of the Nairobi meeting are available from John Lazier, FLAG, ILCA.

\* \* \* \*

## 9. FNE NETWORK NEWS

1) A National Workshop in Livestock and Forage Research will be held at 8 AM on January 8-10, 1985 at ILCA Headquarters in Addis Ababa. Papers will be presented on various aspects of livestock, forage and range. Interested individuals are welcomed to this workshop.

2) Tadesse Tekele Tsadik of IAR transferred from Bako Forage section to Holetta Forage section as of October 1984.

\* \* \* \*

## 10. ADVISORY NOTES

### a) *Leucaena leucocephala*

#### Multipurpose tree for dry conditions

by Alemayehu Mengistu, MOA

*Leucaena leucocephala* (Lam.) de Wit. is a browse legume of great potential for irrigated lower altitude areas of Ethiopia. It grows well under irrigation at Melke Werer (800 m) where it is being successfully fed to dairy cows.

Commonly called *Leucaena* it is a small, deep rooted tree of variable height which has bipinnate leaves and thin, flat pods from 10 to 20 cm long and 1 to 2 cm wide.

Originating in Mexico it has become widespread in the tropics and while it was originally planted as shade for cocoa it is now also planted for forage, fuel wood, erosion control and pulp for paper production.

There are several cultivars available but only two are widely commercially available for forage, cvs Peru and Cunningham. These plants are similar, well branched small trees which produce abundant foliage when kept cut back. Under lowland conditions there is apparently little difference in the yields of the two cultivars. In Ethiopia, however, at medium altitudes, (1650-1850 m) the Peru cultivar has shown more vigour than Cunningham. There are larger, less branched accessions available, such as the cultivars K8 and K28 which are more suitable for firewood and for paper, although they too will produce abundant foliage when cut back to a stump (coppiced).

In Mexico it occurs in areas with rainfall as low as 650 mm but it grows best under higher rainfall and with shorter dry seasons. It produces most vigorously in areas with a dry season of 3 to 4 months or less and 1000 mm or more of rainfall, although it can withstand long periods of drought. A nine month dry season can result in mortality particularly of younger plants on well drained soils. It does however shed leaves during dry periods, and in severe or prolonged droughts can lose all of its leaves. If the plant is cut back severely during the dry period good leafy regrowth can occur, particularly in older trees.

Although it can survive some frosting it requires temperatures of above 15.5°C for reasonable growth and does best between 22° and 30°C. It thus performs best at tropical latitudes although it does provide good summer growth in Southern Queensland at 25°C. Similarly it does best at lower altitudes, probably below 1000 m, although moderately vigorous growth occurs in Ethiopia at 1650 m under irrigation.

Intolerant of waterlogging, it prefers basic, well-drained soils although it can grow in clay soils and those which are mildly acid ( to pH 5.5).

*Leucaena* has specific *Rhizobium* requirements and in places in which it has not been planted previously inoculation is necessary for good growth. The inoculum for it, CB81, is available commercially. Lime pelleting of the seed and inoculum before sowing is advised.



Leucaena is a prolific seed producer even in the first year after planting. Stumps have been successfully transplanted but rooting from cuttings is difficult although some researchers have reported successes.

The percentage germination of Leucaena seeds can be low unless they are pretreated. Methods used include mechanical scarification, concentrated sulphuric acid for 13 minutes or immersion in hot or boiling water for 3 to 4 minutes.

Leucaena seedlings grow slowly and thus for reasonable stands a clean, weedfree seed bed is required and the stands should be kept free of weed competition by cutting and weeding around the plants.

The plant is very palatable, not only to domestic stock but also to game such as antelope, warthog and rabbits. Grazing by smaller animals is a frequently unrecognized cause of failure of plantings.

Leucaena responds well to the addition of fertilizer and grows best under fertile conditions. In Ethiopia the addition of P and possibly S and Ca will provide better growth. In the Rift Valley at Zwai reasonable growth has been achieved with 10 kg/ha of P as TSP applied as an initial and as an annual application.

An extremely productive plant if managed properly, Leucaena can yield up to 25 tonnes of DM/ha. It can be grazed or cut when it reaches 1 to 1.5 m, however, regrowth is best if it is allowed to become 2 to 3 m tall then is cut at 50 cm to provide an abundance of coppiced, leafy regrowth.

It combines well with any tropical pasture grass once it is established as it forms a second pasture storey above the height of the grass.

As the plant is very palatable, animals will frequently concentrate on the complete defoliation of the Leucaena before grazing other available forage. It is common for stems and branches up to 1 cm in diameter to be broken off and consumed. If animals are retained in pastures with Leucaena short enough to be completely grazed they will kill the plants by removing new leaves whenever they appear and thus, in time, exhaust the root reserves. Thus rest periods are advisable and rotational grazing can work very well with one or two weeks grazing out of six being utilized. One management system allows the trees to grow above grazing height and only self-sown seedlings are grazed.

Leucaena is an excellent plant for small farmer operations. It can be grown for cut and carry feeding and in fenced areas as reserved, high quality grazing. It is suitable for rotational cropping systems if planted in hedges with the cropping done in the alley between. The herbage is available for cut and carry feed during cropped years and as browse during fallow years. Mulch from the leaves has maintained maize yields over several years in West Africa. It can be used to make live fencing.

Under good rainfall and reasonably fertile conditions Leucaena grows very rapidly, thus the maintenance of the plants at useful heights can require some effort. Manual lopping or mechanical slashing once or twice a year may be necessary.

The nutritive value of Leucaena is good with high values of protein and most minerals, however, sodium and iodine contents are low.

Leucaena contains an amino acid, mimosine, a toxic break-down product of which (DPH) affects both ruminants and non-ruminants. Symptoms include hair loss, loss of appetite, excessive salivation, lack of co-ordination, enlarged thyroid glands and the production of goitrous calves that die at birth.

Ruminants do, however, gain weight rapidly on Leucaena initially. A rule of thumb when feeding Leucaena is that it should not form more than 1/3 of the diet and it should not be fed as a pure ration for longer than 3 months at a time. If toxicity symptoms appear it can be readily reversed by removing Leucaena from the diet.

Not all animals exhibit toxicity symptoms after prolonged feeding with Leucaena. Animals in Hawaii and the Philippines, areas, where Leucaena has been long grazed, have rumen flora which can break-down DPH. It has been recently discovered that the transfer of rumen flora from these to DPH sensitive animals transfers the ability to break down DPH. Leucaena is thus a plant of great potential as a ruminant fodder.

Seed of Leucaena cultivars are available in experimental quantities from the FLAG programme at ILCA.



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#### **b) Production of Vetch Seed**

Daniel Keftasa

Crop and Pasture Section, ARDU

### Introduction

The use of vetch for production of oat-vetch forage has drawn considerable interest in medium to high altitude regions in Ethiopia. Vetch seed production is generally difficult because of uneven maturity, shattering and frost problems in some regions. The trailing growth habit causes excessive lodging of the crop and results in difficulties for mechanized harvesting. Seed of vetch (Vicia dasycarpa) is produced on about 15 ha every year at Kulumsa (2200 m altitude) in the Arsi Rural Development Unit from which the seed is supplied to farmers and other organizations. The yields obtained so far were about 25 qts/ha (17-31 qt/ha) at the experiment level and 9 qts/ha (5-14 qt/ha) in large scale seed production. Though the yields from large scale seed production were low, the value of vetch as a rotation crop is very high. The result from a short term crop rotation experiment at Kulumsa shows that wheat after vetch produced 43% and 60% higher yield than wheat after wheat when planted with and without fertilizer respectively.

The following information regarding production technology of vetch is taken from the results of experiments carried out at Kulumsa during the period 1981-83.

#### Varieties

From 4 species of vetch tried at Kulumsa, V. sativa has been found to be the best seed producer followed by V. dasycarpa but the former produced lower herbage yields as compared to the other species in the medium and highland regions. V. dasycarpa produced reasonably high herbage and seed yields. The other species were late-growing types and their seed production was inferior to V. dasycarpa.

#### Time of Planting

It takes about 120 days for V. dasycarpa to reach the full flowering stage and 150 days to reach maturity at Kulumsa. From this it has been concluded that planting should be done at the beginning of the main rainy season in June. Dry planting in May has also been found possible.

#### Seeding Rate

The response of vetch to seeding rate has been found to be small in most cases. Seeding rates of between 15-20 kg/ha have been found to be adequate. Lower seeding rates produce poor plant stands and result in high weed infestation during early growth but there were no clear differences in seed yields in the final stands.

#### Spacing

From the results of experiments on row spacing, no clear yield differences were observed due to differences in row spacing from 40-100 cm. It is concluded that a narrower row spacing (40 cm) is advantageous as larger row spacings encourage the development of weeds which compete with the crop and create further problems during harvest. Thus the recommended planting method for large scale vetch seed production is to drill directly at a depth of 2-4 cm in rows 40 cm apart.



### Fertilizer Rate

The response of vetch to phosphorus is generally good in the highlands of Ethiopia. On an old arable field at Kulumsa its response to both phosphorus and nitrogen was not high but there was a profitable yield increase due to both fertilizers. It is recommended to use 100-150 kg/ha DAP (18/46) for medium-highland regions for fast and vigorous development of the crop and accumulation of nutrient reserves in the soil for the subsequent cereal crop.

### Weed Control

Vetch can tolerate weed competition but yield losses can occur due to heavy weed infestation at early stages. Hand weeding (or hoeing) can be done for small scale seed production but the most efficient and economical method for large scale seed production is to use a pre-emergence herbicide commonly known as "Topogard" at the rate of 1.5 litre/ha a.i. (3 litre/ha product) immediately after planting.

### Harvesting/threshing

The major problem with large scale vetch seed production is harvesting and threshing by combine harvester. The lodging habit of the crop makes this difficult. The usual practice followed at Kulumsa has been to harvest the crop manually when the main stems and pods become light brown in colour. There can be some green immature pods on the upper part of the plants at this stage. The crop is left in the field for further maturation and drying for about 2-4 weeks, depending on the weather. When the crop is dry enough for threshing it is fed to a stationary combine or thresher. Past experience shows that there is quite a high loss of seeds and unthreshed pods during harvesting and threshing. Timely harvesting, proper drying after harvest, proper care during threshing and precise calibration of the thresher are some of the major factors in reducing losses in the field.

### Seed Quality

On an average the hectolitre weight of vetch seed is 78 kg with a thousand seed weight of 37.5 gm. The germination percentage is usually about 75% and about 20% is catagorised as hard seed (tested 6 months after harvest).

The analyses for nutritive value show that vetch seeds contain 32.4% CP, 3.3% ash, 7.6% crude fiber, 1.1% fat and 55.6% Nitrogen free extract (NFE). It was shown that vetch seeds contained more digestible crude protein and metabolizable energy than field peas (Daniel, 1984).

### Conclusion

There is a high potential for the production of vetch seed in medium-highland regions in Ethiopia. The major problems in large scale seed production are the difficulty of harvesting by combine harvester and high losses through pod and seed shattering during hand-harvesting and threshing. The high yield (31 qts/ha) obtained from the experimental plots indicates that high yields can be expected if farmers produce vetch seed on a small scale using the experience they have from the production of field peas.

### Reference

Daniel, K, (1984). MSc Thesis (Upsala, Sweden)  
(Unpubl.).



## STEERING COMMITTEE MEMBERS

### Executive members

|                                      |      |          |
|--------------------------------------|------|----------|
| Ato Almeayehu Mengistu, Chairman     | MOA  | 44-75-32 |
| Ato Lulseged Gebre Hiwot, D/Chairman | IAR  | 16-10-55 |
| Ato Abate Tedla, Secretary           | ILCA | 18-32-15 |

### Members

|                       |                                |           |
|-----------------------|--------------------------------|-----------|
| Dr. Chadokar          | Soil & Water<br>(MOA)          | 44-40-80  |
| Ato Gugssa Endeshaw   | ESC                            | 15-50-15  |
| Dr. Samuel Jutzi      | ILCA                           | 18-32-15  |
| Ato Adane Fayissa     | MSF                            | 15-38-81  |
| Ato Asfaw Yemeguhail  | ILCA                           | 18-32-15  |
| Ato Gashaw Shibabew   | ARDP, Asela<br>or Kulumsa      | 92<br>102 |
| Ato Getinet Aklilu    | Sirinka Catch-<br>ment Project |           |
| Ato Fikre Abera       | Ambo Junior<br>College         | 44-31-66  |
| Ato Kidane W/Yohannes | TLDP                           | 15-10-88  |
| Ato Berhanu Hiko      | Forestry &<br>Wildlife (MOA)   | 18-29-81  |

The forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter itself is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia.

If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

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FNE Newsletter  
P. O. Box 5689  
Addis Ababa

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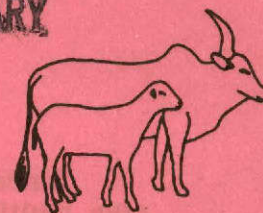
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# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

NO. 7

January - February, 1985

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### 1. INTRODUCTORY MESSAGE

The 13th General Meeting of the Forage Network in Ethiopia took place on February 1 1985 and was both interesting and successful. A total of 47 participants from 9 research and development organizations attended the meeting.

The participants heard talks on several subjects including the new Pasture Network for Eastern and Southern Africa, the National Workshop on Livestock and Forage Research, a proposed project on Vertisol management and the main address of the meeting "Drought Feeding Strategies" by Dr. R. Preston.

During the meeting the forage research work of the individual organizations attending were presented as were the results of the FNE multilocation trials.



Since the meeting, the Steering Committee of the Network has met twice to plan multilocation trials for the 1985 planting season. It was decided to 1) terminate the perennial highland (medium altitude) grass trial, 2) repeat the annual Trifolium - P rate trial, 3) initiate native annual Trifolium and Medicago sativa strip trials, 4) initiate replicated grass-legume mixed sward P rate trials at high and medium altitude, 5) Plant another lowland replicated trial at Awassa.

The trial designs for these are available from ILCA (FLAG), Alemayehu Mengistu (MOA) and Lulseged G/Hiwot (IAR). Organizations wishing to plant these trials should contact John Lazier of the FLAG Unit ILCA as soon as possible for the seed.

The Working Committee of PANESA (Pasture Network for Eastern and Southern Africa) met at ILCA over the week February 18 - 22. Their most important decision was to base their full time, senior scientist co-ordinator in Addis Ababa at ILCA. This will do much to strengthen the FNE Network and to strengthen ties between the FNE and researchers in the region.

The FNE welcomes the participation of Djibouti in the FNE. A forage research officer of the MOA, Djibouti participated in the FNE General meeting and an irrigated forage strip trial will be planted in Djibouti in 1985. FNE strip trials will thus extend from Soddo and Awasa in the south of the Rift Valley to the coast in the north.

Co-operation with Djibouti is seen as a first step toward exchange of information between national and regional forage networks under the umbrella of PANESA.

(Editors Alemayehu Mengistu, John Lazier)

\* \* \* \*

## 2. FORAGE NETWORK STEERING COMMITTEE MEETING

22/2/85

Present     Ato Alemayehu Mengistu - MOA, Chairman  
              Ato Lulseged Gebre Hiwot - IAR, D/Chairman  
              Wt. Yeshwarege W/Meskel - Meat Development Enterprise  
              Dr. John Lazier            - ILCA, FLAG

The meeting was opened at 9:30 A.M.

- 1) The agenda for the General Meeting on 1 February 1985 was organized.
- 2) The forthcoming meeting of the PANESA Working Committee at ILCA on February 18 - 22 was discussed and the committee agreed to meet the members.
- 3) The participation of a Djibouti delegate in the FNE General Meeting was welcomed.

The meeting closed at 10:30 A.M.

\* \* \* \*



**3. THE 13TH FNE GENERAL MEETING**

1/2/85

ILCA Addis Ababa 8.30 - 16:00 hrs

**3.1. Welcome Speech - Alemayehu Mengistu (Chairman of FNE)**

On the behalf of the FNE Committee I welcome all of you to the 13th General Meeting of the Forage Network in Ethiopia.

The FNE is organized to conduct and promote joint forage research on a national level. It hopes to achieve this by increasing communication between scientists and encouraging the change of plant materials. The group's activities include meetings, multi-locational trials, field trips and publication of a Newsletter.

The Network has been in existence since October 1980 when forage researchers (staff of IAR, ARDP, MOA and ILCA) met at ILCA headquarters and the first multi-locational trials resulted. These were planted in 1981 at mid and high altitudes. In 1982 the planting and assessment methods were further refined and both the annual and perennial trials were replanted. A native pasture inventory survey was also initiated. These trials were continuing in 1983 with addition of low altitude trials in the Rift Valley.

While refining its experimental techniques the network has been expanding its membership as scientists from aid, research and development organizations have started to participate.

The formation of Steering Committee was another further important development. It is composed of a representative from each participating organization and plans activities, designs trials, summarizes results, gives advisory services to organizations and publishes a Newsletter.

Dear participants, when the 12th FNE meeting was opened last year (27/1/1984), by Dr. Brumby, Director of ILCA, he spoke about the agricultural problems of Africa, emphasizing the current food situation in Africa which is unsatisfactory. Today in our country because of the current drought there has been an increasing awareness of the need not only for human food but also of the need for dry season feed reserves for livestock. Therefore, I strongly urge the FNE members to take this point into consideration in today's annual meeting. I now call upon Dr. Lambourne, Director of Research at ILCA to open the 13th FNE meeting.

**3.2. Opening Talk by Dr. Jim Lambourne**

Dr. Lambourne welcomed the participants to ILCA and then spent a few minutes explaining ILCA's structure. ILCA has its Headquarters in Ethiopia and, as well as having 5 country research programmes in various African countries. In Ethiopia the ILCA linkage with national organizations in the field of agricultural research in general and in forage work in particular has increased substantially. The link between livestock and crops is important in ILCA's approach to improve production, for an increase in cereal crop production means an increase in crop residues which are vital for animal feed during the dry season, and increased livestock production provides cash income for better cropping.



Dr. Lambourne turned to the current drought situation and showed participants ILCA's zonal classification of Africa in terms of average rainfall, crop requirements for moisture, and soil characteristics. Areas in Africa where current rainfall is insufficient to support crop production were indicated. The rainfall figures for the Debre Berhan, Shola and Debre Zeit ILCA stations enabled ILCA, using the FAO soil moisture computer programme, to calculate the length of the growing period for many years past. Ninety days is the lower limit for productive crop growth and when two or three such years of crop failure occurred in succession, famine resulted. This was illustrated for several areas in Ethiopia. The challenge for ILCA and Ethiopia is to find better ways of cropping, of increasing yields, of preventing erosion and loss of fertility, and of economically and efficiently using crop residues and pastures to feed livestock.

ILCA is currently involved in developing network activities in many aspects of livestock research in Africa. These networks are in forages, animal traction, livestock policy, agricultural by-products and farming systems. One feature of these networks is newsletters, which are designed to be a means of improving communication among scientists and encouraging discussion of relevant issues. Several ILCA network newsletters, are already in existence and others are planned.

Three factors which are important to the success of networks are:

1. Participants should have a strong common interest and desire to work together.
2. A serious contribution should be made by all the participants to the network's activities.
3. A clear organizational focus is needed to initiate and strengthen network activities.

Dr. Lambourne said he believed that FNE had these three features and confirmed ILCA's continued involvement in FNE as well as in PANESA, the forage network which at the moment is being established in Eastern and Southern Africa. ILCA is also planning to start small networks in West Africa in various aspects of forage work and it is quite possible that these might ultimately link with PANESA to cover most workers in African forage research and development.

Finally, Dr. Lambourne congratulated the FNE members for the progress and success made in FNE activities and wished them success in their discussions at the present meeting.

3.3 The minutes of the 1984 Field Trip FNE meeting (27/10/84) and the Steering Committee Meetings of 11/12/84 and 22/1/85 were accepted.

3.4 In the election of FNE officers for 1985, participants agreed that the present officers should continue in their positions for a further year. Dr. Samuel Jutzi of the ILCA Highlands Programme stepped down from the Steering Committee and Dr. John Tothill, Leader of the FLAG Unit (ILCA) and Ato Daniel Keftasa of ARDU joined the Committee.

3.5 Three presentations were given on forage and network related activities:

Dr. Samuel Jutzi of ILCA presented information on a proposed research project on Vertisol management for which funding is being sought. The project would be a co-operative one between ICRISAT, ILCA and the Ethiopian Government. The characteristics of Vertisol soils were described and the negative effect of their poor drainage on crop yields was stressed. The project would emphasise the use of drains to improve crop productivity.



The two other topics discussed are presented elsewhere in this issue of the Newsletter: The Pasture Network for Eastern and Southern Africa (page 9) and the National Workshop on Livestock, Pasture and Forage Research (page 10).

3.6 Research summaries from 1984 and plans for the 1985 season were briefly presented by the organizations present. Summaries which were provided for the editors of the Newsletter are presented in this issue (page 11).

3.7 The FNE multilocation trial results for 1984 were summarized by the participants. These will be presented in detail in the next issue of the Newsletter, following statistical analysis and interpretation.

Festuca arundinacea and Phalaris aquatica (P. tuberosa) cv Australian remained the most persistent and productive grasses in the third year of the high altitude perennial grass species trial. Trifolium quartinianum ILCA 6301 was the most productive line generally in the annual native Trifolium trial, showing a marked response to the addition of P. In the medium altitude trials Chloris gayana, Panicum coloratum, Pennisetum purpureum and Desmodium uncinatum, all continued to give reasonable yields. In lowland trials there was slow growth in 1984 due to the lack of early rains. In the drier areas Stylosanthes scabra, S. hamata, and Macrotyloma axillare grew best. At Soddo in the replicated legume-grass yield trial Stylosanthes guianensis cv Cook gave the best dry matter yields.

3.8 FNE research work for 1985 was discussed. The members agreed that the 1984 multilocation trial results should be analyzed at ILCA and that particular attention should be given to the analysis of the three years accumulated results from the grassland inventory. The design of new 1985 trials was left to the Steering Committee. Suggestions made for 1985 work included:

- termination of the grassland inventory;
- a seed production trial;
- an alfalfa variety trial;
- identification of drought resistant material;
- more emphasis on research in farmers fields;

3.9. The transfer of results of FNE trials was discussed. Alemayehu Mengistu of the MOA outlined the success of the Ministry's many demonstration and farmer participation plots. ILCA's success with legumes in farmers fields near Soddo was also noted.

3.10 The MOA has initiated forage seed production under irrigation at Melka Werer (two lines of alfalfa and one of Siratro) and will start seed production at Soddo under rainfed conditions with ILCA's help (Cook stylo, Desmodium intortum, Lotononis bainesii and Macrotyloma axillare.)

3.11 Dr. R. Preston, ILCA consultant on drought feeding strategies gave a most stimulating and well presented talk on animal nutrition and the determination of the nutritional value of feeds. Dr. Preston has kindly prepared a paper for the newsletter which covers part of his presentation (page 14).



| <u>No.</u> | <u>Name</u>               | <u>Title</u>                          | <u>Organization</u>           |
|------------|---------------------------|---------------------------------------|-------------------------------|
| 1          | Mr. Mohamed Mossa Ibrahim | Research Officer                      | MOA (Djibouti)                |
| 2          | Ato Alemayehu Mengistu    | Senior Pasture &<br>Forage Agronomist | MOA                           |
| 3          | Ato Lulseged Gebre Hiwot  | Research Officer                      | IAR, Holetta                  |
| 4          | Ato Alemu Tadesse         | Research Officer                      | IAR, Bako                     |
| 5          | Ato Tadesse T/Tsadik      | A/Research "                          | IAR                           |
| 6          | Ato Seyoum Bedsye         |                                       | IAR                           |
| 7          | Ato Gebre Medhin Hagos    |                                       | IAR                           |
| 8          | Ato Aschalew Tsegahun     |                                       | IAR                           |
| 9          | Ato Aseffa Haile Selassie |                                       | IAR                           |
| 10         | Ato Sendros Demeke        | Research Assistant                    | IAR                           |
| 11         | Ato Tsegaye Bekele        | Head, Liaison &<br>Publications       | IAR                           |
| 12         | Ato Daniel Keftasa        | Agronomist                            | ARDU                          |
| 13         | Ato Tegene Alemayehu      | Animal Production<br>Expert           | ARDU                          |
| 14         | Ato Getachew Wondimagenhu | Research Assistant                    | ARDU                          |
| 15         | Ato Fikre Abera           | Lecturer                              | Ambo Junior College           |
| 16         | Ato Teshome Yizengaw      |                                       | Ambo Junior College           |
| 17         | Ato Gashaw Shibabaw       | Agronomist Shoa                       | Shoa                          |
| 18         | Ato Getinet Aklilu        | Section Head                          | SCP                           |
| 19         | Ato Wubalem Pekade        | Programming<br>Officer                | Livestock Dev. &<br>Marketing |
| 20         | Ato Zeynu Nur Hussien     |                                       | " " "                         |
| 21         | Wt. Yeshwareg W/Meskel    |                                       | " " "                         |
| 22         | Ato Eshetu Habte-Giorgis  | Dairy farmer                          | Private                       |
| 23         | Dr. P. A. Chadhokar       |                                       | FAO                           |
| 24         | Dr. R. N. Gallacher       | Advisor                               | FAO                           |
| 25         | Ato Tesfaye Tenagne       | RAD                                   | MSFD                          |
| 26         | Ato Habte G/Idan          | RAD                                   | MSFD                          |
| 27         | Dr. J. Lambourne          | Dir/Research                          | ILCA, Addis Ababa             |
| 28         | Ato Taye W/Mariam         |                                       | ILCA, Debre Zeit              |
| 29         | Dr. J. Kahurananga        | Plant Ecologist                       | ILCA, Addis Ababa             |
| 30         | Ato Abayneh Woudneh       | Research Assistant                    | ILCA, Addis Ababa             |
| 31         | Ato Asfaw Yemegenuhal     | Research Assistant                    | ILCA, Addis Ababa             |
| 32         | Ato Abate Tedla           | Forage Agronomist                     | ILCA, Addis Ababa             |
| 33         | Ato Aberra Adhi           | F. Technician                         | ILCA                          |
| 34         | Ato Genemo Gebernessor    |                                       | ILCA                          |
| 35         | Ato Seifu Buta            |                                       | ILCA, Zwai                    |
| 36         | Mr. A. Russell-Smith      |                                       | ILCA                          |
| 37         | Dr. John Tothill          | Leader, FLAG                          | ILCA                          |
| 38         | Wt. Zemam Tekle           | Germplasm                             | ILCA                          |
| 39         | Mr. J. Ochang             | Research Assistant                    | ILCA, Soddo                   |
| 40         | Dr. S. Jutzi              | Forage Agronomist                     | ILCA, Addis Ababa             |
| 41         | Dr. I. Haque              | Soil Scientist                        | ILCA, Addis Ababa             |
| 42         | Ato Girma Getachew        | Research Assistant                    | ILCA, Zwai                    |
| 43         | Wt. Frehywot G.           |                                       | ILCA                          |
| 44         | Wt. Almaz H/Selassie      |                                       | ILCA                          |
| 45         | Ato Abdulkadir Ahmed      |                                       | ILCA                          |
| 46         | Dr. John Lazier           | Forage Agronomist                     | ILCA, Addis Ababa             |



#### 4. FNE STEERING COMMITTEE MEETING

26/2/85

The FNE Steering Committee members met at ILCA Headquarters from 9 to 12 A M. Members present were Dr. J. Tothill, Dr. J. Lazier, Ato Alemayehu Mengistu (Chairman), Ato Lulseged G/Hiwot (D/Chairman), and Ato Abate Tedla.

##### Issues discussed were:

##### 4.1 PANESA:

Dr. J. Lazier reported on the progress made by the PANESA Working Committee meeting (18 - 22 February) which was held at ILCA. Ato Alemayehu Mengistu met the PANESA members and discussed on behalf of FNE members future co-operation and links between FNE and PANESA on behalf of FNE members. FNE members have the opportunity to write articles for the PANESA Newsletter and there will be training opportunities in the future.

##### 4.2 FNE Newsletter no. 7:

It was decided that Dr. Lazier will compile all relevant material which will appear in the Newsletter.

4.3 In the meeting, it was pointed out that some Steering Committee members did not show up at meetings. It was agreed to approach the organizations represented by them to identify new individuals interested in participating in FNE activities and representing their organizations on the Steering Committee.

##### 4.4 1984 trials results:

It was agreed that Ato Lulseged, Ato Alemayehu and Ato Abate will take the responsibility of analysing the data and compiling the 1984 FNE trials results.

##### 4.5 FNE experiments for the coming season:

It was agreed after a long discussion to implement the following forage experiments.

1. A strip trial on Trifolium lines for the highlands with 3 levels of P. This will be designed by Dr. J. Lazier and FLAG (ILCA) will provide the seeds.
2. A strip trial on Medicago sativa lines for the highlands with 3 levels of P. the trial will be designed by Dr. J. Lazier and FLAG will supply the seeds.
3. A grass - legume mixture trial using self re-generating annual native Trifoliums with Phalaris aquatica and Festuca arundinacea for the highland region. Dr. J. Tothill will design the trial and FLAG will supply the seed.
4. A grass-legume mixture trial using alfalfa, Cook Stylos, and Desmodium with Chloris gayana and Panicum coloratum for the lower highland region. Dr. J. Tothill will design the trial and FLAG will supply the seed.

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## 5. FNE STEERING COMMITTEE MEETING

5/3/85

The FNE Steering Committee met at ILCA from 9 to 11:30 A.M. Members present were: Dr. J. Tothill, Dr. J. Lazier, Ato Lulseged G/Hiwet, Ato Alemayehu Mengistu and Ato Abate Tedla.

The purpose of the meeting was to review and finalize the FNE experimental protocols for the coming season.

Dr. J. Tothill and Dr. J. Lazier had prepared the details of the experiments requested by the Committee in its previous meeting.

The details of these trials were discussed and modifications made. 1) The annual Trifolium -P rate trial of 1984 will be repeated in 1985. The lines will remain the same if seed is available. If not another productive line will be substituted. 2) sites of new 1985 trials will be:

- a) Trifolium strip trial: Holetta, Sheno, Kulumsa, Gobe, Debre Berhan.
- b) Medicago sativa strip trial: Holetta, Kulumsa, Debre Zeit.
- c) Grass-legume highlands trial; Debre Berhan, Gobe, Holetta.
- d) Grass-legume medium altitude trial, Debre Zeit, Kulumsa, Bako.

3) Drs. Tothill and Lazier were instructed to prepare the protocols and seed and to get these to the relevant organizations as soon as possible.

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## 6. NEWS AND NOTES

6.1. Ato Abayneh Woudneh of the ILCA FLAG Unit left for Australia in early February to undertake an MSc course in forage agronomy at the University of Queensland in Brisbane. He will take courses until July, then spend 6 months doing research with Mr. Bob Reid at the CSIRO Davies Pastoral Laboratory at Townsville, Queensland, before returning to Ethiopia in early 1986 to complete his research project. He will be working on adaptation to altitude of Leucaena accessions.

6.2. The PANESA Newsletter is due to go to press in May 1985. The Chairman of the PANESA Working Committee Prof. A. B. Lwoga is looking for articles on current forage research or other forage topics for this first issue. FNE members are urged to contribute. The Newsletter will be circulated widely in Eastern and Southern Africa. Prof. Lwoga's address is: Sokoine University of Agriculture, P. O. Box 3000, Chuo Kikuu, Morogoro, Tanzania.

6.3. Dr. John Tothill, Agronomist of long experience with the Cunningham Laboratory, CSIRO, Brisbane, Australia arrived in early February to take the position of Leader of the FLAG Unit, ILCA.

6.4 Professor Nazeer Ahmad, Head of the Soil Science Department, University of the West Indies, Trinidad completed part of a consultancy with the FLAG Unit. During his stay in Ethiopia he travelled widely and will be writing up a report on the Ethiopian ILCA agronomy programmes as well as those of ILCA programmes elsewhere in Africa. He may be returning briefly in September.



6.5 The FLAG unit is interested in commencing forage screening activities in Gambella as the area is apparently representative of the Guinea Savanna, an important African ecological zone. Two visits were made there in the last two months. Settlement and development in the area is occurring rapidly and thus there will apparently be a local need for persistent and productive forages. ILCA's involvement in the area awaits the identification of a suitable graduate who can be hired by the Unit.

6.6 Ato Tadesse Tekle Tsadik a member of Holetta Forage Section staff left for ICARDA Aleppo, Syria on 5th March, 1985. He is attending a three months training course in forage production.

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## **7. INTERNATIONAL FORAGE NETWORK MEETING (PANESA)**

### **Held at ILCA**

The Working Committee of the Pasture Network for Eastern and Southern Africa (PANESA) (FNE Newsletter No. 6 p 8) held its 3rd meeting at ILCA Headquarters, Addis Ababa from February 18-22, sponsored by ILCA.

The Working Committee has 5 members elected by an annual General Meeting (Prof. A. B. Lwoga, Tanzania, (Chairman); Dr. Ben Dzwola, Malawi (Secretary), Dr. John Clatworthy, Zimbabwe; Mr. Doug Chandler, Botswana; Prof. Abdul Said, Kenya) and two coopted members (Dr. John Lazier, ILCA; Prof. Jackson Kategile, IDRC).

The members viewed ILCA facilities and work in Ethiopia at ILCA headquarters, Debre Zeit, and Ethiopian-ILCA co-operative work at Zwai Horticulture Farm and Abernosa Ranch. They also had discussions with ILCA unit and programme heads. Ato Alemayheu Mengistu, Chairman of the FNE had a very spirited session with the Committee, which was much appreciated by the Committee members. The Committee discussed sources of funding for the Network. IDRC will apparently provide basic funding including a co-ordinator and money for a training course. The funding remains to be approved by the Board of IDRC.

After much discussion it was decided to base the PANESA co-ordinator at ILCA, Addis.

The agenda of the General Meeting/Workshop, due to be held in Kenya in October 1985 was discussed. Papers would be presented by invitation on the theme "Feed Resources for the Small-Scale Livestock Producer".

The course outline and timing of a training course on "Forage Plant Introduction and Initial Evaluation" due to be held in Zimbabwe was discussed. It is likely to be held sometime in early August.

PANESA plans to initiate the publication of a newsletter in May with the help of ILCA.

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## **8. HIGHLIGHTS OF THE NATIONAL WORKSHOP ON THE STATUS OF LIVESTOCK, PASTURE AND FORAGE RESEARCH IN ETHIOPIA**

Lulseged Gebrehiwot-IAR

A three day workshop on Livestock, Pasture and Forage Research was held at ILCA, January 8 to 10, 1985. The workshop was organized by the Institute of Agricultural Research (IAR) and was intended to provide a forum to review past, present and future research on livestock, forage and related activities. Specific objectives of the workshop were a) bring together the personnel involved and review past and present achievements; b) to review the extent of application of research results in development programmes and their adoption by livestock owners; c) to review current programmes and discuss major technical constraints in running the programmes; d) to identify priority areas of research, and establish mechanisms through which current and future programmes can be effectively co-ordinated and conducted.

At the workshop, researchers and development workers who were acknowledged authorities on specific aspects of livestock, pasture and forage were invited to present comprehensive review papers in their field of specialization. During the first two days of the workshop 12 papers were presented. These papers were on dairy, beef, sheep and goats, poultry, agriculture, pack animals and traction, fish, nutrition, pasture and forage, range management, animal health and livestock product marketing and processing. Each presentation was followed by a lively discussion. A paper on ILCA's role in strengthening national institutions was presented by the Director General of ILCA.

The third day was devoted to a summary of deliberations, discussions and final recommendations. It was pointed out that livestock are important in the everyday life of the Ethiopian people. Despite its overwhelming importance livestock research has not been given the serious attention it deserves. Research conducted so far has been of a fragmentary nature, and there are some areas such as agriculture, pack animals, fish etc. on which virtually no research has been done. In general, the contribution of research to overall livestock development has been minimal. Hence, it was felt that better co-ordinated research programmes with defined targets should be envisaged. Furthermore, in order to assess the progress made in livestock and forage research, it was suggested that a National Livestock Improvement Conference similar to that of National Crop Improvement Conference (NCIC) should be created.

In order to strengthen and co-ordinate the various aspects of livestock research the house suggested the formation of research teams. Following a committee study it was felt necessary to form 8 Teams (1) Dairy, 2) Beef, 3) Sheep and Goat 4) Poultry, 5) Apiculture, 6) Fish, 7) Pack animals and Traction, 8) Pasture, forage, Range and Nutrition] and 4 Networks [1) Feeds and Nutrition, 2) Animal Breeding, 3) Animal Health, 4) Livestock Marketing].

A five-man committee is charged with the responsibility of finalizing the formation of the various Teams and Networks. When the Teams are operational each will have its own leader and all research projects will have to go through the respective Teams. It is hoped that the Teams will be functional before the year is out.

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## 9. RESEARCH AND DEVELOPMENT SUMMARIES

### 9.1 The Livestock Development & Marketing Enterprise

Wubalem Fekede

#### 9.1.1 Main objectives of the Enterprise

- Participate in the development and economic utilization of the country's livestock.
- Develop and seek commercial outlets, both domestic and foreign, for the various products of the enterprise.
- Supply adequate numbers of cattle to meat factories.

#### 9.1.2 Main products of the Enterprise

- Fattened steers and yearlings for export and for the domestic market.
- Sheep and goats for export.
- Live pigs for private buyers and for supply to the meat processing plant.
- Various processed meat products.

#### 9.1.3 Major problems and bottlenecks encountered by the Enterprise

- Procurement of cattle and sheep is mainly from lowland nomad producers as the Enterprise does not have its own large scale breeding farms. The supply of livestock is thus highly seasonal.

- Managing large numbers of animals procured from varying ecological zones and management conditions has proved a problem. The Enterprise has an acute lack of experience in managing large herds, especially sheep which can occur in hundred of thousands.

- Feed constraints have been a major bottleneck so far. Currently there is a shortage of flour mill by-products. Ranches have not been developed. This problem is accentuated by the present drought particularly when one considers the task assigned to the Enterprise (purchase and maintenance of 200,000 head of cattle, 300,000 head of sheep).

- Synchronization of purchase and sales operations of the Enterprise has been a problem (unreliable foreign markets, limited capacity of meat factories, etc).

- Transportation of animals (trekking, trucking) from purchasing centers, holding areas, feed lots and then to ports has been expensive and uneconomical as trucks specially built for this purpose do not exist (save the five trucks imported a year ago).

#### 9.1.4. Future Plans

- Seeking and developing alternative animal feed resources is planned. Acquiring large areas for ranch development has been initiated. Increased utilization of sugarcane tops, straw, and irrigated pasture has been envisioned.

- Attempts are being made to secure more reliable foreign markets.

- In the livestock rehabilitation programme of the current drought, some 200,000 head of cattle and 300,000 head of sheep are to be procured and disposed of by supplying to meat factories, by exporting live and by resale to peasants after the drought.

\* \* \* \*



## 9. 2. Animal Feed & Nutrition (MOA)

Alemayehu Mengistu

### Development trials on cultivated pasture and fodder crops

In collaboration with the Agriculture Development Department adaptation trials were conducted in all Administrative Regions (except Arsi). Fourteen varieties were planted at 117 sites. The best results were achieved by oats/Vicia mixtures, fodder beet, Lolium perenne and Cocksfoot at higher altitudes and Rhodes, Sudan grass, Columbus grass, alfalfa, Lablab and Desmodium intortum at mid and low altitudes.

Farmers' one hectare demonstration trials were conducted at 65 sites over the Administrative Regions. As cultivation for fodder crops is needed at the same time as for the main crops, the fodder crop cultivation was done poorly and most of the perennial fodder crops performed poorly. Only the oats/Vicia mixtures and fodder beet performed well.

A total of 256 quintals of seeds have been distributed in the 1984 growing season for Dairy Association areas.

Development work executed at Governmental ranches included:

Abernosa Cattle Ranch -with the collaboration of ILCA, screening and adaption trials on tropical grasses, legumes and browse plants has been conducted.

Debre Berhane Sheep Breeding Ranch - The planting of oats and fodder beets on a large scale was successful. A total of 50 quintals of oat seed have been produced from 3 ha of land.

Andasa Cattle Ranch - Oats, fodder beet, Rhodes grass and alfalfa have been planted on a large scale and all performed well.

Leucaena seedlings were tried in different Administrative Regions; and showed good growth except where there was severe attack by wild animals.

Due to the present drought, the country is being faced with a severe shortage of livestock feed. The MOA is in the process of launching a drought feeding programme in some of the more severely affected Administrative Regions, mainly Wello, Hararghe and Shoa. The programme is envisaged to serve an estimated 88,000 head of cattle. The major source of feed under this programme will be a molasses/urea mixture and it is estimated that 21,388 tons of the mixture will be distributed over the next ten months.

The scarcity of water for both domestic use and livestock is another problem in the rural areas of Ethiopia. The MOA drought programmes have launched a pilot stock pond construction scheme in the severely affected Administrative Regions. The scheme is based on ILCA's experience of using oxen drawn metal scoops for pond construction. A total of 480 locally constructed metal scoops will be made to construct 80 ponds with a total capacity of 560,000-640,000 m<sup>3</sup>.



### 9.3 Research Briefs from Holetta

Lulseged Gebrehiwot - IAR

#### 9.3.1 Rainfall:

The total rainfall for 1984 was lower than the previous years' average i.e 972 mm compared with 1100 mm. During the small rains (Belg rains) in February, March and April 175 - 200 mm of rain is expected in normal year. However, last year there was only 50 mm of rainfall at Holetta making 'Belg' planting impossible.

#### 9.3.2 Plant introduction and variety trials:

Fodder oats (15 varieties) and alfalfa (18 varieties) were tested at Holetta, Debre Zeit, Ginchi, Sheno and Bedi. The performance of the oat varieties was generally good. The mean dry matter yields were 13.6, 12.5 and 10 t/ha at Sheno, Holetta, and Debre Zeit respectively. At Bedi and Ginchi the yield was about 5 t/ha. The alfalfa varieties did very poorly at all locations except Debre Zeit where the mean yield was 2 t/ha. Rhodes grass and coloured Guinea tested at Debre Zeit yielded over 5 t/ha dry matter for one harvest. The poor performance of the legumes in the highlands was probably due to late planting.

#### 9.3.3 Pasture species for water -logged areas:

Three species, namely Festuca arundinacea, Phalaris arundinacea and Setaria sphacelata are well adapted to seasonally waterlogged conditions in the highlands. Under relatively good management these species persisted for more than four years at Holetta and Sheno. It was also found that establishment by root split planting was more successful than seed planting.

Two other cultivars for water-logged areas but with short persistence are Phalaris aquatica cvs Sirocco and Australia. Seeds or vegetative planting materials of the above species for experiment purposes are available at the IAR - Holetta Station.

#### 9.3.4 Intercropping of forage crops with food crops:

A three year study conducted at Holetta showed that wheat can be successfully undersown with rye-grass, Phalaris, tall fescue and Setaria. In this study wheat was planted in rows and the forage crops broadcast between the rows. For successful establishment a well prepared weed-free seed bed and fertile soils are necessary. Fast growing forage species such as perennial rye-grass and Phalaris aquatica cv. Sirocco are the most suitable for undersowing in the highlands.

Similar studies were conducted at Awassa and Bako using maize and tropical forage species. The forage species were planted after the first weeding of maize (about six weeks after planting). Rhodes grass and Desmodium showed superior establishment and persistence. In all of these studies the grain yield of the food crops was not seriously affected. Undersowing in marginal rainfall areas (less than 700 mm annual rainfall) was unsuccessful.

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### 9.4 FLAG Activity Summary

The Forage Legume Agronomy Group's 1984 work in the highlands was based at Addis Ababa, at ILCA Headquarters. Unreplicated screening of perennial legumes, planted in 1983 on an Alfisol indicated that Medicago sativa lines were the most productive and cvs Salton, CUF 101, Gargo, Moapa, Paravivo and experimental lines ILCA 5619, 5661 were among the best.



Screening of annual Trifolium lines and analysis of two years observational data by cluster analysis and principal component analysis indicated that T. quartinianum, T. decorum, T. rueppellianum, T. steudneri and T. tembense all had productive genotypes, but the variation within species was greater than between species. The above list of species indicates the ranking of the most vigorous genotypes, both in the observational trials and in a replicated yield trial. The highest dry matter yield obtained in the 1984 yield trial was 10 t/ha (T. quartinianum ILCA 6301). Seed yields were generally over 200 kg/ha. However, 7 of the 27 lines in the trial produced over 1000 kg of seeds/ha and three lines had seed production in the 1.4 to 1.6 t/ha range.

A browse strip trial at Shola indicated that Erythrina, Albizia, Sesbania and Acacia species could germinate and grow in the wet season on a Vertisol. However the trial will be replicated in 1985 in hopes of a more normal rainfall pattern and thus better establishment, and persistence in the dry season.

The 1985 season will also see the first evaluation work on native perennial Trifolium germplasm. Multiplication of these outcrossing lines will be done in screened cages, and a strip trial will be established. Annual Trifolium evaluations will be continued both in strip and replicated yield trials. Forage germplasm collection trips are planned for Ethiopia, Tanzania, and Venezuela.

In the Rift Valley, the 1984 growing season was very short and in the replicated, grazed Stylosanthes trial at Abernosa Ranch only S. hamata cv. Verano grew vigorously from self sown seed. However, it did not flower before drying off. The browse strip trial (165 lines) and the oversowing of natural grassland trial both had poor establishment due to the poor rains. It is planned to replant the browse trial but no new trials will be initiated due to lack of graduate staff.

At Soddo although the introduction plots were planted in August - September, at the end of the rains, a range of legumes have grown well including annual highland Trifolium species, Stylosanthes, Macrotyloma and Desmodium. A much broader range of material will be planted in 1985 in co-operation with the MOA including the entire S. fruticosa collection. The browse strip trial planted in 1984 did not germinate due to improper planting. This will be replaced. A grass strip trial, a replicated Lablab variety trial and an alfalfa-Stylosanthes yield trial are planned for 1985. Strip trials will also be established on wet bottom land, both on artificial ridges and on the flat. Demonstration plantings of adapted forage legumes will be established in co-operation with the MOA on two peasant dairy co-operatives and 5 peasant farms.

FLAG has made two trips to Gambella this year and has been interested in establishing screening of forages for the Guinea savannas there. It is probable that lack of graduate staff will keep any activities there to a minimum.

An MSc student will be establishing fertility response trials as part of his thesis work at Holetta, Shola and Debre Zeit

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## **10. ADVISORY NOTES**

### **10.1 Molasses as an Animal Feed/Supplement with Particular Reference to Ethiopia Dr. R. Preston, ILCA**

#### **Alternative uses for molasses:**

Molasses is the only "concentrated" source of fermentable carbohydrate which is widely available in the tropics and is not a staple of the human diet. It is extremely important as a livestock feed as indicated by the following ways in which it can be used:



As a fermentable carbohydrate source providing the basis of the diet for ruminants;

As a palatable carrier for urea, minerals and other nutrients for improving the efficiency of utilization of low-N diets (eg: crop residues, sugar cane and agro-industrial by-products);

As a strategic drought reserve and as the basis of a supplement for routine feeding during the dry season;

For decades, molasses has been used for the manufacture of potable alcohol (eg. rum). Since the fuel crisis enormous pressure has been applied to develop industrial alcohol production especially as a substitute for gasoline (power-alcohol). The lack of technical knowledge to permit efficient use of molasses in livestock feeds has been the principle reason for advocating its use for industrial purposes. Often due to lack of demand molasses accumulates in storage tanks at sugar mills and is discarded into rivers. Its opportunity cost is thus considered to be very low. This has been an argument for its use in power-ethanol production. However, the recent developments for using molasses in livestock enterprises in developing countries have given firm alternatives for molasses utilization which are vastly superior from an economic stand point (Table 1).

There are extremely strong arguments for retaining molasses as a livestock feed in countries which suffer dry seasons and periodic droughts. The opportunity cost of using molasses (which may be the only feed available) in drought regions in the tropics, is related to the value of a live animal and the survival of subsistence farmers who are dependent on draught animals.

TABLE 1

Molasses has a higher value when used as an animal feed than when it is converted into power-alcohol

|                                               | Opportunity Cost \$/ton | Assumption |
|-----------------------------------------------|-------------------------|------------|
| Survival feeding of cattle in drought         | 540                     | 1          |
| Substitute for cereal grain                   | 150                     | 2          |
| Fattening cattle                              | 92                      | 3          |
| Supplementing crop residues/dry pastures for: |                         |            |
| 1. Milk production                            | 440                     | 4          |
| 2. Prevent body weight loss                   | 47                      | 5          |
| Power-alcohol                                 | 34                      | 6          |

Assumptions:

(1) To maintain cattle alive for six months about 360 kg/head of molasses/urea (1%) is required. The cost of a replacement animal is estimated at US\$200. After substituting the urea and distribution costs the value attributable to molasses is approximately \$540 per tonne.

(2) The value of molasses as a substitute for imported grain is estimated on the basis that it has a substitution value of 75% and that imported grain is US\$200/tonne (CIF).

(3) It is estimated that used as the basal diet (70% of the total feed) for fattening cattle, 6 kg of molasses supplemented with 150 g of urea and 8 kg of fresh legume forage supports a daily live weight gain of 750 g. The urea costs \$0.045, the forage US\$0.46 and the live weight gain is valued at US\$0.87/kg.

(4) The daily consumption of 500 g of molasses/urea blocks (50% molasses, 20% urea, 20% bran, 10% minerals) has increased milk yield on a straw based diet by 1 kg/day (milk is worth US \$0.20/kg to the farmers).

(5) 4 kg molasses are fermented to produce 1 litre of anhydrous alcohol (costs that are not included are the fuel for distillation and the interest/depreciation on the investment in a distillery. A barrel of oil (CIF) is assumed to be worth \$35.



### Molasses for cattle fattening:

In times of severe drought, priority must be given to the use of molasses to keep animals alive. But in normal years it is feasible and will be profitable to use molasses as the basis for feedlot finishing of cattle and even goats and sheep.

The technology for molasses-based fattening systems was first established in Cuba (Preston and Willis, 1974) and has been further developed recently in work done in Mexico and the Dominican Republic (Preston and Leng, 1985).

Molasses is fed free choice after mixing with 2.5% of urea and is supplemented with restricted quantities of both forage (eg. sugarcane tops or cereal straw; usually at 0.8% of liveweight, dry matter basis) and protein meal (about 0.25% of liveweight). A simpler and more economic system employs a protein-rich forage (eg. cassava tops, Leucaena and Gliricidia restricted to 3% of liveweight (fresh basis) to provide both the roughage and protein. In both methods there are economic benefits (better growth and feed efficiency) from giving catalytic amounts (about 500 g/day) of poultry litter. Results from using the two systems are shown in Table 2.

TABLE 2

Comparison of molasses fattening systems using cane tops and wheat bran versus Leucaena forage with and without poultry litter

| Roughage source           | Cane tops |     | <u>Leucaena</u> |     |
|---------------------------|-----------|-----|-----------------|-----|
|                           | -         | +   | -               | +   |
| Poultry litter            | -         | +   | -               | +   |
| Liveweight gain,<br>g/day | 661       | 772 | 585             | 787 |
| Conversion                | 10.1      | 9.6 | 8.9             | 9.3 |

NB: Cane tops were given free choice and the Leucaena at 3% of liveweight; poultry litter was fed at 1.5 kg/day.

From an economical and resource utilization standpoint, the system employing good quality legume forage is to be preferred, since this involves no competition with monogastric species for protein meals. Several legume forage species offer prospects for being grown in Ethiopia in the regions adjacent to the sugar factories. Gliricidia and Leucaena are first choices which are likely to adapt well to the climate and soils of the Awash Valley. Another possibility is the legume Crotalaria being grown as a green manure crop in the sugar estates. Some members of this genus are toxic and at the moment it is not known if the particular species being grown falls into this category. The crop merits being evaluated as animal feed in view of its vigorous growth and high yield.



It is important that feedlots are situated on existing cropping farms and that they are not made too large. This is because:

- (i) The farm should be able to grow all the legume forage required for the feedlot;
- (ii) Other cash crops should be grown in rotation with the legume forage;
- (iii) It should be feasible to recycle the manure from the feedlot as fertilizer for the crops grown on the farm;

It can be estimated that one hectare of legume forage will be sufficient for 15 head of cattle maintained in the feedlot throughout the year. Thus a 200 ha farm with half the area devoted to legume forage and half to cash crops could support a feedlot of 1,500 head capacity. If the fattening period is 100 days then 4,500 head of cattle could be fattened per year. Eight such farms would use about 20,000 tonnes of molasses per year and produce 36,000 fattened cattle annually.

#### Molasses as a carrier for urea in liquid and solid supplements

Apart from the obvious role of molasses/urea supplements to save livestock in times of drought, they can be justified in normal dry seasons as a means of safely and efficiently providing the urea needed to balance N-deficient grazing and crop residues. Reliable data based on animal trials are not yet available to assess the real value of molasses in the Ethiopian context. However, an approximate estimate (Table 1) indicates that molasses used for this purpose would have a value of about Birr 94/tonne.

Solid molasses-urea blocks, which cattle and small ruminants consume by licking, are an alternative to liquid mixtures and may have advantages under certain conditions. The formula of such a block now being evaluated by ILCA is given in Table 3.

**TABLE 3**  
**COMPOSITION OF UREA - MOLASSES**

| Ingredient    | kg |
|---------------|----|
| Molasses      | 55 |
| Wheat bran    | 20 |
| Urea          | 8  |
| Calcium oxide | 10 |
| Salt          | 5  |

The advantages of blocks is that, compared with liquids, they are easier to transport (eg. a flat bed truck can be used instead of a tanker) and store. They may be more acceptable than liquid mixes at the farmer level although this has not yet been verified experimentally.

Blocks lend themselves to the incorporation of insoluble substances such as minerals, protein meals and even drugs such as antihelmintics. Their disadvantage is that the gelling agent, usually lime or magnesium oxide, is effectively an inert filler having little nutritional value, and may even imbalance other minerals (eg. excess calcium relative to phosphorus).



Blocks have yet to be tested as a drought feed and this is one area which merits urgent research. Priority should be given to comparing the two systems (liquid vs blocks) under a wide range of production systems, especially at the farm level, to assess their relative advantages and disadvantages and to identify specific roles for each.

#### Mixing of molasses/urea:

In the pilot scheme carried out in May 1984, it was found that even distribution of the urea in the molasses was achieved by using the movement of a tanker on a long journey (about 400 km) to promote the mixing. The fact that the density of molasses is some 40% greater than that of fuel oil means that the tankers can only to be filled to some 70% of their liquid capacity; the free space thus provided aids the mixing process.

The composition of the mixture used is:

|          | kg     | litres     |
|----------|--------|------------|
| Urea     | 450    | 450 approx |
| Water    | 900    | 900        |
| Molasses | 13,650 | 10,000     |

Urea and water should be put in the tanker at least 50 km away from the sugar factory to ensure there is sufficient time for the two components to be mixed thoroughly before the molasses is added.

The tankers should be charged first with water. This can be done using a hose and two 10 litre buckets (or some equivalent container) and employing a stop watch to measure the rate at which the hose discharges water.

For example if the hose fills the two buckets (20 litres) in 40 seconds then it will take:

$$(900/20) (40/60) = 30 \text{ minutes}$$

to charge the tanker with the required 900 litres of water.

Urea should then be added taking care to avoid the entry of lumps (these should be broken up with a spade or similar instrument).

On arrival at the sugar factory the required amount of molasses should be added. This can be estimated by allowing the molasses to enter the tanker until the contents occupy about 60% of the total depth of the tanker (use a measuring stick to determine this).

The tanker can then be driven to its destination and the contents discharged into pits or culverts. The outlet pipes from the tanker should have an internal diameter of at least 147 mm. It is a comparatively simple matter to weld these pipes onto the tanker body. A special tap is not needed. It will suffice to use a threaded end cap.

Care must be taken to weld a chain or wire between the cap and the chassis so that the cap does not accidentally fall into the pit!!



### Storage:

Concrete culverts set vertically on the ground and unlined pits were tested and found to be satisfactory during the pilot project. The former are portable but more expensive. Both should be covered with tin sheets or other impervious material so that rainwater does not collect on the surface of the molasses mixture. In the case of pits, a drain should be dug around the periphery to carry away surface runoff.

### Distribution to farmers:

The pilot scheme in May showed that distribution from the storage point to individual farmers was not a problem given the special circumstances of the Peasants' Associations which provided the necessary organization and control. The farmers proved to be extremely ingenious in the variety of means used to transport the liquid mixture. Receptacles ranged from earthenware pots normally used for water storage to milk cans; transport was by head load or with donkeys.

In a pilot study done in May the molasses was mixed with 8% urea, on the understanding that the mixture would be fed free choice to cattle, sheep and goats. The high concentration of urea acts as a deterrent to consumption and is advantageous nutritionally if the animals have access to dry season grazing or crop residues since both are deficient in fermentable nitrogen.

At the ILCA station at Debre Berhan the mixture was given free choice to cattle and small ruminants and intakes ranged from 1 to 2 kg/day for cattle and from 80 to 120 g/day for sheep and goats. There were no toxicity problems.

For large scale drought feeding in Ethiopia, it has been decided to reduce the level of urea to 3% mainly on the grounds of economy but also because there will be little other feed available. The amounts needed to keep animals alive are of the order of 2 kg/day for mature cattle and 100 g/day for sheep and goats. Preference should be given to cattle as small ruminants, and goats in particular, can gain access to vegetation not normally eaten by cattle. Cattle are also more important because they are needed for crop cultivation.

To ensure that the molasses/urea mixture is consumed equally by all the target animals it must be rationed on an individual basis, according to the amounts proposed above. In the Ethiopian Southern Rangelands Scheme (Sidamo) it is proposed to allow 12 kg per family every 3 days. This seems reasonable. Nevertheless careful monitoring should be done to check on the number of animals receiving the mixture; and that the procedures are followed to ensure that each animal consumes approximately the correct amount.

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\* \* \* \* \*

## **10.2 Rhodes Grass Seed Production**

Daniel Keftasa

Crop and Pasture Section, ARDU

### Introduction

In most tropical conditions adequate seed supplies of acceptable standards in terms of purity and germination of the important grasses and legumes are limited. This lack of seed places a serious constraint on efforts to raise animal productivity quickly and



effectively by increasing the land area under productive sown pastures. The need for basic information on economic and efficient seed production and processing is acute. In the last two decades several investigations on forage seed production have been carried out by ARDU (Arsi Rural Development Unit). At present seeds of Rhodes grass (Chloris gayana), Coloured Guinea grass (Panicum coloratum), Columbus grass (Sorghum almum), Sudan grass (Sorghum sudanese), oats (Avena sativa), vetch (Vicia dasycarpa) and fodder beet (Beta vulgaris) are being produced.

The main problems encountered with seed production of perennial grasses include low seed yields, and high labour requirements for harvesting and threshing which make their prices much higher than that of field crops. The purity of these perennial grass seeds is usually low when hand harvested due to presence of empty florets, shrivelled seeds, pieces of stems, etc. Rhodes grass (Chloris gayana) has been one of the most used cultivated grasses in low-medium altitudes in Ethiopia. At Kulumsa under optimal management it produces herbage yields of about 8 ton dm/ha/yr under rainfed conditions and perennates for more than 5 years without marked reduction in yield. Seed is produced at Kulumsa from the Kenyan variety known as Mbrara. The popularity of this grass is due to its good seed production, ease of establishment and creeping habit.

### 1. Establishment

The establishment and maintenance of Rhodes grass, in a fully productive state like most perennial pasture crops, calls for more skill and care than is required for field crops. A clean seed bed and uniform tilth are essential. The optimal sowing time is as early as possible after the start of rain in the short rainy season (March - April) in medium altitudes and in the big rainy season (June - July) in the lowlands. At Kulumsa sowing in the short rainy season has been preferable for better control of weeds. The optimum seeding rate is 10 kg/ha seed of 20% germinability. The seeds should be broadcast in mixture with fertilizer either by hand or by a tractor mounted spreader. The field is then compacted with cambridge roller or the seeds are covered lightly by dragging light chains or tree-branches stripped of their leaves over the field. This ensures good seed contact with the soil. The seeds of Rhodes grass are small and must not be sown too deeply otherwise the seedlings may fail to reach the surface. Sowing can be either under a companion crop or alone. If Rhodes grass is to be sown under a companion crop, the procedure is that the crop is sown and covered in the conventional manner and the grass is then oversown. From experience gained at Kulumsa barley has been most suitable crop for this purpose. The seeding rate of barley should be 20-30% less than the recommended seeding rate. The advantages of sowing the grass under a companion crop are (a) there is less competition from fast growing weeds and (b) the grain crop yields in the first season reduces the overall cost of grass establishment. The fertilizer rate used at Kulumsa is 100 kg/ha of DAP (18/46) which is satisfactory both for the companion crop and establishment of the grass.

### 2. Weed control

Sowing under a companion crop offers severe competition to the annual weeds thus making weed control easier than when it is sown in pure stand. When the grass is sown under barley, selective herbicides such as MCPA and 2, 4-D at the rate of 1 litre ai/ha are used to control broad-leaved weeds. If Rhodes grass is established alone (without a companion crop) the weeds can be mowed when they reach height of 20 - 30 cm. This practice can hinder the growth and development of young grass seedlings but rids the area of most broad-leaved weeds and suppresses annual grass weeds. Light grazing might be helpful, but care must be taken not to damage the sown grass due to trampling or uprooting of young seedlings. Hand-slashing can be employed, especially if the weed infestation is heavy and enough labour is available.



### 3. Fertilization

Nitrogen fertilization during subsequent years has been found essential for high seed production of Rhodes grass. Fertilization encourages vegetative growth and thus the number of seed producing panicles. The procedure followed for nitrogen application (top dressing) is that the sward is cut evenly just at the start of the big rainy season, (usually the end of June at Kulumsa), and fertilizer in the form of urea (46% N) is then applied by a tractor drawn fertilizer spreader. The recommended rate for Rhodes grass seed production at Kulumsa is 200 kg/ha of urea, applied in the middle of July. In some years when there is adequate rain during the small rainy season it can be possible to produce two crops of seed per year. In such case 1/3 of the annual fertilizer rate can be applied at the beginning of February and this seed crop is harvested in May.

There is no marked response to phosphorus fertilization, probably because the soils at Kulumsa have been fertilized with phosphorus for many years.

### 4. Harvesting and threshing

In common with most tropical grasses the correct harvesting time of Rhodes grass is difficult to judge since the grass produces panicles unevenly and the seed shatters as it ripens. The best time to harvest must be when the heads produced during the peak heading period are mature. The peak heading period is when the first heads produced at the initial heading start to shed their seed. At Kulumsa, Rhodes grass reaches the peak heading stage at an average of 90 days after the cleaning cut and nitrogen top dressing. The optimal harvesting time is 15 days after the peak heading stage. At this stage the initial panicles have shed seeds and the colour above the flag leaf has become light brown. Harvesting is done by hand using sickles. The harvested heads are gathered in sheaves and covered by vegetative residues to avoid shedding of seeds. Threshing is done either by hitting with sticks or by a stationary thresher. The seeds are cleaned by sieving and blowing away broken culms, florets and immature seeds. Under farm conditions at Kulumsa yields of around 1.5 qt/ha with germinabilities of 20% are commonly obtained. The yields from experimental plots are usually two to three times larger than that of large scale seed production.

Establishment costs have been about Eth.Birr 350 if established alone. This sum can be partially offset if the grass is established under barley. Production costs during the subsequent years has been Eth. Birr 400 - 500 ha/yr, the major costs being for labour during harvesting and threshing. Improvements in harvesting techniques may reduce these costs.

Since Rhodes grass has been one of the best grasses over a wide range of soil conditions in the low-medium altitude regions of Ethiopia, more research is required to improve seed production techniques.

\* \* \* \*

### 10.3. Stylosanthes hamata

John Laziér, FLAG, ILCA

The genus Stylosanthes is a very important source of tropical and sub-tropical forage germplasm for commercial cultivars have been selected from the species S. guianensis, S. scabra, S. capitata and S. humilis. S. humilis was described in an earlier advisory note (FNE no. 4, p. 14).

Stylosanthes hamata is native to Florida, the Caribbean Islands, and the Caribbean coastlines of Central and South America. Not surprisingly it varies considerably within that range. In Florida and the Caribbean Islands the plants are commonly herbaceous and non-determinant, but material from inland Central and South America (including Brazil) are erect woody shrubs. While most accessions have been collected on basic soils, some are acid tolerant.



S.hamata is commonly called Caribbean stylo and there is a commercial cultivar, Verano, which was released by CSIRO, Australia in 1973. This accession was collected in the lowlands of northern Venezuela at Maracaibo Airport in 1965 (11° N, 560 mm rainfall).

A short-lived perennial which nodulates readily with the common (cowpea) type of Rhizobium, Verano is a low growing, rather prostrate plant which may grow to 80 cm. under good conditions.

Adapted to the hot lowland tropics, it grows more slowly in highland or subtropical conditions and is most productive in areas with over 800 mm rainfall though it will grow under 600 mm. For areas with over 1200 mm rainfall there are more productive species.

Particularly adapted to better drained and sandy soils Verano tolerates low fertility, acidity, aluminium, and considerable alkalinity and salinity, but does poorly on waterlogged and black, cracking soils (Vertisols). Intolerant of shading, frost or fire the sward will often persist despite such unfavourable conditions and others, such as drought, due to its early flowering (65 to 75 days) and heavy seeding. Good seed crops will yield up to 1000 kg/ha. This combination of annual and perennial characters allows it to perennialize in better years remaining green long into the dry season and to take advantage of occasional showers.

While nutritively similar to other stylos, it is not very palatable in the wet season. This allows it to attain reasonable growth and to seed. In the late wet season-early dry season it is selectively grazed. In common with other stylos it retains its nutritive value after drying off. Animals will gain considerable nutrition from seeds licked off of the ground. Plants can persist and seedlings establish well under heavy grazing. It can also be used for hay silage. Substantial animal weight gains have been achieved by feeding Verano.

Seeds of Verano, as of all stylos require scarification before planting. Acid (conc  $H_2SO_4$ ) scarification is best as it will kill any anthracnose spores on the seed coat and thus reduce the chances of introducing the disease along with the seed. This method is not fool proof however, as the disease can also be carried inside the seed.

Verano has largely replaced S. humilis in the dry areas of Australia as it is more productive and persistent. S. humilis is badly affected by anthracnose, a serious fungal disease of stylos, while Verano can be only moderately affected.

In Ethiopia, FNE strip trials have indicated that Verano will grow and persist from Nazareth to Soddo, from 1600 m to 1050 m elevation and can persist even under the low rainfall and long dry season of 1983-84.

At Abernosa Ranch it is fairly slow growing but in 1982-83 it survived the dry season and seeded well. It was grazed out and dried off in the long 1983-84 dry season, but was the most vigorous legume in the following year when it regrew very densely from seed. The short rainy season in 1984 did not give all plots the opportunity to flower before the plants again dried off. It will be interesting to see if sufficient seed remains in the soil from 1983 to re-establish the stands in 1985.

At the Zwai Horticulture Farm in soil of pH 8, Verano does not grow as well under irrigation as does the experimental S. hamata line ILCA 167. It also suffers much more severe attacks of anthracnose. Anthracnose has not so far been seen as a serious problem of Verano under rainfed conditions.



While it can grow and persist under higher rainfall and altitude conditions in deeper, more acid soil (1000 mm, 1850 m, pH 5.8) at Soddo, Cook stylo (S. guianensis) is far more vigorous and productive.

S. hamata thus shows promise to areas of Ethiopia with mildly acid to basic soils and with a rainfall of about 800 mm.

Verano is currently showing great promise in the sub-humid zone of Nigeria where ILCA trials have demonstrated its usefulness as reserved fodder (standing hay) for productive animals in the dry season. Extensions of this management technique to farmers is currently underway.

In Gambia, the CIAT experimental line 118 (ILCA 12469) has been more promising than Verano (at 1000 - 1200 mm rainfall, 10 m altitude, 3-4 month rainy season, pH mildly acid). The FLAG programme plans to pursue the study of S. hamata in the FNE strip and replicated trials currently underway in Ethiopia, and in screening trials with a range of germplasm undertaken in co-operation with Dr. Bob Burt of the CSIRO Davies Laboratory. An S. hamata collection trip is planned in Venezuela in 1985 in co-operation with CSIRO.

ILCA currently has 30 lines of S. hamata mainly from the U. of Florida CIAT and CSIRO.

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- Burt, R. L., Rotar, P. P., Wasker, J. L., and Silvey M.W. (1983). The Role of Centrosema, Desmodium and Stylosanthes in Improving Tropical Pastures. Westview Tropical Agriculture Series no. 9, Boulder, Colorado.

\* \* \* \* \*

### **10. 4. Hydroponic Culture, A New Herbage Technology**

Alemayehu Mengistu, MOA

#### A. Introduction

Hydroponic culture is the growing of plants without soil. The word hydroponic is derived from the Greek "hydro" (water) and "panos" (work). As the word indicates mainly water is required for this type of culture, in contrast to geponic farming which requires soil.

All plants can be grown in hydroponic culture, cereals, vegetables and leguminous crops (vetch, peas, beans etc.). Up until now mostly cereals have been grown for animal feed using hydroponics.

Commercial machinery, virtually factories are available in Europe and North America which automatically grow such feeds.

Water, heat and light are the requirements for hydroponic culture. There is not much concern for the addition of fertilizer. A hydroponic pasture can be raised in eight days, one for pregermination, two for germination and five to achieve small plants. Such artificially grown feed consists of seeds, seedlings and young plants.



## B. Value as feed

Hydroponic pastures can be used to feed both ruminants (cattle, sheep and goats) and non-ruminants. The feed is of good value (about 0.3 to 0.4 UF/kg) and while most animals can be fed it without additives it is advisable to add up to 50% fibrous material (straw or poor quality hay) to add bulk to the diet and thus to aid digestion.

In sophisticated operations the feed is mixed mechanically using a grinding mill, a mixer and distribution trailer. The feed can be fed twice a day, once with natural pasture, and the second time with hay or straw. This is one method of accustoming the animals to the new feed.

Poultry feed (chickens, laying hens, ducks, turkeys etc.) requires special "premix" additives in order to raise the volume of the dehydrated hydroponic feed to the required level (2700 to 3200 cal/kg). Commercial firms prepare the "premix" to the customers needs. The resulting mixture is then granulated to allow ready distribution by feeding chains or vending trailers.

## C. Economics

Studies have indicated that feeding costs of chickens in France can be reduced by 30 to 40 % using hydroponics. This is important as feeding costs represent about 60% of the cost of production. An increase in the profit margin of 20% is thus possible.

## D. Advantages of the System

1) Only a small growing area is required to produce feed. For example a ground area of 2m<sup>2</sup> can produce 100 to 120 kg of forage a day (a day's ration for 6 to 8 cows).

2) The quality of the feed (high enzyme and vitamin A, B, C, E and proto vitamin) and digestibility is high. The high degree of sanitation of the feed increases animal productivity as well.

3) Seasonal variations in weather (drought, floods, frosts, heat) have little or no effect on feed production. The feed supply is thus assured year-round.

4) Due to the high quality of the feed the amount of concentrates used in the animals diets can be reduced. The money saved on concentrates may pay off the cost of the equipment in 3 to 5 years.

Part 2: (next issue of the FNE Newsletter).

- How a hydroponics factory works.
- Disadvantages of using a hydroponics system.

\* \* \* \*

JRL/hm

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The Forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter itself is obtained by writing to "The Editors"

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA P. O. Box 5689, Addis Ababa, Ethiopia. If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

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# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 8

August 1985

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### 1. INTRODUCTORY MESSAGE

The annual FNE field trip will visit the southern rangelands in the vicinity of Yabello where the Ministry of Agriculture's Rangelands Development Project is doing cooperative research with the ILCA Ethiopian Rangelands Programme.

On the way to the southern rangelands the group will visit the Ministry of State Farms, Horticulture Division - ILCA forage seed multiplication site at Zwai, the MOA - ILCA research site at Abernosa Ranch, IAR forage research at Awassa, and in Sidamo, on MOA model dairy farm.

Due to the distances to be travelled the field trip will be longer than previous years. Participants will meet at ILCA at 7 a. m. on Wednesday October 2 and will return to Addis on Sunday October 6.

Those wishing to participate in the field trip must inform the FLAG secretary at ILCA by telephone, (18-32-15, Extension 228) or mail by September 15. The numbers to participate in the trip will depend on the number of bus seats ILCA is able to arrange and the accommodation available in the southern rangelands.

The Steering Committee will make every effort to have as many places as possible available and to find places for at least one representative of each organization and institution wishing to participate.

(Editors: Alemayehu Mengistu, John Lazier)



## 2. MOA - ILCA - FNE RESEARCH AT SODDO, WOLAYTA

The Wolayta area, one of the most densely populated areas in Ethiopia, with 250 to 500 people per square km, is an area of particular interest to the agronomist due to its intensive agriculture. With farm sizes averaging 0.5 ha considerable inter-cropping is practiced and almost everything that grows on the farm including weeds, is used.

The region is on the medium altitude (1500 - 2000 m), medium rainfall (1100+ mm) western plateau of Ethiopia, on moderately acid soils (pH 5.5 - 6.0) which are deep, and have a good texture for cultivation. They are low in P, as are most tropical soils, and as well, are easily erodable. The dry season, 5 to 6 months, is not extreme, and water storage in the deep soil profiles allows growth to continue for more than a month into the dry season. In some years occasional showers assist growth in the dry season.

Livestock in the area are mainly cattle. These are a major source of nutrition in the form of milk and butter, and cash when the animals or this produce is sold. They are also essential for land cultivation. Grazing is limited in the area, being confined mainly to eroded areas which are unsuitable for farming, and old lake bottoms which have infertile waterlogged grey soils. A small grassed ceremonial patch in front of each house is also available for grazing. Due to the lack of grazing, animals are frequently confined within the houses and are hand fed with crop weeds, crop residues, browse (mainly Erythrina sp.) which is grown about the house or property lines, and wild herbs and legumes.

The FNE became involved in the area in 1983 through one of its member organizations, the French funded Wolayta Rural Education Programme (WREP) which with the assistance of the Forage Legume Agronomy Group (FLAG) of ILCA planted a range of commercial and experimental lines of tropical and sub-tropical grasses and legumes in small observation plots, and a number of small strip trials in farmer and peasant associations, under coffee and ensete, in native pastures, on eroded and waterlogged sites and inter-cropped with maize.

Growth was excellent in the introduction plots, with most lines performing well. Lotononis bainesii was particularly aggressive; stylo lines were quite productive, particularly Cook stylo (Stylosanthes guianensis). Leucaena leucocephala cvs Cunningham and Peru grew but rather slowly. Peru was better adapted.

The Cook stylo inter-cropped with maize grew well and provided farmers with leguminous cut and carry forage in the first dry season. The original plantings were inter-planted with maize during the 1984 growing season, and more forage was provided after the second season as the stylo plants were much larger.

Strip trials on the waterlogged soils failed due to water standing on the trial sites; in the eroded area some Stylosanthes species persisted despite lack of management of the site.

Desmodium intortum has performed very well under coffee and ensete for two years despite heavy shade, providing farmers with more, and higher quality annual fodder than the weeds which normally grow there.

The native pasture strip trial turned out to be planted in an area reserved for thatching, which is not grazed until after the thatching is removed in the dry season. Again Cook stylo was the most successful line, producing for the last two years a few stemmy plants which competed with the flowering grass. In 1985 there



are masses of stylo seedlings in the original furrows of the trial, under the tall grasses.

The success of the tropical and sub-tropical species in these plantings and the termination of the WREP agronomy programme in the area prompted the MOA in early 1984 to encourage discussions between FLAG and Ato Eshetu, the General Manager of WADU (the Wolayta Agriculture Development Unit) on the feasibility of a joint research programme being initiated on the 350 ha WADU research station.

The advantages to such research were:

1. The re-establishment of agronomic research on WADU.
2. The identification of productive forages for the WADU dairy herd.
3. The identification of adapted forages for local farmers, cooperatives and associations.
4. The programme would bring to WADU ILCA livestock expertise as well as other world class experts who would visit the site, through ILCA.
5. An extension of FNE - MOA - ILCA research activities to a region of great agronomic potential, the medium altitude western plateau of Ethiopia which had received little forage research attention previously.
6. The area is similar to much of medium altitude East Africa so allows ILCA to do research for part of its area of responsibility.
7. The WADU training centre would permit courses for national and international forage researchers, to be run jointly by MOA, FNE and ILCA.

In early 1984 an exchange of letters between ILCA and the MOA gave ILCA 5 ha of land on the research station and the use of one house in order to implement the programme, for 5 years.

All three organizations WADU, MOA and ILCA participated in and agreed on the land which was to be provided for the trials.

In the early rains of 1984 the WADU house was repaired by ILCA and the following established by the FLAG post-doctorate, Dr. Mopoi Nuwanyakpa:

1. An FNE strip trial (0 and 10 kg/ha P) with 67 lines of legumes.
2. An FNE 11 legume replicated grass-legume mixture yield trial.
3. Cook stylo seed production (0.3 ha).
4. An inter-cropping trial of Lablab purpureus in maize.
5. A browse evaluation trial (86 species, 102 lines).

The trials were taken over by the FLAG Research Assistant Mr. James Ochang, on his return from a course in Australia in early August. Despite the late period in the rains about 200 introduction/evaluation plots were established with a wide range of legume species to identify adapted material.

The FNE strip and 11 legume yield trials, the Cook stylo seed production and the introduction/evaluation plots all grew well despite the unusually short rains of 1984. Germination in the browse trial was poor due to deep planting, and the maize - lablab trial had very irregular growth due to variations in soil fertility. The WREP farmer strip trials were visually monitored during 1984.

During 1984 the WADU station became part of the responsibility of the regional agricultural office at Awassa.

With the programme well established MOA station staff, and the Station Director at the time, Ato Shewalule Tessema visited the trials and during discussions



suggested research which would be of value to the station.

- 1) Screening of Lablab purpureus lines.
- 2) Screening of grass germplasm.
- 3) Identification of species adapted to waterlogged soils.
- 4) Expansion of the species and area adapted to forage seed production.
- 5) A trial to assess if Cook stylo or alfalfa is the most productive hay species.

The 1985 planting programme on the 5 ha site thus includes as cooperative MOA Soddo - ILCA work:

- 1) Introduction/evaluation plots of 53 lines of Lablab.
- 2) Introduction/evaluation plots of a wide range of grasses.
- 3) A grass strip trial with 2 fertilizer rates.
- 4) A waterlogged area strip trial with legumes and grasses on the flat and on ridges.
- 5) A replicated Cook stylo - alfalfa yield trial.
- 6) A further 1 ha of seed production planted with 4 legumes. All seed production sites will be turned over to the MOA once they are established.

Other work on the site in 1985 includes:

- 1) The basic ILCA introduction/evaluation programme which has been greatly expanded to over 1000 lines.
- 2) Seed multiplication of over 200 promising lines (25 m<sup>2</sup> plots).
- 3) The browse trial has been expanded and replanted.
- 4) In cooperation with the MOA, planting of Cook stylo, Desmodium intortum and Macroptilium axillare were done for seed production and for fodder in pure stand, and inter-cropped on some 9 sites in the region by local farmers.

Research at the Soddo site has thus greatly expanded in 1985 and the results so far are very promising that productive legumes will be found which will increase fodder productivity in small farmer operations not only in Ethiopia but as well in similar environments through out East Africa.

A cooperative MOA - ILCA - FNE forage training programme has been initiated in which forage workers will have the opportunity to get hands-on experience with tropical and sub-tropical forages at the research station. The programme commenced with the provision to the FLAG programme of a second house which will be a combined hostel/guest house. It is planned to train MOA, IAR and other Ethiopian staff as well as researchers from other countries.

The MOA and ILCA will run a joint field day on August 31, 1985 at the research station to give Headquarters, zonal and regional MOA and planning commission staff the opportunity to see the research. Representatives of local peasant associations and cooperatives will be attending as well.

The 1986 programme on the station is currently being developed through discussions between the MOA and ILCA.

Collaborators from MOA - MOA - ILCA - FNE Research:

- Headquarter level - Ato Alemayehu Mengistu (Senior Pasture Agronomist)
- Regional level - Wzt. Tsehay Reda ( Junior Pasture Agronomist)
- Awarja level - Ato Seifu Mekonen (Livestock Extension Officer)

Collaborators from ILCA - MOA - ILCA - FNE Research

- Headquarter level - Dr. John R. Lazier (Senior Pasture Scientist)
- Regional level - Mr. James Ochang (Research Assistant)

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### 3. ALFALFA IN SYRIA

Dr. Walid M. Sarraj\*

Although the majority of the population in Syria and other Middle East countries is basically engaged in agriculture and livestock production, the need for food and forages is increasing from year to year.

Syria has been establishing large areas of irrigated agriculture along the Euphrates River where the environment is favourable to the production of high yielding forage crops. Alfalfa (*Medicago sativa* L.) is seen as an important Syrian forage crop due to its high quality, excellent yields, adaptation to a range of climatic and soil conditions, flexibility in use, its ability to improve physical soil properties and its ability to fix atmospheric nitrogen.

Cultivation of alfalfa in Syria is spreading, especially in Damascus, Deir Alzor, Hasaka, Homs, Hama, Daraa and Idlib provinces, where sheep and cattle breeding are the occupation of thousands of villagers and steppe tribesmen. Livestock contributes 35% to the total value of agriculture, where 28% of the total area is arable land, and 46% is permanent pasture land (Ansari and Hussain Saha, 1983). About 4000 ha of alfalfa is currently grown under irrigation giving good yields for 3 to 5 years; none is grown under rainfed conditions except for research purposes. Seed sells for 40 Syrian Pounds/kg. While the national average forage yield is still less than 41 t of fresh material/ha (Anonymous 1981) some foreign alfalfa cultivars have proved to be promising, producing in the case of Cyprus Loc. (Cyprus) and Jijazi (Sudan), 118.9 and 114.3 t of green forage respectively. Four cultivars, Cyprus, Hijazi, Cargo (U. S. A.), and Salton (U. S. A.), have been found to be non-dormant in winter, and so can supply forage all through the year (Sarraj, 1984).

The International Center for Agricultural Research in the Dry Areas (ICARDA) had a research program on rainfed alfalfa from 1978 until 1982, but achieved little success because of i) insufficient dry matter yield (1505-2494 kg/ha/year from second year alfalfa); ii) impractical agronomic practices in field experimentation; for instance experiment No. 5 (ICARADA, 1981) was devoted to studying the effect on yield of clipping heights of 5, 10, 15, and 20 cm. First of all, it is well known that optimal alfalfa cutting heights range between 5 - 10 cm and this range of cutting heights is followed all over the world, with 8 cm considered the best cutting height. As well, cutting at 15 and 20 cm is impractical because the farmer will find very little material to harvest, and that is what actually happened, iii) seed production problems (Somaroo and Ceccarelli, 1981).

Good seed yields have been obtained from alfalfa during the last cropping season, 1983-84, on second year alfalfa, when the cultivar Moapa produced three seed yields per season with an extra forage cut in the winter. The first seed harvest was under rainfed conditions and yielded 221 kg/ha, while the second and third were under supplementary irrigation and yielded 271 and 43 kg/ha respectively giving a total of 535 kg seed/ha for the season (Sarraj, unpublished). It is worth mentioning that the third harvest was seriously affected by early autumn rains. There is a need to continue this trial in the future with special emphasis on the identification and activities of native pollinators.

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Persistence of alfalfa under simulated farmer's management in rainfed areas is under trial. The seeding rates for both rainfed and irrigated alfalfa are also being studied, using sowing rates of 12, 16 and 20 kg/ha. Two years data are available now and are currently being analyzed at ICARDA's Computer Service.

In 1983 an evaluation program was initiated by the author to select promising alfalfa cultivars that i) grow and produce good quality hay and green forages either under supplementary irrigation or under irrigation in the arid and semi-arid regions of Syria, ii) persist under rainfed conditions in the semi-arid and semi-humid regions, iii) produce high seed yields from the same stand, iv) perform well in mixed pasture stands with perennial grasses and v) tolerate pests and diseases. The work is being conducted mainly at the Science and Agricultural Research Center (SARC), 35 km south of Aleppo, at latitude 36.05 and longitude 36.55. The site has a mainly continental climate with hot, dry summers and cold wet winters, 350 mm rainfall, mostly distributed in a six month wet season, and a mean annual temperature of 17.4 C. The research program includes 41 alfalfa cultivars from U. S. A., Australia, FAO., France, the Soviet Union, Syria, Turkey, Sudan, Saudi Arabia, Iraq, Cyprus, Argentina, Lebanon and Iran. Most were yield-tested in Aleppo and Hama provinces (semi-arid 350 mm), Rakka province (arid zone 120 mm), and Idleb province (semi-humid zone 450 mm). Seed of the selected cultivars is being multiplied and observations will continue for another two years under rainfed, as well as irrigation conditions in Aleppo, Idleb, and Rakka provinces.

Identification and evaluation of alfalfa pests and diseases have been conducted mainly by ICARDA (Mamluk *et al.*, 1983) and (Masri *et al.*, 1983), and by the author on mole-rat damage (Sarraj, *in press*). There is still a gap in information relating to nitrogen fixation by alfalfa plants, which must be studied in relation to variety, location and cutting management. Research work on alfalfa mixtures with grasses is also needed in different ecological zones, with special emphasis on full mechanization of the crop for hay-making and seed production.

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#### 4. DO MINOR LEGUME CROPS HAVE A PLACE IN ETHIOPIAN FARMING SYSTEMS?

John Lazier\*

The drought in Ethiopia appears to have ended with the rains of 1985. However despite reasonable rainfall this year there will be considerable human distress until the crops are harvested and food is once again available on farms.

In Wolayta, the early rains in 1985 were erratic in many areas leading to poor yields of early sown, early maturing crops such as haricot beans.

I would like to suggest that there are legume crops which might be grown in the area which could provide food during unexpected dry periods and in this article I will describe several minor legume crops and suggest how they may fit into farming systems in Wolayta.

##### A. Annual beans

###### 1) Tepary Bean (Phaseolus acutifolius)

A small bushy plant from arid and semi-arid areas of North America, P. acutifolius has been domesticated for several thousand years. It requires ample moisture to germinate and to grow until flowering but thereafter little or no rain is required to produce a crop. Water from a single rain or flood is sufficient to complete the life cycle if the soil is deep, and yields of 1 to 2 t/ha are achieved with fertilizer and moderate irrigation. High rainfall reduces crop yields. The beans have a high protein content and make excellent human food and the foliage is high quality fodder. Two drawbacks for food production is that they require longer cooking than normal beans, and they induce flatulence (wind).

ILCA has 121 lines of P. acutifolius, some of which have been it has grown on 25 m<sup>2</sup> plots at Zwai under irrigation. Yields as high as 1100 kg/ha were achieved. A few lines were planted at Soddo in Wolayta at the end of the rainy season which grew well.

Tepary beans may have a place as an emergency crop, planted with the first rains which, if rainfall was poor would still be likely to produce a reasonable yield and thus help maintain farmers until the main rains, and the maturation of year's major crops. Tepary beans could be inter-cropped with maize or sorghum and if these crops were retarded, a good crop of beans could be harvested. If the main rains were adequate and vigorous growth of the main crop shaded that of the tepary beans, it would be important only to have the quantity of seeds planted returned by the tepary crop.

Similarly if the main rains appear to be giving poor yields of the major crops, the beans could be planted late and inter-cropped, or planted in pure stands near the end of the rainy season as a fast-maturing catch crop.

2) Phaseolus acontifolius (the moth bean) is a small leguminous bean plant, similar to tepary bean, which is an important crop in India. It matures in 2 to 3 months and is planted as a catch crop at the end of the growing season. It is valued for its edible beans and high quality forage. It is known to grow well as high as 1500 m but requires high temperatures.

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\* ILCA, FLAG Programme



## B. Perennial tuberous vines

A second group of minor legume crops are perennial vines which have edible high-protein tubers. The vines can be cut for fodder in normal years and the tubers can be used as emergency human food during periods of drought. They can be grown along fence lines, or interplanted in open areas among such crops as coffee and ensete.

1) The African yam bean (*Sphenostylis stenocarpa*) has edible tubers as well as edible seeds. It requires a humid environment and well drained soils, and can grow well at altitudes of up to 1800 m. While its fodder value has not been reported it is likely that as the seeds are edible; the leaves should make good fodder.

2) *Vigna vexillata*, is best known as a vigorous, perennial fodder plant which is adapted to acid soils, reasonable rainfall (1200 mm) but is tolerant of severe dry seasons. This plant also produces edible tubers.

3) Wing bean (*Psophocarpus tetragonolobus*), this well publicised vigorous vine from New Guinea has edible leaves, shoots, flowers, pods, seeds and tubers.

4) The yam bean (*Pachyrhizus erosus*, *P. tuberosus*) and *P. vernalis*. These American species produce a large fleshy high-protein root at altitudes of up to 2000 m in a great range of environments. The foliage and seeds are not edible by humans but may be useful for forage. They are widely grown in Central America, China, Philippines and Indonesia where crops can mature in 3 months. Yields of 80 to 90 t/ha have been reported.

ILCA has seed in its collections of lines of all of these species, except the African yam bean.

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## 5. FNE TRIAL PROTOCOLS 1985

### 5.1. African *Trifolium* Initial Evaluation Strip Trial

#### Introduction

In 1983 and 1984 the ILCA, FLAG unit screened and multiplied several hundred lines of annual African *Trifolium* species in unreplicated strip trials at ILCA headquarters, Shoa, Addis Ababa (2400 in altitude, 1100 mm rainfall). The more productive of the lines in the 1983 trial were planted in a replicated yield trial in 1984.

The FNE Steering Committee agreed that breadth of adaptation of these species and their relative vigour require testing through FNE multilocation trials.

Sites: Holetta, IAR; Sheno, IAR; Kulumsa ARDU; Gobe ARDU; Debre Berhan, ILCA

#### Design

The trial consists of cultivated strips which are 50 cm wide and 7.5 m long. The distance between strip centres is 1 m. The 0.5 m between the cultivated strips may be left as natural vegetation in order to reduce erosion and to provide easy access to the trial in wet conditions.

In order to have the trial more rectangular rather than long and narrow, two rows of strips are planted 1 m apart.



As there may be soil variations, a control strip, in this case Trifolium quartinianum ILCA 8301, is planted in each fifth row, and in a 50 cm wide cultivated strip around the trial at a distance of 1 m from the strips. A 2 m wide boundary is maintained about the perimeter control strip.

### Species and planting

The species in the trial are given in table 1. The contents of each legume seed package (1.0 g) should be sown in a line down the middle of each strip, into a well prepared, uniform seedbed. The seeds should be planted no deeper than their own diameter in the soil. The planted row should be compacted by walking along it, or on a board placed on top.

### Fertilizer

The strip will be divided into three 2.5 m sections, each of which will receive a different fertilizer rate: 0, 10, 40 kg/ha P applied as TSP, before planting.

| P  | TSP<br>kg/ha | TSP<br>2.5 m <sup>2</sup> plot (g) |
|----|--------------|------------------------------------|
| 0  | 0            | 0                                  |
| 10 | 55           | 14                                 |
| 30 | 165          | 41                                 |

The fertilizer will be applied to each strip separately. The area will be then 2.5 m<sup>2</sup>, (2.5 m long and 1 m wide, 0.5 m on either side of the strip). The fertilizer should be weighed in a small vial or jar and the volume marked so that it can be applied by volume to each plot.

### Management

The planted lines and tilled areas are kept weeded. If necessary, the grass in the areas between the strips is cut by hand or mower periodically. The plot will be fenced, and chicken wire will be used to keep out rabbits, warthogs etc.

### Observations

These will be done at three weekly intervals using standard ILCA annual observations (Sheet 1). Flowering will be observed each 1 to 3 days.

### Seeds

Seeds produced by the treatments of each line will be harvested and weighed, before bulking for each accession.

### Reporting

Copies of the observation sheets can, if desired be sent to the FLAG programme, Addis so that a running analysis can be done on the results.

Detailed weather data, and soil samples and analysis will also be needed to assist analysis of the results.

Weather data should at least include daily rainfall measurements. Daily maximum and minimum temperatures would also be useful.



Soil samples should be taken before planting. Ideally these would include 30 random samples from the following soil layers 0-15 and 15-30 cm; and 15 samples from 30-45 cm and 45-60 cm. Samples for each level should be combined, mixed thoroughly and a 500 g sub-sample, analyzed texturally and chemically (pH, CEC, TEB, N, P, K, Ca, Mg, Na).

#### Nodulation

Three plants of each line selected at random should be dug out of the soil, retaining as much of the soil as possible. The roots should be gently washed and the number of viable nodules (pink centres) should be counted.

**TABLE 1**  
**Species in trial**

|     | <u>Species</u>                  | <u>ILCA</u> | <u>Flowering</u> |
|-----|---------------------------------|-------------|------------------|
| 1.  | <u>T. quartinianum</u>          | 9379        |                  |
| 2.  |                                 | 10059       | Early            |
| 3.  |                                 | 8540        | Late             |
| 4.  |                                 | 7675        | Late             |
| 5.  | <u>T. decorum</u>               | 9431        | Early            |
| 6.  |                                 | 5795        | Early            |
| 7.  |                                 | 9682        | Medium           |
| 8.  |                                 | 9437        | Late             |
| 9.  | <u>T. rueppellianum</u>         | 9690        |                  |
| 10. |                                 | 6229        | Medium           |
| 11. |                                 | 11552       | Early            |
| 12. |                                 | 10152       | Late             |
| 13. | <u>T. studneri</u>              | 9720        |                  |
| 14. |                                 | 10139       | Medium           |
| 15. |                                 | 9712        | Early            |
| 16. |                                 | 10111       | Medium           |
| 17. | <u>T. tembense</u>              | 5774        |                  |
| 18. |                                 | 9681        |                  |
| 19. |                                 | 8635        | Early            |
| 20. |                                 | 10205       | Late             |
|     | Control: <u>T. quartinianum</u> | 6301        |                  |

## 5.2 Medicago sativa initial evaluation, strip trial

### Introduction

ILCA has been screening perennial temperate legumes at its headquarters site at Shola, Addis Ababa (1100 mm rainfall, 2400 m altitude) for the past three years on a Vertisol and for the past two years on an Alfisol.

Of the broad range of species tested the alfalfa (Medicago sativa) lines were consistently the most productive. On the Vertisol cvs Salton, Moapa, CUF 101, ILCA 5679, and Hunter River performed best. On the Alfisol a wider range of germplasm was planted and, cvs Cargo, CUF 101, and ILCA 5689 showed best vigour. The FNE Steering Committee agreed that these should be tested more broadly in Ethiopia along with several new disease and pest resistant cultivars.

American and European lines of alfalfa have been developed for hay production. They have high crowns and high productivity under good fertility. Australia cultivars



on the other hand are developed for grazing under low fertility and low levels of management. They have low crowns and are thus resistant to grazing. Yields are lower than for hay lines. Performance of alfalfa lines should thus be judged in relation to the situation in which they will be used.

Sites: Holetta, IAR; Kulumsa, ARDU; Debre Zeit, ILCA.

#### Design

The trial consists of cultivated strips which are 50 cm wide and 7.5 m long. The distance between strip centres is 1 m. The 0.50 m between the cultivated strips is left as natural vegetation in order to reduce erosion and to provide conditions similar to that of a pasture sward.

As there may be soil variations, a control strip, in this case Medicago sativa cv. Hunter River is planted in each fifth row, and in a 50 cm wide cultivated strip around the trial at a distance of 1.0 m from the strips. A 2 m wide boundary is maintained about the perimeter control strip.

**TABLE 1**  
**Species in trial**

|     | <u>Cultivar</u>       | <u>ILCA</u> | <u>Source</u>             |
|-----|-----------------------|-------------|---------------------------|
| 1.  | Salton                | 5682        | America                   |
| 2.  | CUF 101               | 5681        | America                   |
| 3.  | Cargo                 | 5683        | America                   |
| 4.  | Moapa                 | 5680        | America                   |
| 5.  | WL 318                | 14175       | America grazing resistant |
| 6.  | WL 514                | 14176       | America grazing resistant |
| 7.  | Siriver               | 5682        | Australia                 |
| 8.  | Sheffield             | 9237        | Australia                 |
| 9.  | Hunterfield           | 9236        | Australia                 |
| 10. | Trifecta              | 9239        | Australia                 |
| 11. | Wakefield             | 9235        | Australia                 |
| 12. | Springfield           | 9238        | Australia                 |
| 13. | Paravivo              | 5658        | Australia                 |
| 14. | Hairy Peruvian        | 6752        | Australia                 |
| 15. |                       | 5661        | ?                         |
| 16. |                       | 5679        | Syria                     |
|     | Control: Hunter River | 6984        | Australia                 |

#### Species and planting

The species in the trial are given in Table 1. The contents of each legume package (0.5 g) should be scarified with sand paper mixed with the inoculum and sown immediately in a line down the middle of each strip, into a well prepared, uniform seedbed. As the seeds are in very small quantity they may be mixed with sand or fine soil to aid uniform planting. The seeds should be planted no deeper than their own diameter in the soil. The planted row should be compacted by walking along it, or on a board placed on top.

#### Fertilizer

The field strips will be divided into three 2.5 sections, by pegs, or a string which is put down when fertilizer is applied. Each section will receive a different



fertilizer rate: 0, 10, 40 kg/ha P initially applied as TSP, and the same amount in 4 split applications annually (after alternate observations).

The fertilizer will be applied to each strip separately. The area will be then 2.5 m<sup>2</sup>, (2.5 m long and 0.5 m on either side of the strip). The fertilizer should be weighed in a small vial or jar and the volume marked so that it can be applied by volume to each plot.

| P  | TSP<br>kg/ha | TSP<br>2.5 m <sup>2</sup> plot (g) |
|----|--------------|------------------------------------|
| 0  | 0            | 0                                  |
| 10 | 56           | 14                                 |
| 40 | 222          | 56                                 |

### Management

The planted lines are weeded for the first year until well established, then only the taller weeds are removed for neatness. If necessary, the grass in the areas between the strips will be cut by hand or mower periodically. The plot will be fenced, and chicken wire should be used to keep out rabbits, porcupines etc. Particular care will have to be taken to keep out porcupines which will dig up the roots of each alfalfa plant, and moles. Initially the trial will be cut at 2.5 cm in the dry season when all vegetation has dried off.

### Observations

These will be done at six weekly intervals using standard ILCA perennial observation sheets (Sheet 2). Particularly close attention will be paid to pests and diseases and every effort will be made to identify these if they have a serious effect on plant productivity.

Attention will also be paid to flowering and seeding, as it has been reported that lines currently being tested in Ethiopia seed poorly. Since alfalfa is an out-crossing plant any seeds produced will be mixtures of lines and thus can be discarded.

### Reporting

Copies of the observation sheets can, if desired be sent to the FLAG programme, Addis so that a running analysis can be done on the results.

Detailed weather data, and soil samples and analyses will also be needed to assist analysis of the results.

Weather data should at least include daily rainfall measurements. Daily maximum and minimum temperatures would also be useful.

Soil samples should be taken before planting. Ideally these would include 30 random samples from the following soil layers 0-15 and 15-30 cm; and 15 samples from 30-45 cm and 45-60 cm. The samples for each level should be combined, mixed thoroughly and a 500 g sub sample analyzed for sand, silt and clay content and such chemical analysis as pH, CEC, TEB, N, P, K, Ca, Mg, Na.

### 5.3 FNE Replicated Grass-legume Mixture Trials

Following on from last year's replicated yield trials of the most promising grass and legume accessions, the next step in the screening and evaluation procedure



is to test an even further refined set of accessions in grass-legume mixtures. This is the stage which begins to approximate a pasture combination. With these trials the Steering Committee have planned a series of legume and grass mixtures which are likely to be suitable for a range of sites in the highland and mid-altitude zones. At this stage the trials are oriented towards cut and carry or hay production rather than a grazing resource. Therefore interpretation of the data should be made for that form of use and may not be applicable for a grazed situation.

The trials are all based on a randomised block design of three phosphorous fertility levels, six grass-legume combinations and 3 replications. The fertility levels used will be  $P_0$  = zero P,  $P_1$  = 10 kg P and  $P_2$  = 40 kg P per hectare. Plot size is 2 m x 3 m.

### 5.3.1 High Altitude Trials (> 2400 m)

|        |              |          |      |
|--------|--------------|----------|------|
| Sites: | Debre Berhan | (2900 m) | ILCA |
|        | Gobe         | (2800 m) | ARDU |
|        | Holetta      | (2400 m) | IAR  |

### Species planted

| <u>Species</u>                                       | <u>ILCA No.</u> | <u>kg/ha</u> | <u>g/plot</u> | <u>D. Berhan</u> | <u>Gobe</u> | <u>Holetta</u> |
|------------------------------------------------------|-----------------|--------------|---------------|------------------|-------------|----------------|
| <u>Grasses</u>                                       |                 |              |               |                  |             |                |
| <u>Festuca arundinacea</u><br>(Demeter)              | 5732            | 6            | 36            | X                | X           | X              |
| <u>Phalaris aquatica</u><br>(P. tuberosa) cv Sirocca | 12749           | 6            | 36            | X                | X           | X              |
| <u>Trifolium quartinianum</u>                        | 6301            | 3            | 1.8           | X                | X           | X              |
| <u>Trifolium temense</u>                             | 5774            | 2            | 1.2           | X                | X           | X              |
| <u>Trifolium semipilosum</u><br>cv Safari            | 6235            | 1            | 0.6           | X                | X           |                |
| <u>Trifolium rueppellianum</u>                       | 9690            | 1            | 0.6           |                  |             | X              |
| <u>Medicago sativa</u> cv Hunter<br>River            | 6984            | 5            | 3.0           |                  |             | x              |

N.B. These rates may need modification depending on the viability of the seed.

### 5.3.2 Medium Altitude Highlands Trials (< 2400 m)

|        |            |          |      |
|--------|------------|----------|------|
| Sites: | Debre Zeit | (1800 m) | ILCA |
|        | Kulumsa    | (2200 m) | ARDU |
|        | Bako       | (1650 m) | IAR  |



### Species planted

At all 3 sites (Debre Zeit, Kulumsa, and Bako) the species will be the same.

| Grasses                                                                                                       | ILCA | kg/ha | g/plot |
|---------------------------------------------------------------------------------------------------------------|------|-------|--------|
| <u>Chloris gayana</u> cv Pioneer                                                                              | 6627 | 6     | 3.6    |
| <u>Panicum coloratum</u> cv Bambatsi                                                                          | 7153 | 6     | 3.6    |
| Legumes                                                                                                       |      |       |        |
| <u>Desmodium uncinatum</u> cv Silverleaf                                                                      | 6765 | 5     | 3.0    |
| <u>Stylosanthes guianensis</u> cv Cook                                                                        | 4    | 3     | 1.8    |
| <u>Medicago sativa</u> cv Hunter River                                                                        | 6984 | 5     | 3.0    |
| ( <u>Leucaena Leucocephala</u> cv Peru)<br>additional except Debre Zeit which has<br><u>Sesbania aculeata</u> | 71   | 8     | 4.8    |

N.B. These rates may need modification depending on the viability of the seed.

#### 5.3.3 For both trials

##### Planting

For planting each combination of grass x legume (2 grasses x 3 legumes = 6 combinations) seeds will be mixed before sowing and planted in rows 20 cm apart and approximately 1 cm deep, covered, and the soil pressed down by lightly treading the ground. The rows should be oriented at right angles to the slope. Fertilizer should be applied before planting.

| Fertilizer rates | P rate (kg/ha) | TSP rate (kg/ha) | Plot rate TSP (g) |
|------------------|----------------|------------------|-------------------|
| P <sub>0</sub>   | 0              | 0                | 0                 |
| P <sub>1</sub>   | 10             | 47               | 28                |
| P <sub>2</sub>   | 40             | 190              | 114               |

Fertilizer will be applied evenly to the surface of each plot. This should be done prior to planting and raked into the soil when in a reasonably dry condition.

##### Maintenance

Weeding as required. Where this involves wild Trifolium this should be carefully supervised until the personnel are fully familiar with the appearance of the planted species. Where possible weeding should be by means of cutting, rather than putting out, to minimize disturbance.

##### Sampling

Sampling should be done at least twice during the season.

- (a) Initiation of maturity - start of grass elongation/early flowering of legumes.
- (b) Late maturity - beginning of senescence/100% flowering.

Following maturity and seed set the plots should be cut back to a uniform height.



## Observations

1. Use the standard ILCA perennial observation sheet (Sheet 2a) for recording plant attributes - columns 3 - 15 for the legume species and columns 16 - 18 for the associated grass. Finally column 19 for ranking the components of the mixture, namely sown grass = 1, sown legume = 2, and other species, weeds etc. = 3, and column 20 for forage yield. The observations should be taken every 6 weeks for all attributes.

2. Procedure for estimating composition: Estimate the proportions of sown grass, sown legumes and other species for each plot using a quadrat of 50 cm x 50 cm dimensions placed so that it represents an average situation for the whole plot. The procedure for this is by ranking the components of the mixture. In column 19 rank or order the three components of the grass/legume mixture in decreasing order of their apparent quantity. For example where the sown grass is predominant in terms of bulk, the sown legume is next and other species next the ranks would be within 1, 2, 3 in column 19. In another case where legume is first, grass is second and other species third the ranks would be written 2, 1, 3.

3. Determining yield: Determine yield by cutting the quadrat which has just been ranked. The cutting height should be at the level of the base of the green material (i. e. do not harvest dead material at the base of the plant, but if it is green to the very base, cut at the very base). Put material in labelled paper bags and dry for 24 hours in an oven. If this is not possible air dry the material in the sun until it achieves optimum dryness. Indicate on the sheet air dry or oven dry. Weigh the dried sample and enter the weight in column 20.

## Reporting

Copies of the observation sheets can, if desired be sent to the FLAG programme, Addis so that a running analysis can be done on the results.

\* \* \* \*

## **6. NEWS AND NOTES**

- 6.1 Ato Daniel Keftasa of ARDU will be working at ILCA during August - September on the analyses and write ups of the FNE 1984 multilocation trials.
- 6.2 Ato Solomon Demeke has been appointed by the Dean of the Jimma Junior Agriculture College as their representative on the Steering Committee of the FNE. The College plans to establish a legume and grass rainfed strip trial during 1985.
- 6.3 Ato Tadesse Tekle Tsadik of the Forage Section, IAR, Holetta returned from ICARDA Syria, on June 10, 1985. Tadesse attended a 3 months training course on forage production.
- 6.4 Ato Solomon Mengistu of FLAG is collecting forage germplasm, particularly highland Trifolium species in Tanzania from July to September.
- 6.5 Tony Russell-Smith of FLAG has returned from the UK where he was doing preparatory work for his Ph.D. and was on leave, from May through July.



- 6.6 The second part of the article "Hydroponic culture, a new forage technology" which was promised by Ato Alemayehu Mengistu for this issue of the FNE has been delayed until the next issue as he has been too busy to write it.

\* \* \* \*

## 7. ADVISORY NOTES

### 7.1 *Lablab purpureus*

John R. Lazier\*

*Lablab purpureus* (L) Sweet was formerly known as *Dolichos lablab*, and thus it is commonly called lablab or dolichos.

A viney or erect bushy annual or short-lived perennial legume, lablab is widely grown in the tropics, particularly in Africa where it is an important human food and fodder plant. As it has great genetic variability and a wide range of uses it has great potential for African farming systems.

Young pods, flowers, leaves and sprouts can all be eaten. Seeds are consumed cooked, either directly, as bean cake, or fermented, and can be used to make a protein concentrate.

Cattle, sheep, goats and pigs find lablab palatable, particularly at a young stage when its protein content is high, (equivalent to alfalfa, though less digestible). It can be made into silage and grows in combination with grasses, improving pasture quality and digestibility.

Due to its N fixing ability and ability to cover soil rapidly, it is used as a green manure crop, in rotation with other crops such as rice, as a cover crop in plantations such as coffee, or inter-cropped with maize in soil erosion control.

The plant is somewhat similar to cowpea *Vigna unguiculata* and like cowpea its morphology is quite variable as it may be viney with stems up to 6 m long or small and bushy, growing 50 cm or less. Trifoliate, with leaves that are usually large, broadly oval, and flowers (white, blue, purple) on racemes on elongated pedicels; most genotypes are short day plants. Pods contain 4 to 6 seeds, are scimitar shaped and retain the persistent style as a beak. It may be an annual, perennial or short lived perennial. It is believed to be out-crossing.

#### Adaptability

Lablab is a sub-tropical to tropical crop (22° - 35°C) with rapid growth reported above 29°C but still showing some growth at temperatures as low as 3°C. It has a low tolerance for frost. Its deep rooting habit (up to 2 m) allows it to persist in arid areas with rainfall from 200 to 450 mm where there are deep soils; however it does best under higher rainfall regimes (750 to 2500 mm).

Tolerant of a range of soil textures (sands to heavy clays) and a wide range of pH (4.4 to 8) it is intolerant of flooding and salinity preferring loamy, well drained soils.

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\* ILCA, FLAG Programme



While lablab nodulates with cowpea strain rhizobia, specific strains for lablab are available. Poor nodulation is not uncommon on virgin soils when no inoculation has been done and yields may be drastically reduced as a result.

Lablab will generally not spread naturally and thus establishes best when sown into a well prepared seed bed, however it can be oversown into roughly ploughed land as long as the seed is covered. It does not establish well in unploughed pastures. Sowing rates are 5 to 7 kg/ha drilled at a 1 m row spacing and 8 to 10 kg/ha broadcast; no sacrifice of seed is required. It can be intercropped in widely spaced rows of maize and sorghum. In maize it is sown at a rate of 20% lablab to 80% maize when the maize is 15 cm high. While fertile soils are necessary for good growth, P is the most common element limiting its growth in the tropics.

Like most vines lablab is most productive when only the leaves are removed, leaving a maximal number of growing points. Cutting should thus not be done at low levels (i. e. below 25 cm) and higher levels are probably better, depending on plant form, in order to leave more stem. Two to three grazings a year can be done on the plants as long as stems are not heavily grazed, leaving four to five months for the plants to regrow leaves and to replace nutrient reserves. Bloat may occur if animals are allowed a pure lablab diet particularly when hungry animals are fed on young regrowth. Intake may be low initially as it may take animals several days to become accustomed to the plant. It may impart a flavour to milk, however this disappears on pasturization. Lablab's rapid growth and drought resistance provides early growing season and dry season feed.

It is important to note that not all qualities are necessarily found in one lablab genotype; there are for example, lines selected for particularly good quality for human nutrition. Pests and diseases can be a problem and in Ethiopia aphids have been noted to be seasonally serious in the Rift Valley.

In order to be edible for humans, mature seeds must be boiled to break down a heat - labile trypsin-inhibitor and to remove a toxic cyanogenic glucoside in the cooking water. Lablab seeds have a hard seed coat thus require longer cooking than the common bean (*Phaseolus vulgaris*).

In Ethiopia lablab is frequently seen on hedges and fences about house compounds, particularly in the medium altitude western plateau area, on red soils.

The MOA at Soddo is particularly pleased with the performance of a lablab line on a well fertilized site and this is cut and fed to their dairy animals. Hay making is often difficult however as the thick stems take longer to dry than the leaves, and leaves are often shed during the drying.

FLAG is currently multiplying and screening 56 lines of lablab and another 83 lines have been recently received from Kenya.

Cultivars: cv Rongai: originating in Kenya (CPI 16883) and late flowering.

It has white flowers and light brown seeds.

cv Highworth: originating in Southern India (CPI 20212) and early flowering

(purple flowers) with a high seed yield (white seeds). In short day lengths

Highworth flowers early in its development and thus appears to be a short bushy plant however it will become viney in time.



## References

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\* \* \* \*

## **7.2 EXPERIMENTAL DESIGN (Part 1)**

Alemayehu Mengistu\*

### **1. Introduction to the design and analysis of experiments**

A series of articles on how to design and analyze experiments will be presented in this and the following Newsletters. The articles are based on a report presented during the course "Australian Trees and Shrubs for Dry Areas" held in Australia, July - September 1984.

#### **1.1 Some basic definitions**

Science is built upon a large body of facts. These facts are generally not easily obtained. They are established through research which is largely concerned with gathering and summarising observations or measurements made by planned experiments. This precise method for establishing facts is called the "Experiment Method". Basically the experimental method consists of a comparison between two treatments whose conditions are identical except for one aspect that is different. This difference is referred to as the experimental treatment or the independent variable (noting in the latter designation that independent stresses that the manipulation is under the control of the experimenter and variable indicates the manipulation may take on more than two values). The dependent variable(s) refers to the actual property being measured or recorded after administering the experimental treatment. The most important feature of the experimental method is that it is possible to infer a cause-effect relationship. It can be concluded that the difference observed between two conditions was caused by the experimental treatment.

#### **1.2 The planning of an experiment**

##### Keeping non-experimental variables constant

The experiment must be capable of answering the question(s) of interest. Variables, which vary systematically with the experimental treatment must not be introduced. Suppose a horticulturist is interested in the effect of fertilizer on plant growth, then watering regimes for a pot trial must be uniform across experimental treatment.

##### Efficiency of the experimental design

An inefficient experimental design increases the "cost" of obtaining a particular

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\* Ministry of Agriculture, Addis Ababa



fact or piece of information. This "cost" may be related to:-

- money
- time required to collect the data
- amount of space available, and (or)
- number of plants/pots required.

#### Selection of the dependent variable

Dependent variable measures are chosen so the effect of the experimental treatment can be monitored. Some dependent variables may provide redundant information, others may be easier to record or be less subject to error when measuring. There should be enough measures included in the experimental design to ensure the phenomenon being investigated is thoroughly described.

### 1.3 Statistical analysis of data

Entire experiments are usually too costly to replicate, so statistical analysis provides a way of determining the repeatability of any differences in an experiment. A single experiment is conducted and the statistical analysis helps decide whether the same differences would be found if the experiment was repeated.

#### Descriptive statistics

A first major role of statistics is to summarise or describe observations. A graphical summary or the summary statistics; mean ( $\bar{x}$ ). Standard deviation (SD) and "n" the sample size may be appropriate.

#### Inferential statistics

A second role of statistics is to enable generalizations about a phenomenon to be made from a sample.

Hypothesis testing is required before such generalizations can be made. The step underlying hypothesis testing are outlined as follows:-

##### Theory

Research hypothesis

Experimental design

Experimental treatments

##### Statistics

Test of statistical hypothesis

Revision and (or) refinement of theory (from Keppel, 1973).

An example of hypothesis testing is outlined below.

### THEORY

Administered in the correct concentrations fertilizer application enhances plant growth.

### RESEARCH HYPOTHESIS

Growth of a grazed pasture crop, Trifolium subterranean cv Seaton Park, in an interburden coal spoil will be improved by the application of superphosphate.



## EXPERIMENTAL DESIGN

Four superphosphate treatments were applied as surface dressings to pots, in which the pasture crop was to be sown. The superphosphate amendment levels applied were as follows:-

|                  |                                           |
|------------------|-------------------------------------------|
| P <sub>0</sub>   | nil added                                 |
| P <sub>170</sub> | the equivalent of 170 kg ha <sup>-1</sup> |
| P <sub>340</sub> | the equivalent of 340 kg ha <sup>-1</sup> |
| P <sub>680</sub> | the equivalent of 680 kg ha <sup>-1</sup> |

There were 16 replicates of each superphosphate treatment. The following dependent variables were recorded after harvesting:-

- (i) dry top growth (g), 62 days after sowing thus simulating grazing; and
- (ii) dry top and root growth (g), 128 days after sowing (total biological yield).

## STATISTICS

Calculation of mean ( $\bar{x}$ ) and standard deviation (SD) for each superphosphate treatment.

## TEST OF STATISTICAL HYPOTHESIS

Comparison of mean dry weights, using the one-way analysis of variance statistical test, determined whether a real difference existed between the four treatment conditions.

## REVISION OR REFINEMENT OF THEORY AFTER THE STUDY'S CONCLUSION IS FORMULATED

The study showed the addition of superphosphate to an interburden coal spoil led to improved growth of the Seaton Park clover cultivar. Measurement of dry plant material after 62 days, showed the growth rate of Seaton Park clover had been improved by the application of both P<sub>340</sub> and P<sub>680</sub> superphosphate levels. Yields after the 128 day harvest were all greater for superphosphate treatments than treatments without super-phosphate.

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- Zar, J. H. (1974). Biostatistical Analysis. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

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## 8. RECENT PUBLICATIONS

**8.1** Dr. Punjab Chadokar a strong supporter of the FNE, has written three very useful publications on tropical and sub-tropical forages. These are aimed at field staff, technicians and extension workers. They are written concisely and in simple English and give basic, clear and very practical instructions on how to grow and manage forage crops for feed, seed and conserved fodder.

These publications are available through Dr. Chadokar (UNDP, P. O. Box 5580, Addis Ababa) and all who are interested or involved in extension, soil conservation and forage production should be familiar with their contents.

**8.1.1. Pasture seed production in soil and water conservation.** (Field Document No. 13) Chadokar P. A., 1985, mimeo 37 pp.

This booklet is concerned with seed multiplication of grass, legume and tree species for pasture and revegetation. A wide range of topics are covered:

- a) factors influencing pasture seed production
- b) factors influencing yield
- c) problems in seed production
- d) site selection, planting methods and management
- e) harvesting, storage, quality testing, seed certification
- f) flowering and seeding characteristics of 7 grasses, and 7 legumes of importance to Ethiopia.

**8.1.2. Multipurpose plant species for soil and water conservation.** (Field Document no. 14) Chadokar, P. A. 1984, mimeo, 90 pp.

General guidelines are provided on planting and management of forage legumes, grasses and browse. Individual sections are devoted to the details of 8 grass, 5 legume and 8 browse species.

**8.1.3. Non conventional feed resources for livestock in soil and water conservation programme.** (Field Document no. 15 ) Chadokar, P. A. 1984, mimeo 28 pp.

This booklet provides descriptions of hay and hay making, silage and silage making, haylage, tree fodder, crop residues and crop by-products, feeds of animal origin from slaughter houses and the use of urea as an N source for feeds.

**8.2 Forage and Browse Plants for Arid and Semi-Arid Africa.** AGPG: IBPGR 84/149 1984, 293 pp.

The arid and semi-arid areas of Africa (less than 600 mm of rainfall) are very much in the news today as these are regions which are currently suffering from over population, poor land management, poor rainfall and consequent human distress, degradation of the vegetation, soil erosion and desert encroachment.

This very well produced and attractive volume has been produced by the IBPGR (International Board for Plant Genetic Resources, Rome) and the staff of SEPASAT (The Survey of Economic Plants for Arid and Semi-Arid Tropics, based at Kew), largely based on the excellent resources of the Royal Botanic Gardens, Kew, U. K. Its aim is to introduce scientists to a sampling of little-known plants of potential value as forage and browse for the region, in order to encourage research on them, and the development of those which are of value. There are detailed descriptions



of 40 trees and shrubs, 39 grasses, 11 herbaceous legumes, and 8 herbs (excluding legumes). Each species is described under the following headings: description, botany, ecology, distribution, uses, seed collections, potential for improvement, agronomy, related species and references. A table of distribution by country is also included.

An examination of this table indicates that of the species described, the majority occur in Ethiopia (trees and shrubs 37, grasses 32, herbaceous legumes 7, herbs 6). Ethiopian field workers in the arid and semi-arid zones should thus be familiar with these potentially valuable species so they can assess their value.

The volume is available from:

IBPGR Executive Secretary  
Crop Genetic Resources Centre  
Plant Production and Protection Division  
FAO, Via delle Terme di Caracalla  
00100 Rome  
ITALY

\* \* \* \*



## STEERING COMMITTEE MEMBERS

### Executive members

|                                      |      |          |
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| Ato Lulseged Gebre Hiwot, D/Chairman | IAR  |          |
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| Dr. John Tothill       | FLAG, ILCA                   | 18-32-15      |
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| Ato Daniel Keftasa     | ARDU, Asela<br>or Kulumsa    | 92<br>102     |
| Ato Getinet Aklilu     | Sirinka Catchment<br>Project |               |
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| Ato Solomon Demeke     | Jima Junior College          | 11-01-02, -44 |
| -----                  | Alemaya College              |               |

The Forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter itself is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia. If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

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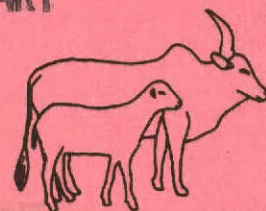
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# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 9

Date. October. 1985

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### 1. INTRODUCTORY MESSAGE

The FNE annual field trip was one of the most successful made thus far by the FNE because the travel programme encompassed research stations as well as peasant and pastoralist development programmes. Researchers, development workers, peasants and pastoralists came together and were able to discuss and exchange views. It is hoped that as a result of this interaction, the researchers will be more responsive to the needs of the peasants, pastoralists and development workers when modifying research protocols.

The 1985 season has been most productive for various forage crops in the peasant co-operatives. Furthermore, pastoralist animals are in better condition because of sufficient rainfall in the last rainy season:

The FNE Steering Committee would like to point out that 1985 results of FNE trials should be submitted by the first week of December at the latest. For this, each station may use the previous report format. Soil, climate, statistically analysed data, results and discussion should be included.

Finally, the Steering Committee of the FNE would like to express appreciation to ILCA for providing transportation for the field trip and to other local organizations for allowing their staff members to attend.

(Editors: Alemayehu Mengistu, John R. Lazier)

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## 2. THE 1985 FNE FIELD TRIP

Eighteen persons from 6 different organizations departed on an NTO bus from Revolution square at 7:00 on Wednesday, October 2, 1985. The purpose of the trip was to see the performance and potential of forage legumes and grasses at different altitudes, their role in the farmers plots and the rangeland activities especially at Yabello, in southern Ethiopia.

The group reached Zwai at about 10:30 AM to visit the co-operative Ministry of State Farms seed multiplication site at the Zwai Horticulture Farm. Alemayehu Mengistu, the FNE Chairman, introduced Girma Getachew and James Ochang both of ILCA, FLAG to the group. Girma, who is responsible for the station's activities, addressed the participants with a welcoming speech and explained about the site in detail. He mentioned that ILCA's main objective at the site is to multiply seeds of promising experimental germplasm of legume, browse and grass species for provision to researchers. He also said that many of the forage spp. that have been established there are for demonstration purposes. The 2 ha site was chosen for the availability of water for irrigation, subtropical temperatures and high solar radiation. The facility is currently in the process of moving to a new 5 ha site on the Horticulture Farm. Girma mentioned that Lablab purpureus, Neonotonia wightii, Desmodium sandwichense, Cajanus cajan and Siratiro lines were found to be promising and heavy seeders. The group was then divided in half and while viewing the performances of the species, participants had the chance to exchange ideas related to their experiences with forage germplasm. Girma explained to one of the sub-groups that so far no seed had yet been harvested from Gliricidia sepium since the flowers have been aborting. However, Alemu of Bako IAR mentioned that they were able to harvest seeds from this species at Bako station. In contrast to this N. wightii would not produce seeds at Bako while it has been yielding well at Zwai.

After the Zwai visit, the group went to the Abernosa Cattle Breeding and Improvement Ranch. A briefing was given by Alemayehu Mengistu but due to a disease outbreak on the ranch (foot and mouth) the group was not able to see the whole ranch and left early for an overnight stay at Awassa. Early the following day the participants went to Awassa IAR station to see the activities, particularly the forage work. Alemayehu Mengistu introduced Assefa Haile Selassie who is in charge of forage research at the station. Assefa mentioned that the station is situated at 1,650 m and receives an average of 900 mm of rainfall. He described the research activities which include:

- a) Tropical legume introduction trial in which a number of legume species, received from Australia, have been screened for their adaptability;
- b) Alfalfa variety trial;
- c) Grass/legume FNE trial;
- d) Vetch growth habit trial; and
- e) Vetch spacing trial.

At the conclusion of the Awassa visit the group continued on to the Woyinmeta Farmers Producer Co-operative arriving at 10:30 AM. The farmers, and the producer chairman together with the workers of the MOA of the District Office warmly received the group. Alemayehu Taye, the Region's expert, welcomed the group and introduced the chairman of the Producers Co-operative. The chairman, after delivering a welcome speech, briefed the group on the establishment of the co-operative and its present status. He mentioned that the association was first formed by 8 farmers with total land holdings of 10 hectares and with a capital of only 519 Birr in 1980. The source of income then was mainly from coffee, false banana (the source of kocho, produced



for human consumption), maize, barley, wheat, teff, field-pea and horse-bean also grow well in the area. In 1981/82 the association bought 4 heifers and one bull for dairy production. The capital then was 5,655 Birr. By the middle of this year, the cooperative had earned 10,000 Birr from the sale of animal products. At present, there are 15 cows, 15 heifers and one bull being reared on 26 ha. The number of members has also increased to 139 and their capital has reached 43,040 Birr. Following the briefing, the group visited plots of oats (grown under the coffee trees), lucerne, leucaena, fodder beets and elephant grass. Cattle were being fed cut and carried elephant grass and leucaena and the stable and milk utensils were also viewed by the group. Finally an exchange of ideas took place between the FNE participants, workers of the MOA and the farmers. The group then continued travelling to Yabello and passed the night there.

On the following morning the group was led to the assembly hall of the Southern Rangeland Development Unit (SORDU) and were introduced to the General Manager of the Project, Dr. Wario Godana. Dr. Wario addressed the participants, explaining about the Project's location, objectives and results obtained thus far. He said that the Project conducts its programmes in two districts encompassing 54,000 sq. km. or 57% of the total area. The half million pastoralists of Borana and other tribes of the area own about a million cattle, 90,000 camels and 40,000 sheep and goats. The erratic rainfall amounts to 300 - 700 mm in two seasons per year. The main rainy season is March through May and the short rainy season is in October and November. However Dr. Wario revealed that severe drought has been common in the area. The three rivers, Genale, Dawa and Sepel in the Project area have been of little use as they are seasonal and the area around the river is over-grazed and cannot support many animals. Although, many of cattle are owned by the pastoralists, only the Somali recognise their economic importance while the others keep them for subsistence. Dr. Wario also mentioned the constraints faced by the farmers such as inefficient management, animal diseases and low market prices. In the Project area, 7,000 animals have been fattened and 6,200 of them were sold. The veterinary service provided by the Project has been very effective in improving the condition of the cattle.

Following the explanation and a discussion the group travelled in the direction of Mega to visit the Leucaena lines planted by the Ministry of Agriculture. These lines, Cunningham and Peru, were established 2 years ago and have been cut only once. They look healthy and have not been affected by the dry periods. The deep wells, called "Illa" by the indigenous people, at Dubluk and Melbana, serve the pastoralists within a 20 km radius and were also of much interest. The cattle seemed to be in good condition which indicates to some degree their tolerance to the water constraints in this area. On the way back to Yabello, a visit was arranged to one of the crater/lakes called "Bako Soda" or "Chew Bete" from which the surrounding people extract salt for consumption as well as for marketing. Late in the afternoon the FNE participants gathered with SORDU's manager and staff at the Project's assembly hall and heard a lecture on "Dry Weight Ranking for Pasture Composition and Yield" given by Dr. J. Tothill, Head of FLAG of ILCA. After an enthusiastic discussion on the subject, all the participants went out to the nearby natural grassland and tried to apply in the field what they had learned from the lecture. Finally, after mastering the methodology, the group attended a barbecue organised by the FNE participants and SORDU staff. There, interesting speeches were delivered by Dr. J. Tothill and Dr. Wario Godana on the strengthened work relationship created by the FNE between ILCA, SORDU, MOA, IAR and others. On October 5, the group travelled all the way to Zwai and passed the night there.



On the following day, prior to the FNE General Meeting, a visit was arranged to the ILCA station at Debre Zeit primarily to view the forage research carried out by the Highlands Programme. Ato Taye Wolde Mariam of the Highlands Programme welcomed the FNE participants and summarized the station's work since its establishment in 1976, and together with Ato Asfaw of the same programme, showed the improved farm implements such as modified plows and seeders. Taye said that his programme of forage agronomy emphasizes upgrading the native pastures using different types and levels of fertilizers, identifying forage species adapted to the station's environment and vertisol management. The group viewed about 30 trials. A long discussion followed. After the FNE General Meeting the group returned to Addis Ababa in the late afternoon.

### Participants in the FNE Trip and the FNE Meeting at Debre Zeit

| <u>Name</u>                               |                                              |
|-------------------------------------------|----------------------------------------------|
| Asfaw Yimegnuhail                         | ILCA                                         |
| Tegene Alemayehu                          | ARDU                                         |
| Tadesse Tekle Tsadik                      | IAR                                          |
| Alemu Tadesse                             | IAR (BRS)                                    |
| Achalew Tsegahun                          | IAR                                          |
| Woubit Befekdadu                          | IAR (MWRS)                                   |
| Girma Getachew                            | ILCA (FLAG)                                  |
| Getachew W/Agenehu                        | ARDU                                         |
| Solomon Demeke                            | JJCA                                         |
| Konrad Gerards                            | JJCA                                         |
| Getinet Aklilu                            | Sirinka Catchment<br>Project                 |
| Hailu Abebe                               | ARDU                                         |
| Girma Chemedi                             | IAR (BRS)                                    |
| Sendros Demeke                            | IAR                                          |
| Taye W/Mariam                             | ILCA                                         |
| Alemayehu Mengistu                        | MOA                                          |
| John Tohill                               | ILCA (FLAG)                                  |
| Wongoi Migongo Bake                       | ILCA (Rangeland Project)                     |
| Assefa Haile Selassie                     | IAR (Adami-Tulu)                             |
| Asres Tsehai                              | ILCA (FLAG)                                  |
| Wario Godana and about 10 technical staff | SORDU (MOA)                                  |
| Four Southern Regional & Awraja staff     | MOA                                          |
| Ten to fifteen Farmers                    | Producers Co-operative<br>(Woyninata-Sidamo) |

\* \* \* \*

### 3. MINUTES FROM THE FNE MEETING

As a follow up to the field trip the FNE General meeting was held in one of the cottages at the Debre Zeit Station. Alemayehu Mengistu, Chairman of the FNE, determined the agenda on which participants would speak. The first was a presentation of short reports on 1985 general forage activities excluding the FNE trials.



(i) **ARDU** - has been dealing with the following forage activities at different altitudes:

- 1) Determining the sowing date of oat varieties;
- 2) Undersowing Rhodes grass with barley, wheat and food crops;
- 3) Fertilizer trials;
- 4) Effect of cultural practices on Rhodes grass;
- 5) Oat/Vicia mixture;
- 6) Sudan grass/Vicia mixture;
- 7) Crop-rotation wheat with forage crops;
- 8) Rhodes/alfalfa mixture.

Harvests have not yet been made in any of the trials, though some were looking good.

(ii) **ILCA Debre Zeit** - has been conducting, in addition to the FNE trials, the following trials:

- 1) Feeding trial on 6 sorghum varieties;
- 2) Determination of grain and straw yield of sorghum varieties;
- 3) Comparison of 4 major highland cereals for grain and straw yield;
- 4) Production of 4 legume species;
- 5) Seed increase of soybean varieties;
- 6) Seed rate trial on Trifolium steudneri;
- 7) Adaptability trial on Sesbania rostrata;
- 8) Screening of Triticale species;
- 9) Intercropping wheat with Trifolium steudneri;
- 10) Seed multiplication of oats and triticale;
- 11) Seed rate trial on drilled crops on bottom land;
- 12) Relay-cropping on broad-beds;
- 13) Sorghum crop configuration on raised beds;
- 14) Effect of raised-bed width for drainage on crop growth;
- 15) Effect of improved drainage on annual grain crops;
- 16) Effect of improved drainage on perennial forage crops;
- 17) Fertilizer rate study;
- 18) Dry versus wet planting on cereal and pulse crops;
- 19) Feasibility of post-harvest plowing as influenced by crop species;
- 20) Row planting effect on weeding;
- 21) " " versus broadcasting on broad-bed;
- 22) Crop growth as influenced by planting time;
- 23) Effect of slope of furrows on crop growth;
- 24) Trifolium steudneri/Teff sequence study;
- 25) Sesbania/Chloris gayana feed garden;
- 26) Sesbania aculeata alley cropping;
- 27) Feeding trial on 4 different legumes;
- 28) Leucaena lines adaptability trial.

(iii) **ILCA-Zwai/Abernosa**

More emphasis is being given to the Zwai site because of the availability of water, and seed of about 1,000 legumes are being or have been multiplied. Forage seed is also being multiplied in small plots at Abernosa under rainfed conditions. The other activities in these two stations are:



- 1) Initial evaluation of forage species;
- 2) Grazing trial on stylo varieties;
- 3) Oversowing trial;
- 4) Browse screening trial on 165 species;
- 5) Strip trials at 11 sites in the whole Rift Valley;
- 6) Leucaena lines adaptability trials and **seed** production.

(iv) **ILCA-Debre Berhan** - Experiments have dealt with both the perennial pasture and legume/grass mixture trials that were started in 1983. Cereals have been tested in intercropping and grazing trials. Leucaena lines adaptability trials are also taking place.

(v) **IAR - Melka Werer** - is a lowland representative in the IAR programmes and has been conducting the following research activities:

- 1) Effect of spacing on Leucaena dry matter yield;
- 2) " " harvesting stage on Leucaena yield;
- 3) Effect of cutting height and interval on Leucaena yield;
- 4) Pastures response to N under "irrigation";
- 5) Nursery row evaluation of forage crops;
- 6) Intercropping forage crops with cotton;
- 7) Selection of salt tolerant forage spp;
- 8) Multilocation trial.

(vi) **Jimma Junior Agricultural College (JJCA)** - has just started forage work in this year. However, it has been dealing with some legume species such as Desmodium, Leucaena and Sesbania lines. It also planted some legume species in strips which have been doing well.

(vii) **IAR-Bako** - is one of the IAR stations and was supposed to conduct 11 projects including the FNE trials. However, due to late arrival of seeds to be tested under FNE trials, the station was able to deal only with other forage activities that include:

- 1) Nursery row evaluation of grasses and legumes;
- 2) Stylosanthes guianensis variety trial;
- 3) Oversowing legumes on natural pasture;
- 4) Seed rate trial on legume and grass species;
- 5) Evaluation trial of grass/legume mixture;
- 6) Effect of frequent harvest on dry matter and nutritive value of Leucaena;
- 7) Effect of frequent harvest on dry matter and chemical composition of different forage crops;
- 8) Natural grassland survey;
- 9) Pasture establishment study;
- 10) Seed production of vetch varieties;
- 11) Leucaena feeding trial.

(viii) **IAR-Holetta** - is one of the IAR stations that has been dealing mostly with the highland forage crops that include:

- 1) Fodder oats variety trial;
- 2) Screening of alfalfa varieties;
- 3) Nursery trial on tropical and temperate legume and grass species;
- 4) Intercropping forage crops with wheat;
- 5) Cereal and forage crop rotation;
- 6) Seed production of vetch;
- 7) Seed increase of selected grasses and legumes;
- 8) Response of cultivated pasture to grazing;
- 9) Effect of harvesting stage on dry matter and protein content of natural pasture.



(ix) **Sirinka Catchment Project** - is in its primary year and has been working on forage activities such as:

- 1) Intercropping forage legumes with sorghum;
- 2) Alley-cropping using Sesbania aculeata and Leucaena leucocephala;
- 3) Evaluation of native legumes;
- 4) Variety trials of forage legumes;
- 5) Legumes strip trial;
- 6) Browse observation trial.

(x) **ILCA/Shola** - is giving most emphasis to the East African highland Trifolium species. The section has established the following trials:

- 1) About 300 lines of 9 annual Trifolium species have been in strips to study their agronomic characteristics while enriching the seed stock;
- 2) Screening of potential annual clovers with the objectives of comparing them for their dry matter yield and determining their effect on the subsequent cereal crops;
- 3) Adaptability trial on a number of browse species;
- 4) Feeding trial on 4 different legumes;
- 5) Highland Leucaena lines adaptability trial at 3 locations;
- 6) Perennial native Trifolium screening trial;
- 7) Establishing perennial temperate grass and legume introduction plots in 1983.

(xi) **MOA** - has been demonstrating forage activities on 78 sites throughout the nation. The adaptability trials have been conducted on a one hectare plot of the farmers holdings. Distribution of inputs like forage seeds and collaboration with departments such as Soil and Water Conservation and ILCA at Abernosa and Soddo, are believed to strengthen the link between institutions which have forage as a common interest.

#### **Summaries of the 1985 FNE Trials**

ARDU. The Trifolium trial has been improving this year. The legume/grass mixture died out from flooding at Meraro. Kulumsa, M. sativa has a good stand.

ILCA-Debre Zeit. Both the legume/grass mixture and the Medicago strip trials have been doing well.

IAR - Melka Werer. About 16 of the 18 Medicago lines in the strip trial were performing well until they were totally damaged by the disastrous flood of the Awash River.

ILCA - Debre Berhan. All the experiments at this station have been affected by hail in the rainy season. However, the following have been carried out as part of the FNE trials :

- 1) Effect of different P levels;
- 2) Grass/legume mixture;
- 3) African Trifolium species adaptability trial.

IAR- Holetta. Although results were not satisfactory due to the climate in the last rainy season, the station has been handling the following trials:

- 1) Effect of P levels on native Trifolium species;
- 2) Grass/legume mixture;
- 3) Sixteen native Trifolium spp. in strip trials;
- 4) Alfalfa strip trial.



## **Briefing the last workshop on Potentials of Forage Legumes in Farming Systems of sub-Saharan Africa**

Ato Alemayehu, Chairman of the FNE noted that the briefing was supposed to be given by Dr. J. Tothill who could not attend this meeting as he went to ILCA for another meeting. However, Ato Alemayehu mentioned that the workshop was organized by ILCA and many scientists attended it. In addition to the important discussions held in this workshop, many scientific papers accompanied by slide shows were presented by the participants. The scientists concluded that this would be an optimum time to carry out forage screening in the farming systems. The proceedings will come out very soon and may appear in the FNE newsletter.

### **Local staff training**

Alemayehu Mengistu announced that training of staff from local institutions was one of the FNE objectives and will be managed in two ways.

- 1) Individuals will be trained on a residential basis (lasting one to two weeks) so that they will become well acquainted with the practical forage work at ILCA Zwai and Soddo stations. The residential courses could be given year round.
- 2) Group training, sponsored by ILCA, will also be given at least once a year.

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## **4. NEWS AND NOTES**

### **4.1. Current status of PANESA**

PANESA will be hiring one co-ordinator sometime early in 1986. This will give a great boost to national forage networks such as FNE, particularly as the co-ordinator will be based in Addis Ababa.

### **4.2. The Pasture Network for Eastern and Southern Africa (PANESA) Annual Workshop**

The conference entitled "Animal Feed Resources for Small-scale Livestock Producers" will be held in Nairobi, Kenya, 11-15 November 1985. The FNE participants Alemayehu Mengistu (Chairman of FNE) and Dr. John Lazier (ILCA) will present the FNE's views and experiences during the annual PANESA General meeting which will also be held during the week.

4.3. Alemayehu Mengistu reminded the participants that they should be writing articles on their research and development work, present and future. Articles describing new ideas, opinions and giving advisory information are also welcome.

4.4. Ato Mengistu Zewagi, MOA Pasture expert, left for Australia to attend a Pasture Management course for the wet tropics held in Queensland from 14 October to 6 December 1985. This course is being given by the Queensland Department of Primary Industries.

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## 5. POTENTIAL OF FORAGE LEGUMES IN FARMING SYSTEMS OF SUB-SAHARAN AFRICA WORKSHOP

John C. Tothill\*

This workshop, held at ILCA from 16 - 19 September 1985, was attended by approximately 80 delegates from 25 countries. Thirty five papers were presented in two broad groupings, the first being "Nutrient and Water Constraints for Forage Legume Growth" and the second and largest "Forage Legumes in Production Systems". Within these sessions the subject areas of the papers ranged widely. Each of the two sessions was discussed and reviewed by a discussion panel and the outcome of these deliberations brought together in a concluding session where priorities were spelled out.

In terms of constraints, the highest priority for future research was given to the use and role of phosphorus, including the role of mycorrhizia in P nutrition. Next was selection of adapted species and strains, particularly to water stress and nutrient supply, responses to micro nutrients, water-use efficiencies and nitrogen fixation. In considering forage legumes and production systems, priority was given to research in inter-cropping of legumes, ley farming/relay cropping and alley cropping, all emphasising an on-farm systems approach, followed by integration of forage research with livestock research, use of crop residues and feeding strategies, seed production, role of forages in rangelands and pasture and forage establishment studies.

A proceedings volume for the workshop will be published by ILCA early in 1986.

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## 6. 1984 FNE MULTILOCATION TRIAL RESULTS

### 6.1 Corrections to 1983 FNE Results

The results of the trial yield assessment of highland perennial species under cutting as presented in the FNE Newsletter No. 5 page 8, Table 4 were incorrect as yield figures for Shola had been transposed before the data was statistically analyzed.

The corrected table and analysis are presented below. The major effect of the correction to the results was to reduce the yield of D. glomerata, and to increase that of P. aquatica.

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\*Leader FLAG, ILCA



**TABLE 4 : Average DM yields (t/ha) of five perennial grasses evaluated during the 1982/83 multilocal trials. (Second year of establishment).**

| Species                                 | D. Berhan | Robe | Holetta | Shola | Species mean |
|-----------------------------------------|-----------|------|---------|-------|--------------|
| <i>Phalaris arundinacea</i>             | 1.69      | 3.65 | 13.07   | 6.8   | 6.30         |
| <i>P. aquatica</i> cv Australia         | 2.08      | 3.37 | 6.97    | 5.5   | 4.57         |
| <i>Lolium multiflorum</i> cv Barspectra | 2.32      | 3.99 | 3.95    | 5.4   | 3.92         |
| <i>L. perenne</i> S. 24                 | 1.65      | 4.09 | 2.74    | 5.0   | 3.37         |
| <i>Dactylis glomerata</i>               | 2.12      | 3.72 | 2.67    | 4.2   | 3.18         |
| Location mean                           | 1.97      | 3.84 | 5.88    | 5.38  |              |
| SE of species mean                      |           |      |         | 1.07  |              |
| LSD (0.05) of species mean              |           |      |         | 3.31  |              |
|                                         |           | CV   |         | 10.7% |              |

## 6.2. Results of 1984 Forage network trials

FNE Cooperators\*

### Introduction

One of the major constraints to livestock production in Ethiopia is inadequate feed, particularly during the dry season. In many areas the dominant feeding practice is to graze animals on wastelands which are not suitable for crop production. In these situations fodder conservation and efficient utilization of crop residues are generally not practised. Thus the poor productivity of livestock results in protein deficiency for humans and low foreign exchange earnings from livestock and livestock products.

Research to improve natural grasslands and to introduce improved fodder crops has been going on in Ethiopia for the last two decades and is currently underway at the Institute of Agricultural Research (IAR), the Arsi Rural Development Unit (ARDU), as well as the International Livestock Centre for Africa (ILCA) and other institutions. Some progress has been made in the selection of high yielding fodder crops which are suitable to various ecological zones.

In 1980 researchers from IAR, ARDU, MOA and ILCA agreed to set up a network and conduct joint forage trials on a national level. The first network trials were conducted in 1981 under the title "multilocal yield assessment trials". The network helped to standardize and co-ordinate forage evaluation methods and stimulate relevant research by promoting better communication among researchers for better exchange of information and experimental materials. As a result of the network, research - extension relationships have become stronger and thus helped to speed the adoption of improved forage practices.

\* Lulseged G/Hiwot, Alemayehu Mengistu, Taddese T/Tsadik, Alemu Taddese, Gashaw Shibabaw, Getachew W/Agnew, Abate Tedla, Taye W/Marim, Abayneh Woudneh, John Lazier. Compiled by Daniel Keftasa.



This report contains results of experiments conducted in the 1984/85 cropping season. The 1982/83 experimental results were reported in the FNE Newsletter No. 5, pages 2-14, and in this issue. The 1984 results of the high and medium altitude trials include:

- a) Yield assessment for hay of perennial forage species under cutting (established in 1982); Yield assessment for hay of three native Ethiopian varieties.
- b) Yield assessment for hay of three endemic Trifolium species under 3 levels of phosphorus fertilizer.

The experiments on perennial species were established in the 1982 crop season. The stations and the species from which 1984 harvests were taken were as follows:

a) Highland perennial species :

Festuca arundinacea (tall fescue);  
Dactylis glomerata (cocksfoot);  
Phalaris aquatica (tuberosa) cv Australian;  
Phalaris aquatica (tuberosa) cv Sirocco;  
Lolium perenne cv S 24;  
Lolium multiflorum cv Barspectra.

Stations: Holetta (IAR); Shola (ILCA).

b) Medium altitude perennial species :

Chloris gayana (Rhodes grass);  
Panicum coloratum (coloured guinea grass);  
Desmodium uncinatum (silverleaf Desmodium);  
Pennisetum purpureum (Napier/elephant grass).

Stations: Debre Zeit (ILCA), Ginchi & Bako (IAR).

Details of the design of the perennial trials were presented earlier (FNE No 5, page 2 - 14).

c) Highland annual Trifolium species :

In 1982 and 1983, the International Livestock Centre for Africa (ILCA) collected a large number of accessions of native clovers from the Ethiopian Highlands to evaluate their forage potential. Preliminary evaluation of the accessions identified of the most promising genotypes. It was found that these native clovers respond well to low levels of phosphorus fertilization. From the preliminary screening studies it was observed that T. tembense, T. quartinianum and T. decorum were among those which had highest forage potential. The most promising genotypes of these native clover species were put in a replicated FNE multilocation trial with phosphorus fertilizer beginning in 1984.

The native Trifolium species T. tembense ILCA 7102 (ILCA 5774), T. quartinianum ILCA 6301 and T. decorum ILCA 6264 were planted at Debre Berhan, Holetta, Robe, Bekoji and Shola with 0, 10, and 30 kg/ha, phosphorus in the form of TSP applied at planting. The seeding rate was 10 kg/ha and the plot size (gross) was 2 m x 5 m from which the border 20 cm was excluded and the middle 3.68 m<sup>2</sup> net plot area was harvested for the determination



of either herbage or seed yield. Harvesting for forage was done when the plants reached full flowering stage and for seed production at seed maturity. The trial protocol was published earlier (FNE 4, 12).

#### Climatic conditions during the 1984 season

Meteorological data of those stations from which 1984 FNE trials were reported are presented in Table 1. 1984 was a drought year, with values for total rainfall being significantly lower than the average values in previous years. The main rains were shorter than usual, stopping abruptly in late September.

#### Results and Discussions

##### a) Highland perennial species

This trial was started in June 1982 at Debre Berhan, Shola, Holetta, Sheno, Robe and Bekoji but 1984 yields were reported only from Holetta and Shola. At the other stations no substantial yields were obtained for a variety of reasons. At Bekoji and Robe all species except Festuca arundinacea and Phalaris aquatica had poor stands due to the early cessation of the rains and no substantial yields could be reported. At Sheno the persistence of all species was poor due to poor initial establishment, continuous grazing by rabbits throughout the dry season, long dry spells and cracking of the black clay soils which exposed and broke the plant roots. Hence substantial forage yields were harvested only in 1982 and 1983. The two year results indicate that Phalaris aquatica cvs Sirocco and Australia, Festuca arundinacea and Lolium spp are well adapted and could be productive under proper management. At Holetta, N was applied at 46 kg/ha in split applications, i.e. 1/3 during the short rains (March - April) and the remaining 2/3 during the main rains (July - August). Establishment and persistence were good for all species in the first two years. A separate analysis of variance of yields from 1984 harvests at Holetta and Shola (Table 2) shows that there were statistically significant ( $P < 0.01$ ) yield differences among the species and that yield variations at the two stations were also high. Of the five highland perennial species (temperate types) in the trial Lolium multiflorum showed vigorous, rapid growth in the first year (1982) producing significantly higher yields than the other species but in 1984 the yields declined more than the other species. The best yielders over the 3 harvest seasons have been Phalaris aquatica cvs Sirocco and Australia and Festuca arundinacea. The two species Lolium perenne and Dactylis glomerata were found to be inferior to the other species at all stations.



Table 1. Monthly mean temperature and total rainfall recorded at the FNE trial sites in 1984

| Month      | D. Berhan |           |                | Shola     |           |                | D. Zeit   |           |                | Holetta   |           |                | Ginchi    |           |                |
|------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|
|            | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm |
| January    | 18.7      | 3.2       | 0.0            | 22.8      | 5.8       | 0.1            | 25.9      | 5.4       | 0.0            | 22.3      | 1.4       | 0.0            | 25.3      | 5.2       | 0.3            |
| February   | 20.0      | 3.2       | 0.2            | 23.8      | 6.3       | 2.7            | 29.6      | 5.4       | 1.0            | 24.6      | 3.8       | 0.0            | 27.1      | 6.1       | 9.6            |
| March      | 20.9      | 7.7       | 13.6           | 25.0      | 11.4      | 31.4           | 28.3      | 9.5       | 19.0           | 25.3      | 8.8       | 41.8           | 28.0      | 9.8       | 18.5           |
| April      | 21.8      | 7.3       | 8.4            | 26.3      | 11.0      | 12.7           | 29.4      | 10.0      | 0.0            | 26.3      | 9.4       | 8.5            | 29.2      | 10.7      | 12.3           |
| May        | 19.9      | 8.3       | 92.7           | 23.9      | 12.0      | 153.2          | 27.4      | 10.2      | 92.2           | 23.6      | 9.7       | 141.6          | 26.0      | 12.4      | 130.9          |
| June       | 18.3      | 7.4       | 128.4          | 21.3      | 10.8      | 214.2          | 26.2      | 9.1       | 102.7          | 21.2      | 9.2       | 178.5          | 22.5      | 11.6      | 253.2          |
| July       | 17.6      | 8.0       | 292.5          | 20.0      | 10.5      | 283.8          | 24.3      | 9.8       | 195.3          | 19.4      | 8.7       | 260.5          | 21.2      | 10.4      | 200.5          |
| August     | 18.0      | 7.5       | 203.8          | 20.8      | 10.6      | 162.7          | 24.6      | 9.9       | 186.9          | 19.9      | 8.3       | 221.8          | 21.5      | 10.4      | 151.7          |
| September  | 17.0      | 6.5       | 117.0          | 20.9      | 10.4      | 100.0          | 24.8      | 8.8       | 74.7           | 20.6      | 7.4       | 106.1          | 22.0      | 9.4       | 133.0          |
| October    | 18.0      | 3.6       | 0.0            | 22.3      | 8.5       | 0.0            | 25.6      | 6.3       | 0.0            | 22.6      | 2.2       | 0.0            | 24.4      | 5.8       | 4.6            |
| November   | 18.1      | 4.7       | 0.0            | 22.6      | 8.0       | 0.0            | 26.4      | 5.6       | 0.0            | 23.1      | 3.0       | 0.6            | 25.0      | 6.9       | 6.0            |
| December   | 17.8      | 4.5       | 4.0            | 22.1      | 7.3       | 2.8            | 25.2      | 5.5       | 4.0            | 22.7      | 1.8       | 13.1           | 24.6      | 6.7       | 6.9            |
| Mean/total | 18.8      | 6.0       | 860.6          | 22.6      | 9.4       | 963.6          | 26.5      | 8.0       | 672.2          | 22.6      | 6.1       | 972.5          | 24.7      | 8.8       | 927.5          |



Table 1 continued

| Month      | B a k o   |           |                | Kulumsa   |           |                | Bekoji    |           |                | R o b e   |           |                | Dherra    |           |                |
|------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|-----------|-----------|----------------|
|            | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm | Max<br>°C | Min<br>°C | Rainfall<br>mm |
| January    | 29.4      | 9.7       | 5.6            | 23.1      | 6.7       | 0.0            | 20.1      | 5.5       | 4.6            | 24.1      | -         | 0.0            | 25.8      | 11.6      | 0.0            |
| February   | 31.4      | 9.9       | 0.0            | 24.4      | 6.5       | 0.0            | 21.6      | 6.1       | 0.0            | 25.5      | -         | 0.0            | 27.4      | 10.0      | 0.0            |
| March      | 32.0      | 15.2      | 19.0           | 26.7      | 9.4       | 9.5            | 21.9      | 8.9       | 10.6           | 25.8      | -         | 18.9           | 30.9      | 15.7      | 50.8           |
| April      | 32.6      | 16.5      | 44.9           | 28.1      | 12.0      | 2.2            | 22.2      | 9.2       | 17.7           | 26.6      | -         | 8.5            | 31.7      | 17.3      | 20.0           |
| May        | 28.5      | 16.1      | 163.5          | 24.5      | 11.6      | 151.0          | 19.7      | 8.6       | 135.5          | 23.4      | -         | 113.3          | 28.7      | 14.3      | 74.4           |
| June       | 24.6      | 15.0      | 224.7          | 23.0      | 10.6      | 84.1           | 16.7      | 7.4       | 183.8          | 21.1      | -         | 130.2          | 27.9      | 14.7      | 77.5           |
| July       | 23.7      | 14.5      | 243.8          | 21.9      | 10.2      | 79.9           | 15.4      | 6.5       | 162.3          | 21.4      | -         | 110.1          | 26.4      | 12.8      | 104.9          |
| August     | 24.5      | 14.4      | 165.5          | 21.6      | 10.4      | 155.0          | 18.6      | 5.9       | 107.8          | 22.1      | -         | 97.0           | 25.9      | 13.0      | 128.5          |
| September  | 25.2      | 13.6      | 117.9          | 22.3      | 9.8       | 122.9          | 16.8      | 6.6       | 66.3           | 21.5      | -         | 108.1          | 29.7      | 12.0      | 61.0           |
| October    | 28.4      | 10.0      | 9.1            | 24.9      | 8.8       | 10.6           | 18.9      | 5.8       | 3.5            | 22.9      | -         | 3.3            | 28.6      | 11.9      | 0.0            |
| November   | 28.6      | 12.2      | 30.0           | 24.3      | 7.8       | 0.0            | 16.7      | 7.9       | 36.7           | 21.9      | -         | 10.4           | 27.5      | 12.1      | 0.0            |
| December   | 29.3      | 11.1      | 5.7            | 22.8      | 6.5       | 17.0           | 19.8      | 6.5       | 11.6           | -         | -         | 0.0            | 25.3      | 10.6      | 2.5            |
| Mean/total | 28.2      | 13.2      | 1029.7         | 23.9      | 10.0      | 632.2          | 19.0      | 7.1       | 791.9          | 23.3      | -         | 599.8          | 28.0      | 13.0      | 519.6          |

TABLE 2. Dry Matter yields (t/ha) of perennial species at highland stations, 1984/85 (third year of establishment)

| Species/cultivar                        |                                       | Holetta | Shola | Mean  |
|-----------------------------------------|---------------------------------------|---------|-------|-------|
| 1.                                      | <u>Festuca arundinacea</u>            | 5.34    | 1.36  | 3.35  |
| 2.                                      | <u>Dactylis glomerata</u>             | 2.09    | 0.07  | 1.08  |
| 3.                                      | <u>Phalaris aquatica</u> cv Australia | 10.81   | 1.24  | 6.03  |
| 4.                                      | <u>Phalaris aquatica</u> cv Sirocco   | 13.60   | -     | 13.60 |
| 5.                                      | <u>Lolium perenne</u>                 | n       | 0.37  | 0.37  |
| 6.                                      | <u>Lolium multiflorum</u>             | n       | 0.35  | 0.35  |
| Station mean                            |                                       | 7.96    | 0.68  |       |
| SE                                      |                                       | 0.60    | 0.16  |       |
| LSD (t/ha) P. = 0.05                    |                                       | 1.71    | 0.53  |       |
| P. = 0.01                               |                                       | 2.59    | 0.77  |       |
| P. = 0.001                              |                                       | 4.17    | 1.16  |       |
| CV %                                    |                                       | 13      | 38    |       |
| - not planted      n = negligible yield |                                       |         |       |       |

NOTE : Harvest dates in 1984 and % mean dry matter (% DM) at Holetta.

|                                 | harvest dates | % DM |
|---------------------------------|---------------|------|
| <u>F. arundinacea</u>           | 20/8, 23/10   | 27.5 |
| <u>D. glomerata</u>             | 20/8, 23/10   | 30.3 |
| <u>P. aquatica</u> cv Australia | 20/8, 23/10   | 20.6 |
| <u>P. aquatica</u> cv Sirocco   | 20/8, 23/10   | 22.4 |
| <u>L. perenne</u>               | -             | -    |
| <u>L. multiflorum</u>           | -             | -    |

Overall mean yields (mean of all stations over 3 years) indicate that Phalaris aquatica and Festuca arundinacea produced higher yields than other species and thus can be recommended for future use for long-term leys (3-5 years). Lolium multiflorum cv Barspectra can be used for short-term leys (1-2 years) either for grazing or hay making in the highlands of Ethiopia (altitude > 2400, rainfall > 850 mm/yr).

b) Medium altitude perennial species

At the beginning in 1982 these trials were planted at Debre Zeit, Ginchi, Bako, Kulumsa and Dherra but yields for 1984 were reported only from the first three stations (Table 3).



TABLE 3. Dry matter yields (t/ha) of perennial species at medium altitude stations (3rd year of establishment)

| Species                         | D. Zeit | Bako  | Ginchi   | Species mean |
|---------------------------------|---------|-------|----------|--------------|
| <u>Chloris gayana</u>           | 6.22    | 20.57 | 5.0      | 10.60        |
| <u>Panicum coloratum</u>        | 7.65    | 13.64 | 2.68     | 7.99         |
| <u>Desmodium uncinatum</u>      | 10.09   | 8.72  | 0.60     | 6.47         |
| <u>Pennisetum purpureum</u>     | 7.31    | 14.78 | 3.14     | 8.41         |
| Station mean                    | 7.82    | 14.43 | 2.86     |              |
|                                 | SE =    | 1.37  | CV = 28% |              |
| LSD (t/ha)                      | 5%      | 1%    | 0.1%     |              |
| among the species means         | 2.32    | 3.16  | 4.25     |              |
| among the station "             | 2.01    | 2.73  | 3.68     |              |
| interaction (species x station) | 4.02    | 5.47  | 7.36     |              |

Harvesting dates (H.d) in 1984 and % mean dry matter (% DM)

|                     | H. d       | H. d        | % DM | H. d       | % DM |
|---------------------|------------|-------------|------|------------|------|
| <u>C. gayana</u>    | 24/7, 3/10 | 26/7, 1/20  | 23.9 | 20/8, 9/10 | 32.0 |
| <u>P. coloratum</u> | 24/7, 3/10 | 4/7, 29/8   |      |            |      |
|                     |            | 13/11       | 28.9 | 20/8       | 31.7 |
| <u>D. uncinatum</u> | 3/10       | 29/8        | 24.4 | 20/8, 9/10 | 19.5 |
| <u>P. purpureum</u> | 24/7, 3/10 | 10/8, 13/11 | 20.0 | 20/8, 9/10 | 20.2 |

A combined analysis of variance shows that there were statistically significant ( $P < 0.01$ ) herbage yield differences among the species, between stations and also the species responded differently at different stations. Desmodium uncinatum, for example, performed best at Debre Zeit and poorest at the other stations while Chloris gayana performed poorest at Debre Zeit and best at the other stations.

Overall mean yields show that Chloris gayana produced the highest yield especially at Bako where high rainfall permitted more than one harvest per season. Pennisetum purpureum was consistently the second highest yielder in 1984. The performance of Desmodium uncinatum was also high particularly at Debre Zeit producing higher yields than the previous years, except at Ginchi.

Generally the performance of these tropical forage crops has been quite promising particularly at the sites receiving high rainfall on well drained soils. Based on the data from this set of experiments and other related work of ARDU and IAR sites, Chloris gayana can be recommended for a wide range of soils and climates for low-medium altitudes for use in long term leys. Pennisetum purpureum can also be recommended for cut and carry feeding. It is particularly valuable for soil and water conservation on terraces.

c) Evaluation of 3 annual native Trifolium species under 3 levels of phosphorus fertilizer

Herbage yields from Debre Berhan and Holetta and seed yields from Holetta are presented in Tables 4 and 5 respectively. The analysis of variance revealed statistically significant ( $P < 0.01$ ) differences in overall mean herbage dry matter yields between species, phosphorus levels and sites. T. decorum gave the highest mean yield. The response to increasing levels of phosphorus was high overall but greater at Holetta than at Debre Berhan. Overall responses to phosphorus observed in these experiments were lower than results previously obtained at Debre Berhan and Shola by ILCA researchers. The reduced yields may be due to the lower rainfall and the shorter rainy season in 1984.

It was also observed that the species performed differently at different stations. T. quartinianum, for example, was the best at Holetta and poorest at Debre Berhan.

At Shola and Robe establishment was poor and growth was stunted, thus no substantial yields were reported. On the red clay soil at Bekoji (ARDU) initial emergence of the seedlings was good but the vegetative growth was stunted mainly due to lack of moisture at the later growth stages. Of the three species T. quartinianum produced 0.5, 1.2, 1.5 t/ha DM at 0, 10, and 30 kg/ha phosphorus respectively, showing fairly high responses to phosphorus. No significant yields were obtained from the other species.

The seed yields at Holetta show that there were highly significant ( $P < 0.001$ ) yield differences between the two species (Table 5). T. quartinianum produced the highest yield, 146% higher than T. tembense while, due to frost damage at the pod stage, T. decorum produced no seed. The seed yield responses to increasing rates of phosphorus were not statistically significant.

From the data of this season it appears that T. decorum is better suited to the heavy clay soils (vertisols) found at Debre Berhan while T. quartinianum to lighter reddish clay soils similar to Holetta and Bekoji. Further studies on these local clovers is necessary to produce clearer results.

### Recommendations

These experiments have offered opportunities to test a number of promising species under different ecological systems and to give recommendations. From the results of these experiments and previous research in Ethiopia the following species can be recommended for future use.

a) Low-medium altitude

|             |                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Annuals:    | Sudan grass ( <u>Sorghum sudanese</u> );<br>Oats/ <u>Vicia</u> mixture.                                                                                                                                                                                     |
| Perennials: | Rhodes grass ( <u>Chloris gayana</u> );<br>Coloured guinea grass ( <u>Panicum coloratum</u> );<br>Napier/elephant grass ( <u>Pennisetum purpureum</u> );<br>Columbus grass ( <u>Sorghum alnum</u> );<br>Greenleaf Desmodium ( <u>Desmodium uncinatum</u> ). |



**TABLE 4. Dry matter yields (t/ha) of 3 annual local Trifolium species under 3 levels of phosphorus fertilizer**

| species                | Debre Berhan     |      |      | Holetta          |      |      | Species mean |
|------------------------|------------------|------|------|------------------|------|------|--------------|
|                        | P-levels (kg/ha) |      |      | P levels (kg/ha) |      |      |              |
|                        | 0                | 10   | 30   | 0                | 10   | 30   |              |
| <u>T. tembense</u>     | 3.38             | 3.19 | 3.49 | 2.61             | 3.71 | 4.49 | 3.48         |
| <u>T. decorum</u>      | 3.41             | 3.33 | 4.26 | 3.69             | 4.60 | 5.15 | 4.07         |
| <u>T. quartinianum</u> | 1.29             | 2.11 | 1.43 | 4.38             | 5.31 | 5.39 | 3.32         |
| P mean                 | 2.69             | 2.89 | 3.06 | 3.56             | 4.54 | 5.01 | 3.62         |

|                       |      |      |      |      |
|-----------------------|------|------|------|------|
| SE                    | 0.42 | CV   | 20%  |      |
| LSD (t/ha)            |      | 5%   | 1%   | 0.1% |
| among species means   |      | 0.51 | 0.68 | 0.90 |
| among P-level means   |      | 0.43 | 0.57 | 0.76 |
| between station means |      | 0.35 | 0.47 | 0.62 |
| interaction           |      | 1.22 | 1.64 | 2.17 |

|                        | Holetta          |                   |                    | % DM | D. Berhan        |                    |
|------------------------|------------------|-------------------|--------------------|------|------------------|--------------------|
|                        | Date of planting | Date of flowering | Date of harvesting |      | Date of Planting | Date of harvesting |
| <u>T. tembense</u>     | 29/5             | 15/9              | 25/9               | 19.0 | 30/3             | 1/11               |
| <u>T. decorum</u>      | 29/5             | -                 | 9/10               | 27.0 | 30/3             | 1/11               |
| <u>T. quartinianum</u> | 29/5             | 22/9              | 5/10               | 21.2 | 30/3             | 1/11               |

**TABLE 5 . Seed yields (kg/ha) of 2 annual local Trifolium species under 3 levels of phosphorus at Holetta**

| Species                | P - levels |     |     | Species mean |
|------------------------|------------|-----|-----|--------------|
|                        | 0          | 10  | 30  |              |
| <u>T. tembense</u>     | 122        | 142 | 143 | 136          |
| <u>T. quartinianum</u> | 275        | 373 | 355 | 335          |
| P-level mean           | 199        | 258 | 249 | 236          |

|                       |          |      |       |
|-----------------------|----------|------|-------|
| SE 0                  | 30 kg/ha | Cv 0 | 21.7% |
| LSD (kg/ha)           | 5%       | 1%   | 0.1%  |
| between species means | 54       | 76   | 111   |
| among P-level         | NS       | NS   | NS    |
| interaction           | NS       | NS   | NS    |

Perennials : Phalaris aquatica cvs Sirocco and Australia Tall fescue;  
(Festuca arundinacea) Italian rye grass (Lolium multiflorum)  
cv Barspectra.

More work is required on the agronomy of perennial tropical legumes particular when they are sown in mixture with grasses. Further studies are also needed on the agronomy of the native clovers, particularly the perennial species which have received almost no attention.

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## **7. PRELIMINARY RESULT OF ALFALFA SCREENING UNDER SUPPLEMENTARY IRRIGATION IN THE SEMI-ARID ZONE OF SYRIA**

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### Summary

Alfalfa is the most nutritive crop among cereal and legume forages. Of the 12 alfalfa cultivars tested under irrigation in the semi-arid region of Syria, very significant differences were found between native (Damascus local) and foreign cultivars. Cyprus Local (Cyprus) and Hijazi (Sudan) produced fresh weight yields of 118.9 and 114.3 tonnes/ha, respectively, 235 % and 226 % as much as Damascus Local (50.7 t/ha). A total of 15 irrigations in the establishment year enabled 7 cuts to be taken, in addition to 3 cuts under rainfed condition in the case of Cyprus Local and Hijazi. Four cultivars (Cyprus Local, Hijazi, Cargo and Salton) were found to be non-dormant in winter, and so could be used to supply continuous forage at this critical time.

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## Introduction

Alfalfa (*Medicago sativa* L.) is generally regarded as the world's most valuable cultivated fodder crop and the most useful legume known. It is adapted to such a diversity of climatic and soil conditions that it is grown on a scale which probably exceeds that of any other forage crop. It can be used in such areas where seasonal temperatures range from as high as 49°C (120°F) to as low as -46°C (-50°). Diurnal temperature fluctuations of 40° are common. Annual precipitation may vary from 500 mm to below 250 mm with periods of drought common at any time (Ries 1982).

Literally thousands of worker years have been spent on research on its production, breeding and management. And it is small wonder that alfalfa's history parallels that of all major civilizations, and that it has received the title of "Queen of the forages" (Hanson 1972). It produces various types of forages such as green matter, permanent pasture for grazing, fresh hay, pelleted, cubed, blocked or dropped hay, silage and untreated fresh matter stored in an air-tight tower silo. Volumes have been written on the merits and aspects of lucerne use in dry land conditions (Rumbaugh and Petersen 1979, Rumbaugh 1982, Russel *et al* 1982, Leach 1977 and 1978, Leach *et al* 1982) as well as under irrigation (Abdul-Jabbar 1982, Abdul-Jabbar *et al* 1983, Yanshine and Yanshina 1981), but not much work has been reported under supplementary irrigation, especially in the Middle-East countries. So the objective of this study was to evaluate some native and foreign alfalfa cultivars under the above mentioned conditions.

## Alfalfa Water-Use Efficiencies

Several researchers have studied the Water-Use Efficiencies (WUE) of alfalfa, because it is vital to the success of the crop and plays a great role in increasing or decreasing yield, quality, stand longevity and economic returns. Miller *et al* (1982) found a three way interaction indicating that crude protein content of some varieties changed with irrigation regimes and cuttings. Donovan and Meek (1983) reported that alfalfa yields increased with the increase in applied water. Delaney *et al* (1978) showed, that WEU was greater under low than under high water regimes. Jodari-Karimi *et al* (1983) proved that, losses of water through evapo-transpiration and during conveyance and application can be reduced by less frequent but heavier irrigations, which penetrate deeper into the soil and encourage the growth of a deep root system. So soil moisture is among the factors which affects the rate of root growth and pattern of distribution; dry soil will induce plants to develop a more extensive root system especially in the establishment year. Similar results were found by Benz *et al* (1982).

## Materials and methods

A field experiment was conducted in which 12 alfalfa varieties were seeded on 27 March 1983, at Tel Hadya village, south of Aleppo city (about 350 mm average annual precipitation). Details of varieties are given in Table 3. The soils are classified as vertic (calcic) luvisol (FAO), or chromoxertic Rhodoxeralf and calcic Rhodoxeralf (USDA-system), with pH-KCL 8.8 - 6.9 (Harlmsen, 1981). The experimental design was a randomized complete block in three replicates. Alfalfa was seeded with a 12 row planter (Oyjord) with 16 cm between rows; the seeding rate was 16 kg/ha. The plot size was 2 x 3m. Cuts were made at the 10% bloom stage in spring and summer, and late vegetative stage in autumn and winter. The grazing season lasts from the beginning of March until the following February. Irrigation was applied by sprinkler irrigators at a rate of 8.7 mm/hour at a pressure of 44.2 bars (bar = kg/cm<sup>2</sup>).



The first irrigation was applied immediately following seeding to ensure uniform germination. Later alfalfa was irrigated as needed (on average twice monthly) till October (see Table 2). Alfalfa yields were determined by cutting to a stubble height of 5 - 8 cm, and the fresh weight was determined. Annual and perennial weed competition was minimal and alfalfa yields were adjusted to a weed free status. No herbicides, insecticides or fungicides were used throughout the first year. Super-phosphate fertilizer was added in autumn 1982 at the rate of 60 kg P<sub>2</sub>O<sub>5</sub> per ha.

## Results and Discussions

Fresh alfalfa can increase herbage yield (DM), crude protein (CP), provitamin A (carotene), digestible protein (DP), and digestible energy (DE), and thus improve forage palatability and digestibility more than any cereal forages or even important legumes. See Table 1.

**TABLE 1. Variations in nutritional and chemical composition between alfalfa and some important cereal and legume forages, in % (Kearl 1979)**

| Forage      | Dry matter (DM) | Crude fiber (CF) | Crude Protein (CP) | Ca  | P   | Provitamin A (carotene) mg/kg | Digestible Protein (DP) |       | Digestible Energy (DE) megacal/kg |       |
|-------------|-----------------|------------------|--------------------|-----|-----|-------------------------------|-------------------------|-------|-----------------------------------|-------|
|             |                 |                  |                    |     |     |                               | Cattle                  | Sheep | Cattle                            | Sheep |
| Barley      | 21              | 5.6              | 3.5                | .12 | .07 | 47.3                          | 2.6                     | 2.7   | .50                               | .54   |
| Oats        | 16              | 4.2              | 2.0                | .08 | .04 | -                             | 1.4                     | 1.5   | .53                               | .45   |
| Ryegrass    | 19              | 4.8              | 4.0                | .10 | .07 | -                             | 3.0                     | 2.5   | .55                               | .55   |
| Sudan-grass | 20              | 6.3              | 2.8                | .11 | .04 | 36.7                          | 2.0                     | 1.8   | .51                               | .54   |
| Vetch       | 19              | 4.2              | 3.7                | .03 | .05 | -                             | 2.8                     | 2.8   | .53                               | .50   |
| Pea         | 17              | 4.1              | 3.2                | .20 | .05 | -                             | 2.4                     | 2.5   | .50                               | .49   |
| Red clover  | 20              | 5.5              | 2.8                | .35 | .07 | -                             | 2.0                     | 2.0   | .53                               | .54   |
| Sainfoin    | 22              | 5.4              | 3.0                | .30 | .07 | -                             | 2.1                     | 2.1   | .61                               | .61   |
| Alfalfa     | 22              | 5.1              | 5.0                | .41 | .06 | 37.9                          | 3.8                     | 4.0   | .61                               | .66   |

The water used by alfalfa varieties from irrigation and rainfall, the intensity and interval of cutting and air temperatures (C°) are given in Table 2.

**TABLE 2. Cutting and quantity of water used by alfalfa under trial, 1st season 1983 - 1984**

| Cut             | Cutting date | Cutting intervals (days) | No. of irrigation | Water-used, mm |           | Air temperature C° |      |      | No. of frost days | Absolute minimum (C°) |
|-----------------|--------------|--------------------------|-------------------|----------------|-----------|--------------------|------|------|-------------------|-----------------------|
|                 |              |                          |                   | irrigation     | rain-fall | total              | Max. | Min. | Mean              |                       |
| 1               | June 2       | 67                       | 4                 | 170.5          | 69.5      | 240.0              | 26.1 | 10.1 | 18.1              | -                     |
| 2               | June 26      | 24                       | 2                 | 118.8          | 1.6       | 120.4              | 32.6 | 16.1 | 24.3              | -                     |
| 3               | July 17      | 21                       | 2                 | 118.8          | -         | 118.8              | 35.2 | 18.7 | 26.9              | -                     |
| 4               | Aug. 7       | 21                       | 2                 | 98.4           | -         | 98.4               | 35.8 | 20.7 | 28.2              | -                     |
| 5               | Aug. 30      | 23                       | 2                 | 85.8           | -         | 85.8               | 33.5 | 18.7 | 26.1              | -                     |
| 6               | Sept. 22     | 23                       | 1                 | 77.3           | -         | 77.3               | 34.3 | 17.8 | 26.0              | -                     |
| 7               | Oct. 17      | 25                       | 2                 | 53.8           | 5.2       | 59.0               | 28.8 | 10.9 | 19.7              | -                     |
| 8               | Nov. 20      | 34                       | -                 | -              | 66.9      | 66.9               | 22.9 | 9.6  | 16.2              | -                     |
| 9               | Dec. 18      | 28                       | -                 | -              | 26.0      | 26.0               | 15.6 | 6.1  | 10.8              | 2                     |
| 10              | Feb. 16      | 60                       | -                 | -              | 61.7      | 61.7               | 13.2 | 2.5  | 7.8               | 16                    |
| Total / average |              | 33                       | 15                | 723.4          | 230.9     | 954.3              | 27.8 | 13.1 | 20.4              | 18                    |



The amount of seasonal water used by alfalfa plants was 954.3 mm including 230.9 mm precipitation, which was quite enough for the non-dormant tested varieties like Cyprus and Jijazi to give 3 cuts in autumn/winter (rainfed), in addition to which, the seventh cut required only 53.8 mm of irrigation to supplement the 5.2 mm of rainfall in October. Water requirements decreased from a high in summer and to a low in autumn and winter, and it was, as expected, high during the establishment year, but will be lower in the second season and still less in the third; the quantity of water required decreased as root depth increased.

The total fresh yields of alfalfa varieties with statistical analysis are given in Table 3.

TABLE 3. First season fresh yield alfalfa varieties, 1983 - 1984

| Variety                 | Origin | No. of cuts per season | Green Matter Tonnes/ha | % of control | Rank |
|-------------------------|--------|------------------------|------------------------|--------------|------|
| Damascus Loc. (Control) | Syria  | 7                      | 50.7                   | 100          | 11   |
| Cyprus Loc.             | Cyprus | 10                     | 118.9                  | 235          | 1    |
| Cargo                   | USA    | 9                      | 104.9                  | 207          | 3    |
| Salton                  | USA    | 9                      | 99.8                   | 195          | 4    |
| Europe                  | France | 7                      | 60.1                   | 119          | 8    |
| Jertus                  | France | 8                      | 59.4                   | 118          | 9    |
| Euver                   | France | 8                      | 60.5                   | 120          | 7    |
| Resis                   | France | 8                      | 47.1                   | 94           | 12   |
| Turkey                  | Turkey | 8                      | 75.3                   | 149          | 6    |
| Hijazi                  | Sudan  | 10                     | 114.3                  | 226          | 2    |
| Team                    | USA    | 8                      | 75.5                   | 149          | 5    |
| Sitel                   | France | 8                      | 57.6                   | 114          | 10   |
| LSD, P = 0.05           |        |                        |                        | 13.5         |      |

Although it was only the establishment year, four non-dormant varieties (Cyprus, Hijazi, Cargo and Salton) gave 9 - 10 high yielding cuts, a total of 118.9, 114.3, 104.9, 99.8 tonnes/ha green matter respectively, 235 %, 226 %, 207 %, 195 % as much the control (Damascus Local). It is quite evident that the results are very significant.

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## 8. OATS FOR GRAIN PRODUCTION IN ETHIOPIA

Daniel Keftasa \*

### Introduction

In total world production, oats consistently ranks fifth and barley fourth; maize fluctuates from third to second and rice from second to third and wheat is consistently ranked first (Baum, 1977). More than 80% of acreage planted with oats in the world contains varieties of Avena sativa L species (2n = 42). The remainder is mainly sown with varieties of Avena byzantina (Coffman, 1961). Coffman (1961) reviewed various investigations on the origin and history of oats and concluded that the derivation of the Latin word Avena remains somewhat obscure. It seems probable that it is from the Latin word Aveo (to desire), however, it is generally thought to be from the Celtic 'aten' from 'etan' meaning 'eat'. According to Coffman (1977) oats were first used as a pasturage or forage crop in southern Europe long before they were grown for grain and thus Linneaus may have used sativa to imply 'sown or cultivated'. Coffman (1961) concludes that the origin of oats is in the Asia minor region. Fulling (1953) stated that common oats, the most important of the cultivated and botanical forms of Avena, appears to have originated in regions of Western Europe, from which it spread to parts of the world having a favourable environment for its growth and culture. A detailed study on the world collection of oats (Baum 1977) showed that the species A. abyssinica, A. vaviloviana and their crosses are exclusively found in Ethiopia. A. sativa is also native to Ethiopia. One species native to Ethiopia, A. abyssinica, grows on the elevated basalt plateaus above 2400 m in cereal fields as a "tolerated weed" and is quite often harvested as a cultivated plant or even cultivated alone. Thus Ethiopia has a wide genetic base for research on the improvement of oats.

### Climatic Requirements

Oats are best suited to cool, moist highland regions. Experience shows that oats for forage can be grown in most medium - highland regions but oats for grain grow best in regions above 2200 m altitude having about 400 mm of rainfall, a mean maximum temperature of 19°C and a mean minimum temperature of 8°C during the main crop season (June - October). Oats require more moisture than any of the other small grains. Hot dry weather when the grain is developing often results in poor filling of the grain and low yield while hot humid weather favours the development of disease organisms to which oats are particularly susceptible (e. g. leaf and stem rusts).

\* ARDU, Asella, Ethiopia



## Present Status of Oats Production in Ethiopia

Compared to other cereals the production of oats in Ethiopia is quite small. Oats are grown to some extent at altitudes from 2000 - 3000 m for human consumption. They are most commonly observed in Selale, Gojam and Debre Berhan regions and to some extent in the Arsi region. About 20,000 ha are sown to oats and the average grain yield is about 700 kg/ha (FAO 1981). A crop survey in Arsi region showed that oats are grown on about 2000 ha, mainly on the poorly drained black clay soils of the open plateau which are less favourable to barley and wheat. An investigation by the Highland programme of the International Livestock Centre for Africa (ILCA) around Debre Berhan showed that under the very wet conditions during the main rainy season, oats performed better and produced higher grain yields than other cereals.

Agronomic advantages of oats include the relative absence or tolerance of aphid infestation and good frost tolerance. Other agronomic advantages which were recognized by farmers included high grain and straw yield, good general adaptation to the highland climate and soils, good regrowth when cut green for hay and less land preparation required than for barley.

As part of the effort to improve the pastures and forage production in Ethiopia research on oats for forage has been going on for about 2 decades. The use of oats for forage has attracted considerable interest due to its capacity for high dry-matter production in a short time and ease of seed production. Currently a total of about 1000 quintals of improved seed (Lampton) is planted annually for forage production.

In many countries oats are mainly cultivated for grain which is fed to animals. However, some are processed for human consumption. Although there are regions in Ethiopia where oats are used for human consumption (enjera, preparation of local beer and distilled spirits) it has not been tried widely.

The purpose of this article is to provide information to professionals working in agronomy and nutrition and to stimulate greater research on and use of oats.

### Production Techniques

#### Seed rate

The results of field experiments at two highland sites over two seasons showed that the best sowing rate for oats for grain production was 75 kg/ha in rows drilled at a spacing of 20 cm and 100 kg/ha if broadcast. The seeding rate for grain production should preferably be 20 - 30% less than for herbage production. Lower seeding rates are desirable for grain particularly where lodging is expected to be a problem.

#### Time of Planting

Oats are a slow maturing crop compared to other small grain cereals. It takes about 160 days for grain maturity in the highland regions and about 400 mm of well distributed rainfall up to the stage when the grain fills. Oats should be planted as soon as the main rains begin, normally in the first week of June.

#### Fertilizer Rate

Oats respond both to nitrogen and phosphorus fertilization but the extent depends on the fertility of the soil and the crop rotation used. It was observed that in soils which were manured or when oats were planted after a leguminous crop there was no need to fertilize, especially for grain production. Generally



oats for forage are fertilized more liberally with nitrogen than are plantings for grain production. When fertilizer is needed 100 kg/ha DAP (Diammonium phosphate) (18/46) is usually enough. Higher rates of fertilization, especially of nitrogen, causes lodging and creates an unfavourable grain to straw ratio.

### Weed Control

Experience shows that oats can compete well with weeds. If adequate seed bed preparation practices are followed and planting is done early in the season there is no need to worry about weed control. Where broad leaved weeds are troublesome, MOPA (herbicide) at the rate of 2.5 lt/ha can be used about 30 - 45 days after planting.

### Harvesting

Harvesting can be done by an ordinary combine harvester adapted for other small grain cereals. Oats should be harvested in bright dry weather when the seeds contain only about 13% moisture. Average grain yields are about 23 qt/ha at ARDU under large scale grain production but results of up to 75 qt/ha have been obtained from small plots. With good management and favourable weather yields of about 35 qt/ha can be expected from large scale seed production. Cost of production (for seed, fertilizer, herbicide and farm machinery) is about 550 birr/ha (approximately \$275 US/ha).

The following data is taken from research work at ARDU (Daniel, 1984). Seven oat varieties were compared for grain yield, (Table 1) grain quality (along with other varieties), (Table 2) and chemical composition (Table 3).

### Grain Yield

As shown in Table 1 cultivars Jasari and Lampton produced significantly higher grain yields than other varieties. The low yield produced by the late maturing variety CI 8251 at Kulumsa was due to lack of moisture in October, before the crop had matured. At Bekoji, where there was sufficient moisture throughout the crop maturation period, significant differences were observed between the varieties and Jasari had significantly superior yields compared to all other varieties. This observation agrees with reports from the Institute of Agricultural Research in other regions of Ethiopia (Gebrehiwot 1981). The grains of Jasari were short and plump and thus more easily threshed than the long, slim grains of other varieties.

Generally wheat and barley may be more productive in the Ethiopian Highlands than oats, but the adaptability of oats to relatively poor soil moisture conditions make it a useful crop for both human consumption and livestock feed.

### Agronomic qualities and chemical composition of seeds

On average, the oat varieties tested had a hectolitre weight and 1000 kernel weight of 45.8 kg and 24.52 g compared to 61.3 kg and 34.0 g and 32.9 g and 75.8 kg for barley and wheat, respectively. Some differences were also observed between the oat varieties. The kernel contents of the oat varieties varied from 60.7 % (Jasari) and 72.1 % (Grey Algier). There was a close and positive correlation between the hectolitre weight, 1000 kernel weight and kernel content.

**TABLE 1. Grain yield (kg/ha) of varieties of oats at Kulumsa and Bekoji, 1980**

| Varieties | Kulumsa | Bekoji | Mean  |
|-----------|---------|--------|-------|
| Lampton   | 4,150   | 2,850  | 3,500 |
| CI 8235   | 2,630   | 2,790  | 2,710 |
| CI 8237   | 2,540   | 3,070  | 2,810 |
| CI 8251   | 700     | 2,920  | 1,810 |
| CI 8257   | -       | 3,090  | -     |
| Jasari    | 4,750   | 4,580  | 4,670 |

**TABLE 2. Hectolitre weight, 1,000 kernel weight, kernel content and germination percent of seeds of different varieties of oats, other cereals and some legumes**

| Seeds         | Hl. wt.<br>kg | 1000<br>Kernel<br>wt. g | Kernel<br>Content<br>% | Germination |            |                 |
|---------------|---------------|-------------------------|------------------------|-------------|------------|-----------------|
|               |               |                         |                        | Lab<br>%    | Field<br>% | Field<br>lab. % |
| <u>Oats</u>   |               |                         |                        |             |            |                 |
| Lampton       | 49.0          | 25.0                    | 67.3                   | 94          | 78         | 83              |
| CI 8235       | 41.3          | 21.8                    | 64.8                   | 75          | 76         | 101             |
| CI 8237       | 46.2          | 22.9                    | 62.8                   | 85          | 79         | 93              |
| CI 8251       | 47.3          | 22.0                    | 66.0                   | 85          | 83         | 98              |
| CI 8257       | 44.4          | 24.5                    | 65.0                   | 88          | 81         | 92              |
| Jasari        | 42.7          | 27.0                    | 60.7                   | 92          | 86         | 93              |
| Grey Algiers  | 50.0          | 28.3                    | 72.1                   | 93          | 90         | 97              |
| <u>Wheat</u>  |               |                         |                        |             |            |                 |
| K 6295 - 4A   | 77.3          | 32.0                    | -                      | 96          | 92         | 96              |
| Enkoy         | 74.3          | 33.8                    | -                      | 93          | 86         | 92              |
| <u>Barley</u> |               |                         |                        |             |            |                 |
| IAR H 485     | 61.3          | 39.0                    | -                      | 98          | 93         | 95              |
| Holker        | 61.2          | 29.8                    | -                      | 93          | 88         | 95              |
| <u>Maize</u>  |               |                         |                        |             |            |                 |
| Alem comp.    | 72.9          | 399.5                   | -                      | 87          | 65         | 75              |
| <u>Vetch</u>  |               |                         |                        |             |            |                 |
| Lana          | 78.0          | 37.5                    | -                      | 94          | 57         | 61              |
| <u>Pea</u>    |               |                         |                        |             |            |                 |
| C. S. 436 K   | 79.5          | 154.0                   | -                      | 92          | 95         | 103             |
| Mohanderfer   | 80.2          | 236.0                   | -                      | 88          | 81         | 92              |

The germination of oat varieties, both in the laboratory (about 22/17 °C day/night temperatures) and in the field (23/11 °C max/min temperatures) at Kulumsa, was generally lower than the values for wheat and barley.

Table 3 shows the chemical composition of varieties of oats and other grains. All varieties of oats had lower contents of crude protein, nitrogen-free extract (NFE) and metabolizable energy than barley and wheat. On the other hand, oats had higher contents of crude fibre, ash and fat than barley



and wheat. All varieties of oats except CI 8235 contained higher crude protein contents than maize and all varieties of oats contained less metabolizable energy than the other grains due to their high crude fibre contents.

There were significant variations in digestible crude protein content between the oat varieties. Lampton showed the highest content of digestible crude protein, followed by Jasari. The chemical composition of Lampton was close to the specifications given for commercial oats by Western and Graham (1961) but other varieties were below this standard. These results are preliminary as they were obtained from only one season's harvest at Bekoji and composition may vary with such environmental factors as soil and the weather conditions before and during harvest. It appears that kernel composition (groat) is the major factor influencing the composition of oats as hulls generally contain less protein and energy than the grain. With maintenance of varietal purity and adequate seed cleaning (grading) it is probably possible to produce seeds of higher quality than reported in this study.

**TABLE 3. Chemical composition, digestible crude protein (DCP) and metabolizable energy (ME) contents of seeds of varieties of oats, other cereals and some legumes**

| Species and varieties | Contents of the dry matter, % |      |      |     |      | DCP<br>g/kg dm | ME<br>MJ/kg dm |
|-----------------------|-------------------------------|------|------|-----|------|----------------|----------------|
|                       | ash                           | CP   | CF   | fat | NFE  |                |                |
| <u>Oats</u>           |                               |      |      |     |      |                |                |
| Lampton               | 3.8                           | 12.0 | 11.5 | 6.5 | 66.3 | 90.8           | 12.0           |
| CI 8235               | 3.5                           | 8.1  | 14.1 | 6.4 | 68.0 | 61.7           | 11.7           |
| CI 8237               | 3.8                           | 9.9  | 13.4 | 6.8 | 66.2 | 75.4           | 11.8           |
| CI 8251               | 3.6                           | 8.8  | 14.6 | 6.5 | 66.5 | 67.1           | 11.7           |
| CI 8257               | 3.6                           | 9.2  | 15.7 | 6.9 | 64.6 | 70.2           | 11.7           |
| Jasari                | 3.6                           | 10.9 | 15.9 | 7.2 | 62.4 | 82.9           | 11.7           |
| Grey Algiers          | 3.7                           | 10.3 | 12.0 | 7.5 | 66.5 | 78.5           | 12.1           |
| <u>Wheat</u>          |                               |      |      |     |      |                |                |
| K 6295 - 4A           | 3.0                           | 15.8 | 2.7  | 2.1 | 76.4 | 127.7          | 13.9           |
| Enkoy                 | 2.1                           | 14.2 | 2.9  | 2.0 | 79.0 | 114.6          | 14.0           |
| <u>Barley</u>         |                               |      |      |     |      |                |                |
| IAR H 485             | 2.7                           | 12.7 | 6.6  | 2.1 | 75.9 | 96.6           | 13.3           |
| Holker                | 3.1                           | 11.1 | 5.2  | 2.1 | 78.4 | 81.0           | 13.3           |
| <u>Maize</u>          |                               |      |      |     |      |                |                |
| Alem. comp.           | 1.3                           | 8.6  | 2.1  | 4.8 | 83.2 | 62.6           | 14.7           |
| <u>Vetch</u>          |                               |      |      |     |      |                |                |
| Lana                  | 3.3                           | 32.4 | 7.6  | 1.1 | 55.6 | 285.2          | 13.9           |
| <u>Pea</u>            |                               |      |      |     |      |                |                |
| C. S. 435 K           | 2.9                           | 27.7 | 2.7  | 1.1 | 59.5 | 244.0          | 13.8           |

## Conclusion

The available information indicates that oats grain production can be a complementary crop to the traditional cereal crop, barley, of the Ethiopian highlands. Although it is unlikely that oats will replace barley in the near future, it can be a partial substitute especially where the climate and soil conditions permit better production of oats.

The oat grain is particularly valuable as feed for horses, dairy cows, poultry, swine and young breeding animals of all kinds. Oats usually furnish cheaper protein than any other grain, often resulting in reduction of the amount of expensive protein supplement used. The fact that oats are bulky, have high digestibility and are palatable to livestock make them popular as animal feed.

In the highland parts of Ethiopia, the major constraint for improved dairy production is high quality feed. Due to the lack of industrial by-products (concentrates) and the poor transportation facilities, farm produced oats grain can be a good supplementary ration particularly when combined with leguminous crops (beans and peas).

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## **9. ANIMAL MANAGEMENT IN WOLAITA AWRAJA, SODDO**

James Ochang \*

In the Wolaita Region, crop and livestock production are limited by the amount of land per individual small holder (average 0.5 ha). Crop production entails very complex mixed farming and crop rotation. Individual farmers, including ILCA FLAG forage research cooperators, were questioned about



methods of handling the animal production cycle with in this system and subsequent gains from animals and animal products. This information was collected from farmers living within 3.5 km of Soddo town.

Land for grazing is limited to crop margins, stony and infertile areas and communally owned lands. The communal land is grazed only part of the year as some grass is reserved for thatching huts. In some areas, water-logging limits the growth of many grasses. Crop residues provide a large percentage of the feed and like the native grasses, they are limited in the dry season. Therefore the farmer only keeps approximately 5 cattle including a milking cow, calf, breeding bull and two oxen and possibly one or two sheep. If less than 5 cattle can be kept the bull will be borrowed from a neighbour.

Calving frequency is very low with intervals of 2 - 2½ years. The average pregnancy is 9 months, with a lactation of 10 - 12 months. In some cases, cows are bred 6 months after calving which increases frequency. However when more animals are produced restricted feed supplies result in sales of animals below one year of age. Therefore, the farmers prefer longer milking periods to frequent calving.

Caring for a calf is simple and requires little time. In the first week the calf takes all the milk (colostrum), suckling directly. In the second week, two teats are milked for human consumption leaving two for the calf. Some farmers, however, stimulate milk let-down by allowing the calf to suckle for a while and then drawing it away. After milking, the calf is allowed to suckle the remaining milk. This is repeated three times daily. As less milk is allowed for the calf, it is expected to increase grass intake and within 6 - 8 weeks will be completely weaned. The calf grazes and is stall-fed additional grass and weeds from crops and waste areas, as well as some specially collected legumes, eg. Zornia, Stylosanthes, Erythrina spp and various herbs. The farmer may also feed malted barley (after beer making requirements are met) and locally purchased cotton seed. The weaning period is not immediately obvious as the calves retain contact with their mothers when grazing and sleeping. Complete separation occurs when the cow is again pregnant and lactation ceases.

The highest yielding animals are kept by the farmers while low yielders are sold. Older males are fattened before harvest and sold for between 200-300 Birr. Yields of milk vary from 1 to 3 liters/day from 3 milkings. Three liters/day is ultimately obtained by the time the calf is weaned and this quantity slowly declines until the end of lactation.

The family will consume 50% of the milk after butter extraction. The remaining 50% is marketed at 30 - 50 cents per liter. Butter sells for approximately 7.50 - 10.00 Birr/kg with prices fluctuating seasonally. Surplus milk is also made into cheese which sells for 1 birr/kg.

According to the farmers, high milk yields and good butter quality are maintained by feeding selected legumes such as Zornia, Trifolium, Stylosanthes, and Crotalaria spp. mixed with herbs which have been boiled or pounded into a paste. This is a traditional method of supplementing the diet.

The cooperation of the farmers is appreciated in providing this information. Future studies on animal husbandry are planned using more outlying regions of the area.

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## 10. ADVISORY NOTES

### 10. 1. Macrotyloma axillare

John Lazier\*

Macrotyloma axillare (E. Mey) Verde is a viney legume native to Africa, Madagascar and Sri Lanka has shown considerable promise in forage trials run by the FLAG unit of ILCA both in the Central Rift Valley, and at Soddo.

M. axillare is commonly known as axillaris and there is one cultivar, cv Archer, which is available commercially.

Axillaris is a perennial self-fertile viney legume which climbs or trails with most stems originating at a crown at ground level. It is trifoliate with smallish ovate, slightly hairy leaves, 3 to 5 cm long. It has yellowish green flowers in groups of three in the leaf axils, and pods which are slightly curved and hairy containing seven to eight seeds.

Native to Ethiopia (two varieties axillare and glabrum) it occurs widely from 1500 to 2300 m in grassland, bush and forest margins. In sub-Saharan Africa it occurs widely as well, from the Sudan to South Africa. Adapted to cooler environments it shows good early season growth and although susceptible to frost and fire it recovers rapidly. It is also tolerant of high temperatures (it grows well at Melke Werer) and is little affected by pests or diseases.

While it is reported that it grows well only up to altitudes of 1200 m, it has performed very well at the FLAG sites at Zwai (1650 m) and at Soddo (1850 m). Despite recommendation of 1000 mm as a minimum annual level of rainfall, it is as vigorous as Stylosanthes scabra cultivars under 800 mm near Meki and has shown relatively good growth and persistence under the drought conditions prevailing in the region in 1984.

Intolerant of water-logging, it grows well in a wide range of soils from the well-drained volcanic tufa based soils of Zwai (pH 8) to the well-drained Nitosols of the medium altitude western plateau of Ethiopia (pH 4.8).

Responsive to applications of phosphorus axillaris combines well with a range of grasses (including Setaria, Paspalum and Chloris gayana but not Digitaria decumbens) and legumes (Desmodium spp, Neonotonia wightii and Siratro). Its ability to combine well with Chloris was particularly marked in Soddo where in a strip trial it formed a solid wedge of legume about a meter high in flowering Chloris gayana which was about 1.5 m high. Its climbing character helps it to compete with weeds, which it can be useful in suppressing.

The plant may be of relatively low palatability when young, or initially until animals become accustomed to it. However, in Soddo there was no apparent palatability problem when well-fed dairy animals grazed it in a strip trial for the first time. As the stems are easily damaged by trampling, and abundant residual stems are required for rapid regrowth, axillaris can withstand lenient defoliation and trampling. It has been reported as being productive when rotationally grazed to 15 cm. The most productive management system however may be cut and carry, as cutting heights can be lenient, leaving at least 50 cm of stem for rapid regrowth. If care is taken in drying, and to prevent loss of leaves axillaris should be good for hay, or silage. Its relative drought tolerance makes it useful as a standing hay in the dry season as most leaves remain on the plant.

---

\* ILCA, FLAG



Flowering is prolonged, and sparse with scattered pods developed close to the ground making harvesting difficult and resulting in low seed yields (100 to 150 kg/ha normally). Harvesting is done by cutting the stems and allowing them to dry over a concrete or sealed mud floor. The pods will shatter as they dry.

Screening is best done at 3 to 5 kg/ha into a well prepared seed bed. The seeds do not require scarification before planting nor inoculation as axillaris normally nodulates readily with native (cowpea strain) rhizobia.

While it has been stated that it is a complementary legume to Siratro on well drained soils in Australia, in Ethiopia it has out-performed Siratro at most locations. Where tested in the Rift Valley, due to its sensitivity to trampling and requirement for rotational grazing, it would probably be best used as cut and carry or a reserve source of protein grazed by selected stock for a short period daily.

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## **10. 2. Hydroponic Culture, A New Herbage Technology Part 2\*\***

Alemayehu Mengistu\*

### How a hydroponic factory works

1. Hydroponic farming consists of three phases:
  - 1) Steeping: The grain, placed in a water-tight plastic tank, is soaked in water for 24 hours to initiate germination.
  - 2) Germination: The soaked grain is put for 48 hours into a perforated plastic tank to facilitate drainage and aeration during the start of the germination.
  - 3) Growing: The germinated grain is put on aluminium trays specially designed for the growth of the grain. Irrigation, light and temperature are controlled to produce maximum growth in five days.
2. The best conditions for growth are Temperature : 20 to 25 ° (for temperate cereals).  
Humidity - 80 to 90 percent.  
Lighting - (natural or artificial) 10 to 12 hour a day.  
Quality of water- salt content of less than 500 ppm (international norm).  
Quality of grain- minimal germination of 70 percent.

The daily production is about 120 kilos (wet weight) of pasture for 15 kilos of dried grain sown on five trays.

---

\* Ministry of Agriculture, Addis Ababa, Ethiopia

\*\* Continued from FNE Newsletter No. 7

### 3) The Farming area

Light is essential for the success of the farming, so it is necessary to have premises well lit either naturally or artificially. Direct radiation of the sun has to be avoided and frosted glass is used.

In regions where sunlight is not strong enough, artificial lighting has to be created with fluorescent tubes, or incandescent tubes if heating is required at the same time.

Temperature must be higher than 18°C, so a heating system is necessary in cold regions during winter.

The indoor farming area amounts to 2 square meters per production unit. It is advised to keep one meter between units and to partition the areas to facilitate loading and unloading. A free and continuous air flow is needed, and a drain to remove excess irrigation water.

### Equipment

Each unit has three plastic tanks, one for steeping (24 hours) which is watertight and two which are perforated for drainage and germination (48 hours). Five rows of five ionized aluminum trays are used to grow the crop. These trays are arranged to receive a continuous electronically regulated flow of water by means of sprinklers or drip irrigation. The length and frequency of the watering periods is determined by the temperature, humidity and water use of the plants. The crops roots are thus maintained in a humid, non-asphyxiating environment.

### Disadvantages

- 1) It is expensive to establish and run;
- 2) It has sophisticated mechanical and electronic equipment for which expertise and spare parts must be available;
- 3) It is adapted to temperate countries where temperatures do not allow field raising of forages;
- 4) A high market price for animal products is required to pay for the factory's operation.

### Constraints for use in developing countries

- 1) Market prices for animal products would not cover the running expenses;
- 2) Technical expertise and spare parts are not readily available;
- 3) Forages can be raised year-round much more cheaply by irrigation.

Such systems may be used in tropical countries which have high market prices for animal products, for example Saudi Arabia. This system is also used for vegetable production in oil wealthy tropical countries such as Trinidad (N. Ahmad, pers comm.) where excessive rainfall and the range of pests and diseases inhibits field production.

In summary, this system is not suitable for developing countries.



### 10. 3 Experimental design (Part II)

Alemayehu Mengistu\*

#### 1) Single - Factor Experimental Design

The analysis of variance is a statistical method which is fundamental to the design of experiments in biology, horticulture and agricultural science and to the subsequent application of statistics to the collected data.

A single-factor or one-way analysis of variance implies that the researcher has manipulated only ONE independent variable.

#### Example 1 (Simplified fictitious data)

An acid tolerant pasture species Trifolium subterraneum cv Northam shows promise for stabilizing very acidic coal mine waste (spoil) dumps. A seam being currently considered as a dump surface may require liming and (or) phosphorus addition. The aim of the study was to contrast growth of the cultivar Northam in the overburden material, when different nutrients were applied.

Coal spoil was added to fifteen 25 cm diameter plastic pots and three fertilizer regimes (P at 170 and 340 kg ha<sup>-1</sup> and lime at 3t ha<sup>-1</sup>) were applied to each of the 5 pots. The pots were sown with the pasture crop and after four weeks growth was thinned to 4 good plants. Growth was defined as biomass accumulation (dry wt, gm) over time and this dependent variable was recorded after 112 days. The experimental procedure and collected data are presented in Table 1.

TABLE 1 : Experiment procedure used to investigate growth of Trifolium subterraneum cv Northam in overburden spoil material.  
Dry weight per pot (g x 10<sup>-1</sup>) recorded after 112 days growth.

| Fertilizer Levels                                       |                                                         |                                                       |
|---------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------|
| P<br>170<br>(equivalent to 170 kg<br>ha <sup>-1</sup> ) | P<br>340<br>(equivalent to 340<br>kg ha <sup>-1</sup> ) | Lime<br>(equivalent to<br>3 tonnes ha <sup>-1</sup> ) |
| 4                                                       | 2                                                       | 16                                                    |
| 6                                                       | 10                                                      | 18                                                    |
| 8                                                       | 9                                                       | 10                                                    |
| 10                                                      | 13                                                      | 12                                                    |
| 2                                                       | 11                                                      | 19                                                    |
| $\bar{x}$ 6                                             | 9                                                       | 15                                                    |

\* Senior Pasture Agronomist, Ministry of Agriculture, Addis Ababa, Ethiopia.

The following principles of experimental design are embodied in this study:

- i) The independent variable, fertilizer regime, was administered with three treatment levels.
- ii) Replication overcomes variation from pot to pot.
- iii) The three treatment levels were randomly assigned to the pots.
- iv) Watering procedures and the weather conditions were uniform for all pots.
- v) Other variables, i. e. herbicides, pesticides, fungicides and fertilizers, were not introduced.
- vi) Other dependent variables of interest were recorded, i.e. concentration of nutrients in the plants.

Mean dry weights have been compared statistically using the one-way analysis of variance test (see Table 2). It can be concluded that total growth in the three fertilizer regimes was not the same

**TABLE 2. One-way analysis of variance summary comparing fertilizer regimes Trifolium subterraneum cv Northam in overburden coal spoil**

| Source of variation | SS     | df | MS     | F    | Probability |
|---------------------|--------|----|--------|------|-------------|
| Fertilizer          | 210.00 | 2  | 105.00 | 7.41 | P<0.01      |
| Error               | 170.00 | 12 | 14.17  |      |             |
| Total               | 380.00 | 14 |        |      |             |

The analysis of variance is usually the first step in analysing data. Further statistical analyses enable comparisons between pairs and groups of means. In the example outlined above, after further analyses it would be possible to conclude that treatment had enhanced plant material production.

## 2) Contrasts or planned comparisons<sup>1</sup>

These enable comparisons between pairs of means, which have experimental relevance. Using the outlined example the following questions can be answered by the use of CONTRASTS.

Does the higher phosphate application improve growth of Trifolium subterraneum cv Northam? Does this plant material production differ for lime and phosphate applications?

The summary of these contrasts is provided in Table 3. It can now be concluded that plant material production was not improved by application of the higher phosphate level, equivalent to 3 tonnes ha<sup>-1</sup>. However, lime application did enhance the growth of Trifolium subterraneum cv. Northam.

<sup>1</sup> Mathematical details are provided in Keppel (1973), pp 85 - 132.



**TABLE 3 . Analysis of variance summary for contrast 1: lime with average of the phosphate  
Contrast 2: Phosphate 170 with phosphate 340**

| Sources of variation | SS     | df | MS     | F     | Probability |
|----------------------|--------|----|--------|-------|-------------|
| Fertilizer           | 210    | 2  |        |       |             |
| Contrast 1           | 187.50 | 1  | 187.50 | 13.23 | P<0.01      |
| Contrast 2           | 22.50  | 1  | 22.50  | 1.59  | P<0.1       |
| Error                | 170.00 | 12 | 14.17  |       |             |
| Total                | 380.00 |    |        |       |             |

### 3) Nutrient omission trials

The example given above is a modification of nutrient omission or subtractive trials as outlined by Bell (1981). Such trials involve growing the plant species or pasture crop in the presence of a complete nutrient treatment and a series of other treatments from which one essential nutrient is omitted in turn. The biomass accumulation in the various subtractive treatments is compared with the biomass in all the nutrient treatments. The nutrient omission treatment method requires levels of nutrient treatments which are non-toxic but sufficient to obtain a good yield plateau for the plant species studied.

Bell (1982) compares the nutrient omission experimental design with oneway factorial experiments which also study many nutrient combinations simultaneously.

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#### 10. 4. Dry Weight Ranking for Pasture Composition and Yield

John C. Tothill\*

The proportions or percent composition of species components of a pasture has been found to be simply determined by ranking the species within a series of quadrats into first second and third places on the basis of their apparent yields. When these ranks are weighted by the standard multipliers 8.04 for rank 1, 2.41 for rank 2 and 1.0 for rank 3 and then totalled over the set of samples taken, an accurate estimate of percentage composition is obtained.

By taking a separate yield estimate for the weight of herbage, pasture composition expressed as total dry matter percentage composition on a dry matter basis can be calculated. The example shows how this can be done by the hand calculation method.

##### Example 1

Pasture with three components - sown grass, sown legume, other species  
Four quadrats are taken for ranking of yields  
One quadrat is cut to obtain yield dry weight

TABLE 1

| Quadrat No. | Sown Grass Rank | Score | Sown Legume Rank | Score | Other Species Rank | Score | Totals |
|-------------|-----------------|-------|------------------|-------|--------------------|-------|--------|
| 1           | 1               | 8.04  | 2                | 2.41  | 3                  | 1.00  | -      |
| 2           | 1               | 8.04  | 3                | 1.00  | 2                  | 2.41  | -      |
| 3           | 1               | 8.04  | 2                | 2.41  | 3                  | 1.00  | -      |
| 4           | 2               | 2.41  | 1                | 8.04  | 3                  | 1.00  | -      |
| Totals      |                 | 27.53 |                  | 13.86 |                    | 5.51  | 46.80  |

|                                                               |      |      |          |                     |
|---------------------------------------------------------------|------|------|----------|---------------------|
| % of Total                                                    | 58.8 | 29.6 | 11.6     | 100                 |
| % composition                                                 |      |      |          |                     |
| Composition D. W.                                             |      |      |          |                     |
| basis kg/ha                                                   | 1176 | 592  | 232      | 2000                |
| Weight of herbage from quadrat (0.25 m <sup>2</sup> ) air dry |      |      | 55 g     |                     |
|                                                               |      |      | oven dry |                     |
|                                                               |      |      | 50 g     |                     |
| Conversion factor for g per =.25 m <sup>2</sup> to kg/ha      |      | =    | 40       |                     |
| Therefore overall pasture yield = 2000 kg/ha D. M.            |      |      |          |                     |
|                                                               |      |      |          | 2200 kg/ha A. D. M. |

\* Leader of FLAG, ILCA



This is, in fact, a very simple example of the procedure but it is applicable to the small plots being used in these trials. Ideally a minimum of ten samples per plot should be taken. Where large numbers of samples are being taken then it is more convenient to calculate the results by computer and for this a programme has been written which is called BOTANAL. There are a number of papers written on this procedure, one of which is available at ILCA for those who have a further interest. The programmes can be run on ILCA's HP 3000 but will soon be available for the HP 150 microcomputer or similar machine which the PGRC/E has and IAR are getting.

\* \* \* \*

## STEERING COMMITTEE MEMBERS

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The Forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia. If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

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# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 10

December, 1985

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### 1. INTRODUCTORY MESSAGE

The FNE is pleased to congratulate the authors and editors whose efforts culminated in the publication of the first PANESA newsletter, which was distributed at the PANESA workshop held in Nairobi, Kenya (11 - 15 November, 1985).

The PANESA newsletter will become a regular line of communication for those interested in pasture research and development in Eastern and Southern Africa.

PANESA is the acronym for "Pasture Network for Eastern and Southern Africa." It was established in November of 1984 with the following objectives:

- (i) To encourage and stimulate pasture research in member countries;
- (ii) to assist member countries to develop national pasture research capabilities;
- (iii) to procure, disseminate and facilitate the exchange of pasture plant germplasm in member countries;
- (iv) to collect, disseminate and facilitate the exchange of information in member countries; and
- (v) to popularize pasture research and development in member countries.

The Steering Committee of FNE would like to announce that the next FNE General Meeting will be held at ILCA headquarters from February 6-7, 1986. On the first day of the meeting, research and development results from past years will be reviewed, new work planned for 1986, and present knowledge of forage production discussed. Presentation of general and activity papers by invited professionals will take place on the second day.

The meeting, a very important one for the Network, will start February 6 at 9 a.m. in the small auditorium at ILCA. All individuals and organizations interested in forage production should attend and they need not be FNE members.

Details of the programme will be distributed during the meeting.

(The Editors: - Alemayehu Mengistu, John Lazier).

\* \* \* \*

## 2. FNE ANNUAL GENERAL MEETING PROGRAMME February 6 and 7, 1986

### THURSDAY, 6 FEBRUARY

|       |   |       |                                                               |                                                                                 |
|-------|---|-------|---------------------------------------------------------------|---------------------------------------------------------------------------------|
| 09:00 | - | 09:15 | Registration                                                  |                                                                                 |
| 09:15 | - | 09:30 | Welcome Address                                               | Alemayehu Mengistu<br>Chairman, FNE (MOA)                                       |
| 09:30 | - | 10:00 | opening of the<br>meeting                                     | Dr. Kurt Peters,<br>Director of research (ILCA)                                 |
| 10:00 | - | 10:30 | <b>Coffee</b>                                                 |                                                                                 |
| 10:30 | - | 13:00 | Short reports on<br>general forage<br>activities              | Research Institutes, ILCA<br>Higer Education & Development<br>Organizations     |
| 13:00 | - | 14:00 | <b>Lunch</b>                                                  |                                                                                 |
| 14:00 | - | 15:30 | FNE Multilocation<br>Trials                                   | ILCA, IAR, ARDU, JJAC,<br>AJAC & Sirinka                                        |
| 15:30 | - | 16:00 | <b>Coffee</b>                                                 |                                                                                 |
| 16:00 | - | 16:30 | Report on PANESA<br>Workshop and<br>Annual General<br>Meeting | Alemayehu Mengistu                                                              |
| 16:30 | - | 17:00 | Networks<br>ILCA Training<br>programme                        | Dr. John Lazier, (ILCA)<br><br>Dr. R. Scholtens, Director<br>of Training (ILCA) |
|       |   |       | " " "                                                         | Ato Worku Mekasha' (ILCA)                                                       |

+ + + +

### FRIDAY, 7 FEBRUARY

|       |   |       |                                                |                                                  |
|-------|---|-------|------------------------------------------------|--------------------------------------------------|
| 09:00 | - | 09:45 | Range Ecology<br>Techniques                    | Dr. John Tothill, Head<br>Forage Agronomy (ILCA) |
| 09:45 | - | 10:30 | Dairy Technology<br>Development in<br>Ethiopia | Mr. Frank O'Mahony<br>Dairy Technologist (ILCA)  |



|       |   |       |                                                                 |                                                              |
|-------|---|-------|-----------------------------------------------------------------|--------------------------------------------------------------|
| 10:30 | - | 11:00 | <b>Coffee</b>                                                   |                                                              |
| 11:00 | - | 13:00 | <b>Leucaena Toxicity Control, through Rumen Micro-organisms</b> | Dr. R. J. Jones<br>Principal Scientist<br>(CSIRO, Australia) |
| 13:00 | - | 14:00 | <b>Lunch</b>                                                    |                                                              |
| 14:00 | - | 14:45 | <b>Animal Nutrition</b>                                         | Dr. Jess Reed<br>Animal Nutritionist (ILCA)                  |
| 14:45 | - | 15:30 | <b>Vertisol Management</b>                                      | Dr. S. Jutzi, Forage<br>Agronomist (ILCA)                    |
| 15:30 | - | 16:00 | <b>Coffee</b>                                                   |                                                              |
| 16:00 | - | 16:45 | <b>Rhizobium</b>                                                | Ato Amare Abebe<br>Research Officer (IAR)                    |
| 16:45 | - | 17:30 | <b>FNE business</b>                                             | Alemayehu Mengistu &<br>Lulseged G/Hiwot (IAR)               |

\* \* \* \*

### 3. PASTURE NETWORK FOR EASTERN AND SOUTHERN AFRICA (PANESA) ANNUAL WORKSHOP Alemayehu Mengistu\*

A six day workshop on "Animal Feed Resources for Small-scale Livestock Producers" was held in Nairobi, Kenya from 11 - 15 November, 1985. The Workshop was sponsored by the Agriculture, Food and Nutrition Sciences Division of International Development Research Centre and organized by Pasture Network for Eastern and Southern Africa (PANESA). Thirteen countries participated and about 50 professionals attended the workshop; three of these were from Ethiopia (Alemayehu Mengistu, MOA, Dr. John Lazier and Dr. Frank Anderson - ILCA).

The Workshop's objectives were:

- (i) To identify animal resources and their utilization and constraints to development in various countries;
- (ii) to review research and development in animal feed resources;
- (iii) to identify research priority areas and research strategies;
- (iv) to review the activities of PANESA; and
- (v) to develop regional/subregional pasture research programmes.

Before the opening ceremonies participants were briefed on registration and administrative and financial details. Chairman of the Working Organizational Committee, Prof. Abdullahi N. Said, then welcomed the participants and thanked the Director General and the administration of ILRAD for use of the ILRAD facilities. He anticipated productive discussion in the week ahead.

Prof. A. B. Lwoga, Chairman of the Pastures Network for Eastern and Southern Africa (PANESA) Working Committee, welcomed the guest speaker of the opening ceremonies, Prof. G. M. Maloy, Principal of College of Agriculture and Veterinary Science and all participants to the workshop.

\* Senior Pasture Agronomist (MOA)



He acknowledged the presence of all the participants from PANESA region as a great honour to PANESA and thanked IDRC for financial support through the Regional Nairobi and Ottawa offices by the Government of Canada. He gave a brief history about the formation of PANESA saying that it was conceived at the 1984 Harare Pastures Workshop for Eastern and Southern Africa. The objectives of PANESA are to encourage research in pastures as well as information exchange among scientists. He was happy to see that this Nairobi workshop on "Feed Resources for Small-Scale Livestock Producers" was the culmination of PANESA's activities for 1985. He thanked ILCA for supporting the publication of the first newsletter for PANESA, which was made available to participants. He mentioned that IDRC had agreed to fund the activities of PANESA including a full time co-ordinator, who would receive logistical support and be based at ILCA. It is likely that other agencies such as USAID and ACIAR would also lend support. He called upon participants to encourage formation of national pasture/forage networks in their respective countries. Finally, he wished all the participants well in their deliberations.

Mr. R. Bruce Scott, regional Director, IDRC, Nairobi, expressed gratitude and pride on behalf of IDRC for being associated with PANESA formation and subsequent arrangements for the Nairobi workshop. IDRC's aim is to encourage indigenous research that promotes science and technology for local development. Thus, IDRC supported the network concept as a forum for contact and exchange of research experience and information among scientists as well as between international centers of excellence such as ILCA. He stated finally that IDRC would contribute Ca \$200,000 per year to PANESA for the initial 2 years. The PANESA project proposal would be presented for approval to the board in Canada early in 1986.

Prof. G. M. Maloy, in the formal introduction, thanked IDRC for supporting the workshop and for the research grants which benefit the national programmes. He congratulated those scientists who, during the Harare workshop on Pasture, had the vision to form PANESA. As chairman, he encouraged the formation of networks similar to PANESA. He regretted the absence in recent years, of such useful topical monographs as "Range Management in East Africa" (Heady) or Bogdan's "Grass and Legumes species of Kenya". He further stressed the need for research on aspects of ecology, livestock, production systems, forage and range utilization by livestock and other related issues and he encouraged a multi-disciplinary approach among scientists in the region. He finally thanked the other distinguished speakers at the opening ceremonies for encouraging and defining PANESA's role in improving livestock production.

In an attempt to achieve pre-determined objectives the workshop was structured into 4 sessions:

- (i) Session I - Inventory of Animal Feed Resources.
- (ii) Session II - Research and Development Experience.
- (iii) Session III - Socio-economics Aspects.
- (iv) Session IV - Regional/Sub-Regional Research Programme.

The first two days were devoted to country papers on feed inventory, resources and research and development experiences. On the third day, workshop participants visited Katumani Research Station and Satellite Demonstration Farms. The last two days were allocated for socio-economics and regional/sub-regional research programmes and discussions.



At the end of the workshop in the plenary session, groups delivered reports and regional and sub-regional research programmes were established based on farming intensity (i.e. intensive, semi-intensive and extensive types of farming systems). Three committees were set up to facilitate the formation of regional and sub-regional research programmes.

\* \* \* \*

#### **4. REPORT ON PASTURE NETWORK FOR EASTERN AND SOUTHERN AFRICA (PANESA) GENERAL MEETING 11 - 15 November 1985, Nairobi, Kenya**

Alemayehu Mengistu\*

##### Agenda

1. Chairman's Report 1984/85.
2. Reports from National Networks.
3. 1986 PANESA Workshop and Annual General Meeting.
4. Election of New PANESA Working Committee.
5. Other business.

##### 1. Chairman's Report 1984/85

(a) Pasture Workshop, Harare, 17 - 21 September 1984: A workshop on Pasture Research in Eastern and Southern Africa sponsored by IDRC and SADCC was held in Harare, Zimbabwe from 17 - 21 September 1984. The workshop formed a Steering Committee, which was given the task of establishing the network.

(b) First meeting of the Steering Committee Harare, 21 September, 1984:

The principle decisions of the meeting:

- Coopted Prof. J. A. Kategile (IDRC) and Dr. J. Lazier (ILCA) to the committee;
- appointed Dr. Dzowela Secretary of the Committee;
- prepared an agenda and budget for the Nairobi workshop; and requested IDRC to provide funds for the committee meeting in Nairobi.

(c) At the second meeting of the Steering Committee, Nairobi, 26-29 November, 1984, the committee produced a proposal for the formation of the network and submitted the same to IDRC to consider for funding. The committee agreed to announce the official launching of PANESA and urged the formation of National network which would form the core of the regional network.

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\* Senior Pasture Agronomist (MOA)

d) During the third meeting of the Working Committee, ILCA, Addis Ababa, 18-22 February, 1985, the following matters were dealt with:

- 1985 Workshop and Annual Meeting;
- Training Course on "Introduction and Preliminary Evolution of Germplasm";
- PANESA newsletter;
- PANESA project proposal;
- PANESA co-ordinator.

(e) In the fourth meeting of the Working Committee, Nairobi, 12-13 November, 1985, committee reviewed progress made on issues that had been discussed at the third meeting particularly:

- PANESA project proposal;
- Training course on "Introduction and Preliminary Evaluation of Germplasm."

(f) PANESA activities/accomplishments to date includes:

Establishment of national network - up to date information not available, but national networks have already been formed in several countries since November 1984.

PANESA newsletter - first issue produced in time for the 1985 workshop.

Workshop and Annual meeting 1985 - held according to schedule.

## 2. Reports from National Networks

To date, local networks in Ethiopia, Zimbabwe, Kenya, and Tanzania have been established. Reports from the participating countries about their local networks were presented. PANESA pledged its assistance to the national/local networks. On this occasion, the Forage Network of Ethiopia congratulated Tanzania and Kenya on the establishment of their local networks and expressed hope that the other countries will soon form these networks.

## 3. 1986 PANESA Workshop and Annual General Meeting

In this Workshop and annual general meeting, feed resources for the small-scale livestock producers were identified as follows:

- a) Natural pasture. Main constraints:
- Seasonal productivity;
  - communal grazing management problem;
  - land tenure system;
  - destocking problem.

Action needed:

- Proper grazing management;
- inclusion of grass/legume mixture;
- provision of water points.



b) Cultivated pasture. Main constraint: Seed.

Action needed:

- Improvement of agronomical practices;
- use of legumes and manure;
- revise production system to get year round forage production;
- inclusion of forage legumes;
- techniques for conservation;
- seed production of grass and legumes.

c) Crop residues. Main constraints:

- Mode of harvest;
- transport problem;
- utilization.

Action needed in:

- Availability of feed inventories;
- corporation of crop residues with other feed system like with Molasses and urea mixture, oil seed cake etc.;
- chemical treatment (high price and availability is big question);
- preparation of present feed inventory;
- improve method of harvest.

d) Agro industrial by-products. Main constraints:

- Proper inventory lacking;
- transport;
- poor utilization.

Action needed:

- Study of nutritive value;
- proper utilization - depends on processing at big industries and home;
- improving feeding system like molasses/urea already practised in Africa.

In addition, the workshop recommended the use of socio-economic studies, which would contribute important information to the development of pasture/livestock/crop farming systems.

Suggestions were made for the themes and venues of the next workshop/annual meeting:

Themes:

- (i) African forage plant genetic resources.
- (ii) Germplasm evaluation.
- (iii) Extensive livestock farming system (pasture/livestock).

Venues:

- (i) Malagasy.
- (ii) Tanzania.

Themes and venues will be selected by the Working Committee of PANESA and will be reported in the PANESA newsletter.

5. Election of new PANESA Working Committee

The Working Committee for PANESA is comprised of 5 members, broadly representative of national institutions, sub-regional specialists and coopted representatives of relevant organizations. Based upon the recommendations of the September 1984 Harare workshop, the Working Committee for PANESA is responsible for:

- Organizing annual meetings for PANESA;
- planning annual programmes of PANESA as directed by the annual meeting;
- preparing the PANESA budget; and
- monitoring the implementation of PANESA activities.

Discussion regarding the election of new PANESA Working Committee resulted in the following decisions.

- (i) Election for the Chairman's post will be made every two years and the present chairman will maintain his post till the end of 1986.
- (ii) The newly appointed coordinator of PANESA will also take the position of secretary.
- (iii) Two positions on the Working Committee will be subject to turnover every year and the rest every two years.

6. Other business

(a) PANESA co-ordinator. It was agreed that in view of the excellent back-up facilities at ILCA, it would be appropriate for the PANESA co-ordinator to be based at ILCA headquarters. IDRC and ILCA will resolve the technical issues and other matters involved.

(b) Strengthening communication and information bases can be achieved by:

- Publishing a newsletter and/or Journal to keep members informed about research activities and results in the region. PANESA newsletter will be the best medium for execution of such activities. The first issue of PANESA newsletter has been well accepted and participating countries have been advised to contribute articles for the second issue.

- Publishing PANESA proceedings. Proceedings from "Pasture Improvement Research in Eastern and Southern Africa", held in Harare, Zimbabwe 17 - 21 September, 1984 have been published and distributed at Nairobi, PANESA Workshop. The proceedings from the Nairobi, PANESA Workshop will come out in November 1986 in time for the next PANESA annual meeting.



- Exchange of germplasm/seed etc. Participants from different countries agreed on the need for germplasm/seed as a basic tool for pasture development. Dr. John Lazier, ILCA (FLAG) promised to send a few grams of seeds from ILCA when requested.

- Training. The training workshop, which was scheduled for June or July in Zimbabwe 1985, on "Introduction and Preliminary Evaluation of germplasm" was not executed due to unforeseen problems. The Working Committee of PANESA agreed to hold this course in Ethiopia which ILCA (FLAG) will host. Dr. John Lazier and Alemayehu Mengistu (MOA) will work on the logistics and contact the PANESA Working Committee.

- Words of thanks: The Working Committee expresses sincere thanks to IDRC and ILCA for financial and other support extended to PANESA. It is unlikely that PANESA would be in existence without such support. The committee is also thankful to PANESA members for the support and encouragement it has received from them since September 1984. This Workshop was organized by Professors A. N. Said and J. A. Kategile with the assistance of members of the Kenya network. The committee is most thankful to them for the excellent preparations which made the workshop a success.

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## 5. NATURAL GRASSLAND INVENTORY

FNE Cooperators\*

### Introduction

Livestock are important in the Ethiopian economy and they feed almost entirely on natural vegetation. Efficient interplanting and improvement of the natural grasslands require knowledge of grass composition and productivity as well as sound pasture management and soil conservation. Studies of these subjects in Ethiopia have been limited mainly to Chilalo Awraja of Arsi administrative region.

In 1982, four groups joined to form the Forage Network of Ethiopia (FNE): Ministry of Agriculture, Arsi Rural Development Unit, Institute of Agricultural Research and the International Livestock Centre for Africa. To fill gaps in knowledge of the natural grasslands and ecosystems of Ethiopia, the FNE initiated a natural grassland inventory which would survey dominant species and estimate dry matter yields of natural grasslands.

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\* Lulseged G/Hiwot, Alemayehu Mengistu, Taddese T/Tsadik, Alemu Taddese, Gashaw Shibabaw, Getachew W/Agnew, Abate Tedla, Taye W/Mariam, Abayneh Woudneh, John R. Lazier. Compiled by Daniel Keftassa.

## Materials and methods

### a) Sites

| Location     | Altitude<br>m | Soil<br>texture | Soil<br>PH | Mean<br>rainfall (mm) | Organization |
|--------------|---------------|-----------------|------------|-----------------------|--------------|
| Gobe         | 2780          | clay loam       | 5.0        | 1200                  | ARDU         |
| Lemu         | 2610          | red clay        | 5.2        | 1100                  | ARDU         |
| Holetta      | 2400          | clay            | 5.0        | 1065                  | IAR          |
| Bako         | 1600          | clay            | 5.7        | 1300                  | IAR          |
| Debre Berhan | 2800          | clay loam       | 5.0        | 900                   | ILCA         |

### b) Sampling

A representative site of about 50 x 50 m area was chosen and 9 sampling quadrats (0.5 x 0.5 m) were inserted cross-wise, one in the middle, eight on the cross and two on each arm, with a distance of 14 m between two adjacent sampling sites.

Total dry matter yield was measured by harvesting all vegetation within the quadrat at ground level. The harvested green material from all quadrats was thoroughly mixed and sub-sampled for determination of dry matter content. The sub-samples were dried in a force draught oven at 65°C.

The percentage ground cover of the dominant species (grass, legume, weed) of the 9 sampling plots was visually estimated before harvesting. Harvested samples were botanically sorted into grass, legume and weed.

## Results and discussion

### 1) Gobe and Lemu

The site at Gobe was located south of the Gobe Cattle Breeding Station on undulating topography at a site with a 3% slope. The dominant species were Pennisetum schimperi, Andropogon chrysostachus and Trifolium semipilosum. The grassland was used for grazing during both the dry and wet seasons. The grazing management was on-and-off type depending on the availability of pasture.

The site at Lemu was located on a farmers'/producers' cooperative dairy farm at a distance of about 45 km south of Asella. The grassland was a fallow land which was previously under cultivation. It was used for grazing usually after the main wet season. The dominant species were Andropogon abyssinica and Trifolium spp.



**Table 1.1. Yield (ton/ha)**

|                     | <u>Gobe</u> | <u>Lemu</u> |
|---------------------|-------------|-------------|
| Green matter ton/ha | 23.2        | 42.0        |
| % dry matter        | 32.6        | 20.0        |
| Dry matter ton/ha   | 7.6         | 8.4         |

**Table 1.2 Botanical composition (%) of the hand sorted green material  
(% by weight)**

|             | <u>Gobe</u> | <u>Lemu</u> |
|-------------|-------------|-------------|
| Grasses     | 50          | 55          |
| Legumes     | 15          | 22          |
| Weedy herbs | 35          | 23          |

**Table 1.3 Visual assessment of ground cover (% mean)**

|             | <u>Gobe</u> | <u>Lemu</u> |
|-------------|-------------|-------------|
| Grasses     | 65          | 55          |
| Legumes     | 10          | 32          |
| Weedy herbs | 24          | 13          |
| Bare ground | 1           | 2           |

More extensive surveys of natural grasslands were conducted during 1967-74 in Chilalo Awraja. These surveys included agro-botanical investigations in grazed areas by Hakansson (1968), agro-botanical investigation of leguminous species by Thulin (1972), inventory of indigenous ecotypes of some species by Carlsson (1972), identification of grasses and pasture legumes by Froman (1975) and ecological study of the grassland condition by Alemayehu Mengistu (1974). Results from experiments on improvement and management of natural grasslands were summarized by Froman (1975).

As initially reported by Hakansson (1968) and later on supported by Alemayehu (1974), the natural grasslands in Chilalo Awraja show substantial variation in stands of species and types of grasses and legumes. It was recognized that vegetation changes with altitude as a result of rapid climatic and/or edaphic changes. The proportion of grasses, legumes, sedges and per cent area of bare soil alters with change in altitude mainly due to variation in the average humidity. In the lower altitudes the climate is drier and overgrazing is more pronounced, resulting in higher percentage area of bare soil.

Corresponding to altitude, the most common species in Chilalo Awraja are shown in Table 1 (source: Alemayehu Menigstu, 1974).

**Table 1.4 : Altitude**

| 1500 - 2000 m                | 2000 - 2500 m                  | > 2500 m                    |
|------------------------------|--------------------------------|-----------------------------|
| <u>Cynodon dactylon</u>      | <u>Pennisetum schimperi</u>    | <u>Pennisetum glabrum</u>   |
| <u>Chloris pycnothrix</u>    | <u>Pennisetum clandestinum</u> | <u>Pennisetum schimperi</u> |
| <u>Eragrostis tenuifolia</u> | <u>Hyparrhenia spp</u>         | <u>Andropogon spp</u>       |
| <u>Hyparrhenia spp</u>       | <u>Andropogon spp</u>          | <u>Trifolium spp</u>        |

Grass types were more numerous and per cent ground cover was found to be greater in the higher altitudes than the lower altitudes.

Differences in vegetation types were also observed as a result of variation in the surface water conditions. Some species such as Eulalia polyneura and Setaria atrata were frequently observed where surface water slowly disappears after rains. On the other hand, species such as Pennisetum schimperi, Digitaria scalarum and Hyparrhenia spp. were found on well drained sites.

Variation in vegetation between different fields at the same altitude were also observed. One of the main reasons for this was differences in their ages as grassland. Andropogon abyssinicus, Digitaria scalarum and Cynodon dactylon were more frequent on young grasslands whereas Andropogon chrysostachyus, Pennisetum schimperi and Hyparrhenia spp. were often dominant on old grasslands.

From his studies in Chilalo Awraja, Hakansson (1968) concludes that most medium highland grasslands are rich in Andropogon spp. Cynodon spp., Pennisetum spp., Hyparrhenia spp. and Trifolium spp. These species are potentially productive under optimum management. Morphological characteristics and growth habits of the dominant species in Chilalo Awraja were illustrated by Hakansson (1968), Froman and Persson (1974), Froman (1975) and Alemayehu Mengistu (1975).

## 2. Holetta

At Holetta, sampling was done at 8 sites. Estimates of the dry matter yields and botanical composition of the grassland were made in October 1982 and 1984. Results were grouped according to the topography and textures of the soil.

**Table 2.1.: Yields from botanically sorted material, October 1982**

|                 | <u>Bottomland heavy clay soil</u> |                | <u>Slope reddish clay soil</u> |                |
|-----------------|-----------------------------------|----------------|--------------------------------|----------------|
|                 | <u>GM t/ha</u>                    | <u>DM t/ha</u> | <u>GM t/ha</u>                 | <u>DM t/ha</u> |
| Total           | 14.8                              | 5.1            | 15.6                           | 4.3            |
| Grasses         | 8.8                               | 3.2            | 7.5                            | 2.5            |
| Legumes         | 3.1                               | 0.7            | 2.3                            | 0.6            |
| Weeds           | 0.8                               | 0.2            | 3.4                            | 0.4            |
| Others (sedges) | 2.1                               | 1.0            | 2.3                            | 0.9            |



**Table 2.2. Mean botanical composition (%) of the green material**

|             | <u>ground cover hand separated</u> |                      | <u>% ground cover hand separated</u> |                      |
|-------------|------------------------------------|----------------------|--------------------------------------|----------------------|
|             | <u>Visual</u>                      | <u>Sub-samples %</u> | <u>Visual assessment</u>             | <u>Sub-samples %</u> |
| Grasses     | 48.4                               | 60.8                 | 40.9                                 | 48.2                 |
| Legumes     | 16.2                               | 18.1                 | 13.8                                 | 11.2                 |
| Weeds       | 5.8                                | 5.5                  | 11.2                                 | 19.7                 |
| Others*     | 22.8                               | 15.7                 | 25.1                                 | 20.8                 |
| Bare ground | 6.8                                | -                    | 1.0                                  | -                    |

In 1984 sampling was done on three different areas i.e. seasonally flooded, unfertilized upland (drained area) and manured (drained) area. Mean values of botanical composition (%) of the green and dry matters and dry matter yields (t/ha) for the three areas are shown in Table 2.3.

**Table 2.3.**

|         | <u>Seasonally flooded</u> |                |                | <u>Drained area</u> |                |                | <u>Manured drained area</u> |                |                |
|---------|---------------------------|----------------|----------------|---------------------|----------------|----------------|-----------------------------|----------------|----------------|
|         | <u>% of GM</u>            | <u>% of DM</u> | <u>DM t/ha</u> | <u>% of GM</u>      | <u>% of DM</u> | <u>DM t/ha</u> | <u>% of GM</u>              | <u>% of DM</u> | <u>DM t/ha</u> |
| Grasses | 17.0                      | 13.7           | 0.75           | 47.2                | 47.7           | 2.5            | 38.0                        | 39.4           | 3.2            |
| Legumes | 6.0                       | 7.8            | 0.42           | 21.0                | 22.3           | 1.2            | 20.3                        | 21.1           | 1.7            |
| Sedges  | 64.0                      | 68.0           | 3.70           | 20.8                | 20.4           | 1.1            | 29.5                        | 26.6           | 2.2            |
| Others  | 13.0                      | 11.5           | 0.63           | 11.1                | 9.6            | 0.5            | 12.3                        | 13.0           | 1.1            |
| Total   | 100.0                     | 100.0          | 5.5            | 100.0               | 100.0          | 5.3            | 100.1                       | 100.1          | 8.2            |

In the waterlogged area, the proportion of legume was below 10% and that of sedges (*Cyperus* spp.) was high. On the other hand in drained pasture areas there was a significant proportion of legume.

The earlier study by Berhanu Debele (1982) at Holetta indicates that the dominant species were *Andropogon*, *Hyparrhenia*, *Pennisetum* and *Trifolium*. The species association of the area was closely correlated to the major soil types. The three major soil types and characteristic species were:

- Chromic vertisol - *Trifolium simense* and *Cyperus* spp.
- Nito-Fluvic phaeozem - *Pennisetum villosum*, *P. clandestinum* (in permanent pastures) and *Andropogon abyssinicus* (on cultivated or more disturbed areas).
- Vettri-Haplic phaeozem (better drained vertisol) - *Hyparrhenia* spp. and *Andropogon pratensis*.

### 3. Bako

The sampling site was located on the gentle slope of scattered tree grassland. The dominant vegetation of the area was tall grasses of Hyparrhenia species. There were some trees and bushes scattered in the grassland but there were few legumes. The area was utilized for grazing.

Sampling was conducted in September 1982, January 1983, September 1983 and January 1984. Dry matter yields are shown on Table 3.1.

**Table 3.1.: Dry matter yields of natural grassland at Bako**

| <u>Period</u>  | <u>DM yield t/ha</u> | <u>% DM</u> |
|----------------|----------------------|-------------|
| September 1982 | 4.6                  | 41          |
| January 1983   | 5.4                  | 68          |
| September 1983 | 5.9                  | 43          |
| January 1984   | 4.1                  | 64          |

The botanical composition of the grassland for the periods 1982/83 and 1983/84 is shown on Table 3.2.

**Table 3.2.: Botanical composition of the natural grassland at Bako**

|                          | <u>1982/83</u> | <u>1983/84</u> |
|--------------------------|----------------|----------------|
| Grasses total %          | 91.1           | 84.0           |
| <u>Hyparrhenia</u> spp.  | 52.0           | 46.8           |
| <u>Sporobolus</u> spp.   | 3.4            | 16.8           |
| <u>Paspalum</u> spp.     | 1.4            | 7.8            |
| <u>Brachiaria</u> spp.   | 1.5            | 2.9            |
| <u>Cyperus</u> spp.      | 0.1            |                |
| <u>Eragrostis</u> spp.   | 8.1            | 12.0           |
| <u>Bothriochloa</u> spp. | -              | 10.0           |
| <u>Setaria</u> spp.      | 0.1            |                |
| <u>Digitaria</u> spp.    | 8.1            | -              |
| <u>Andropogon</u> spp.   | 22.0           | -              |
| <u>Cynodon</u> spp.      | 2.5            | -              |
| Legumes                  | 1.2            |                |
| Others                   |                |                |
| Bare ground              | 5.7            | 5.6            |
| Rocks and stones         | -              | -              |

As shown on Table 3.2 the dominant species at Bako was Hyparrhenia species, typical of most tropical grass cover of Africa where rainfall and mean temperature are high (Rattray, 1960). The results of this inventory correspond with the earlier observations by Hakansson (1968), when he inventoried grasslands at various sites from Bako (1600 m altitude) to Addis Ababa (2330 m) covering a distance of 230 km.



#### 4. Debre Berhan

The sampling site was located at the bottomland of ILCA's field station which had been under native pasture. Most of the land was flat or slightly sloping and thus susceptible to flooding during the wet season. The grassland has been utilized for hay production and/or grazing during the dry season.

Percentage ground cover of the vegetation and botanical composition of the species estimated on 1/11/82.

**Table 4.1.: percentage botanical composition of harvested quadrats from visual estimates at Debre Berhan**

| <u>Plant</u>                   | <u>Type</u> | <u>Mean ground cover %</u> |
|--------------------------------|-------------|----------------------------|
| <u>Andropogon distachys</u>    | grass       | 72.0                       |
| <u>Festuca abyssinica</u>      | "           | 5.0                        |
| <u>Alchemilla spp.</u>         | weed        | 4.5                        |
| <u>Cyperus spp.</u>            | "           | 5.5                        |
| <u>Plectrocephalus varians</u> | "           | 1.8                        |
| <u>Ranunculus multifidus</u>   | "           | 0.3                        |
| <u>Other spp.</u>              | "           | 5.0                        |
| Bare ground                    | "           | 5.4                        |
| Rocks and stones               |             |                            |

Dry matter yield of the native pasture was measured from 9 sites on 31/10/83. The mean yield was 6.8 ton/ha.

#### **Conclusion**

The results of this grassland inventory provide information regarding the production potential and botanical composition of the existing natural grasslands. The inventory was mainly carried out in the highland part of the country where there is great diversity of natural vegetation. The highlands support large human and livestock populations leading to intensive cultivation and overgrazing. Thus the natural grasslands were formed as a result of both environmental (altitude, climate, edaphic) and biotic (cultivation, grazing, burning) interactions.

The mean dry matter yields were between 4.7 ton/ha at Holetta and 8.4 ton/ha at Lemu (in Arsi) which were fairly high as compared with some yields of cultivated fodder crops in the FNE trials. On the other hand the proportion of legumes in the grasslands was found to be quite low whereas the proportion of weeds and sedges was high. High proportion of weedy species result in overall low yield and nutritive value of herbage from native pasture.

The analyses of botanical composition of the native pastures show that there are a large number of species of Andropogon, Pennisetum, Hyparrhenia and Trifolium, some of which are known for their high potential as livestock feed.

A thorough knowledge of the natural stands and naturally appearing species will be of great help in the attempt to improve the natural grasslands. The potential for grasslands improvement depends on the quality of the initial inventory of the grasslands. Thus this study will be considered as a basis for future work on the agro-botanical studies of native pastures in Ethiopia.

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### 6. NEWS AND NOTES

1) Ato Mengistie Zewgie (MOA) returned from Australia after attending an "International Course in Pasture Management for the Wet Tropics" conducted by Queensland Department of Primary Industries from 14 October to 6 December, 1985.

2) Dr. Frank Anderson, Dr. J. Lazier (ILCA) and Ato Alemayehu Mengistu (MOA) attended the Pasture Network for Eastern and Southern Africa (PANESA) Annual workshop conducted in Nairobi, Kenya from 11 - 15 November 1985.



3) Dr. J. Tothill (Leader of FLAG - ILCA) attended the workshop in Harare Zimbabwe, on " Responses of Savannas to Stress and Disturbance" which is part of the IUBS Decade of the Tropics Savanna sub-programme, launched last year in Brisbane, Australia from December 9 - 13.

4) The Forage Network in Ethiopia (FNE) annual general meeting will be held at 9 a.m. on February 6-7, 1986 at ILCA headquarters in Addis Ababa. In addition to FNE members, any other interested individuals and organizations are welcomed to attend this meeting.

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## 7. ADVISORY NOTES

### 7.1. Experimental Design (Part III) Alemayehu Mengistu\*

#### Randomised Block Design

The randomised block experimental design is a type of two-factor analysis of variance especially common in agriculture and horticulture field research, but with many other applications in laboratory experiments and biological research. In agricultural field experiments, experience has shown that plots close to each other tend to have similar growth rates or yields. Such groups of adjacent plots are called BLOCKS and each BLOCK represents a homogenous environment. If a study area is patchy, then blocks take on shapes that remove as much patchiness as possible. When testing for differences among treatment regimes all the replicates of a treatment should not be placed into the same block. Otherwise, what may appear to be a significantly different effect of a treatment may actually be due to the general area in which the treatment plots are located with soil or other microclimatic conditions affecting the treatment regimes.

#### Example 1

A species trial was established in one area where rainfall is low (about 560 mm/year) and the dry season long (7-9 months). Four fertilizer combinations were applied to Eucalyptus resinifera seedlings and one year after planting the survival (percentage) and initial height growth were recorded.

The experimental design implemented for this study was a randomised block layout with five replicates of each of the four amendments (see Figure 2). There was a trend at the study site for soil conditions to improve from north to south. In the absence of different treatments, plant growth systematically lower in BLOCK 1 and higher in BLOCK 5 would be expected. Blocks were subdivided such that each plot was equally affected by this soil trend.

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\* Senior Pasture Agronomist (MOA)

**Figure 1 : Randomised block layout for five replicates of four fertilizer amendments on a study site having fertility trend in the direction indicated**

|       |   |   |   |   |   |                      |
|-------|---|---|---|---|---|----------------------|
| BLOCK | 1 | 3 | 4 | 1 | 2 | N                    |
| BLOCK | 2 | 4 | 3 | 2 | 4 |                      |
| BLOCK | 3 | 3 | 2 | 4 | 1 | Soil trend amendment |
| BLOCK | 4 | 2 | 1 | 3 |   |                      |
| BLOCK | 5 | 1 | 4 | 3 | 2 |                      |

Key: amendment 1 - no nutrients  
amendment 2 - phosphate  
amendment 3 - phosphate plus nitrate  
amendment 4 - phosphate plus nitrate plus trace

The four fertilizer amendments have been randomly allocated to each of the five blocks. The randomised block layout assumes such random allocation thus ensuring treatments are not always maintaining the identical relative position in the study area. After 12 months growth the height of the seedlings was recorded and the data are summarised in Table 1. The analysis of variance summary is provided in Table 2.

**Table 1.: Height (cm) after 12 months of *Eucalyptus resinifera* seedlings, grown in four fertilizer amendments**

| Source of variation |   | 1<br>none | 2<br>P | 3<br>P + N | 4<br>P + N + Trace elements |
|---------------------|---|-----------|--------|------------|-----------------------------|
| BLOCK               | 1 | 13        | 15     | 21         | 27                          |
| BLOCK               | 2 | 10        | 14     | 22         | 29                          |
| BLOCK               | 3 | 11        | 14     | 24         | 21                          |
| BLOCK               | 4 | 13        | 12     | 20         | 30                          |
| BLOCK               | 5 | 15        | 14     | 25         | 33                          |
|                     | X | 12.40     | 13.80  | 22.40      | 23.30                       |

**Table 2. : Analysis of variance summary comparing fertilizer amendments for *Eucalyptus resinifera* seedlings.**

| Source of variation | SS     | df | MS     | F     | Probability |
|---------------------|--------|----|--------|-------|-------------|
| Fertilizer          | 815.35 | 3  | 271.78 | 41.88 | P<0.001     |
| Block               | 39.30  | 4  | 9.83   | 1.52  | P>0.1       |
| Error               | 77.90  | 12 | 6.49   |       |             |
| Total               | 932.55 | 19 |        |       |             |



The block mean square (MS) is rarely tested as differences between blocks are expected. The treatment mean square, tested statistically, indicated that fertilizer application has influenced the growth of Eucalyptus resinifera seedlings.

### 3.2. Unplanned comparisons or Multiple Range Testing

Multiple Range Tests refer to comparisons that are made between all possible combinations of pairs of treatment means. The most commonly used methods are listed below in order of least to most conservative tests.

- LSD (Least Significant Difference)
- Duncan
- Student Newman - Keuls
- Turkey
- Scheffe
- Dunn (specifically to compare a control group with other treatments).

Multiple Range Tests , used in conjunction with the analysis of variance statistical method, enable the researcher to shift through the data and search for interesting findings. Thus the maximum amount of information can be extracted from a study. A Multiple Range Test, the LSD test has been conducted on the data from Tables 1 and 2 and this test is summarised in Table 3. From this additional analysis specific conclusions for the study can now be formulated. It can be concluded that growth of Eucalyptus resinifera seedlings was enhanced by the P + N trace elements fertilizer amendment. Phosphate addition alone did not enhance plant material production.

**Table 3. : Mean height of Eucalyptus resinifera seedlings after 12 months growth for four fertilizer amendment, means which do not differ are under-scored ( $P < 0.01$ , LSD test).**

| <u>None</u> | <u>P</u> | <u>P + N</u> | <u>P + N + Trace Element</u> |
|-------------|----------|--------------|------------------------------|
| X           | 13.80    |              | 28.0                         |

### 3.3 Latin Square Design

In agricultural and horticultural field experiments it may be necessary to layout two-dimensional blocks. The study areas may be heterogenous in the north-south direction and in the east-west direction. In utilising the Latin Square layout, each treatment in the experiment appears only once in each row and only once in each column. (See Figure 2).

**Figure 2. : Latin square layout of five fertilizer amendments on a study having a fertility trend and slope variation in the directions indicated**

|     |   | Column |   |   |   |   |
|-----|---|--------|---|---|---|---|
|     |   | 1      | 2 | 3 | 4 | 5 |
| Row | 1 | 5      | 2 | 1 | 4 | 3 |
| Row | 2 | 3      | 1 | 4 | 5 | 2 |
| Row | 3 | 2      | 5 | 3 | 1 | 4 |
| Row | 4 | 1      | 4 | 2 | 3 | 5 |
| Row | 5 | 4      | 3 | 5 | 2 | 1 |

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### **7. 2. Acacia, an Important Natural Forage Plant in Ethiopia**

J. R. Lazier\*

Acacia is a large genus of mainly tropical and sub-tropical trees and shrubs containing about 1100 species. The majority of these are Australian but about 130 occur in Africa. Ethiopia has 49 native species and these occur from sea level to 2600 m elevation. There are also about 10 exotic species present, originating from Australia.



Acacias are the dominant trees and shrubs in much of the drier medium and lower altitude areas of Ethiopia. In recent years, however, with increasing population pressures in these regions, the trees are rapidly being cleared to open the land for farming, for fuel, for charcoal manufacture and to some extent, for construction.

Acacias were probably once important in some of the medium altitude areas of the country as well, for remnant mature trees can still be seen in the fields, cut back (pallarded) for dry season fodder and construction material. In drier areas little farming is normally done due to the unreliability of the rainfall and livestock are grazed under these trees. In the dry season herdsmen are seen with long sticks knocking the pods off the trees for their livestock to eat.

However, the role of Acacia in livestock production apparently extends beyond the use of the trees as a direct source of fodder. In low rainfall areas if one walks in Acacia woodland after the rains have ceased, it is very noticeable that the grass is taller, and greener under the trees than the grass outside the circles of the tree canopies. Frequently there is little or no grass beyond the shadow of the tree, and what there is, is brown and dry long before that under the trees. This is a somewhat surprising observation as one does not expect grass to grow better in shade, or under the canopy of trees most of which require a great deal of water for transpiration.

The main reason for the better growth of the grass, is mainly due to Acacia being leguminous. Bacteria (Rhizobium) exists in nodules on their roots and fix nitrogen. The leaves, thus, year-round, have a high protein content. A close inspection of the canopy of an Acacia will show that there is a large population of insects which depend directly or indirectly upon Acacia leaves for their food. Birds are also abundant about the Acacia feeding on the insects. The Acacia micro-environment is in great contrast to the canopies of other genera, particularly non-leguminous ones which have almost no insect populations, resulting in a rapid cycling of nutrients from the tree to the soil in the form of dead insects, insect parts, and bird droppings. As well, most Acacia lose part or all of their leaves in the dry season, adding N to the soil below.

Organic matter, and nutrients from the leaves improve and maintain the soil fertility, permeability, organic matter content, and thus the water holding capacity beneath the canopy. The shade helps conserve moisture by reducing the evapo-transpiration of the grasses and evaporation from the soil.

The feeding roots of the tree will help hold soil from erosion and perhaps supply nutrients directly to the grass at the onset of the dry season when nodules are sloughed.

Local herdsmen know the value of the Acacia and local farmers whom I have spoken to say the grass grows much better under the Acacia and that the Acacia is a critically important part of this natural pasture.

A walk through an area in which Acacias are thinned is quite educational. Not only is most grass under the trees, despite cattle doing most of their grazing there, but the decline in grass production can be clearly seen in areas where trees have been cut for charcoal production. Barely a year after the removal of a tree there is greatly reduced grass cover and commonly, the beginnings of soil erosion.

Abernosa Ranch, the Ministry of Agriculture Borana Dairy Breeding Ranch, in the Rift Valley has a good cover of Acacia trees. The animals on the ranch do almost as well in liveweight gain in the dry season as they do in the wet. As the natural value of the grass vegetation is considerably lower in the dry season than in the wet, the additional nutrition must come from the consumption of Acacia pods and, perhaps, leaves.

The leaves which are dropped in the dry season undoubtedly add to the diet of the animals as they are probably picked up off the ground.

Acacia trees are thus an extremely important natural resource, particularly in the drier parts of the country. They promote grass growth under uncontrolled grazing, provide dry season fodder, maintain soil structure and fertility and prevent soil erosion. All agronomists should be well aware of the culture of these trees.

\* \* \* \*



## STEERING COMMITTEE MEMBERS

### Executive members

|                                      |      |          |
|--------------------------------------|------|----------|
| Ato Alemayehu Menigstu, Chairman     | MOA  | 44-75-32 |
| Ato Lulseged Gebre Hiwot, D/Chairman | IAR  |          |
| Ato Abate Tedla, Secretary           | ILCA | 18-32-15 |

### Members

|                       |                              |          |
|-----------------------|------------------------------|----------|
| Dr. Chadokar          | Soil & Water (MOA)           | 15-54-07 |
| Ato Gugessa Endeshaw  | ESA                          | 15-50-15 |
| Dr. John Tothill      | FLAG, ILCA                   | 18-32-15 |
| Ato Belete Adnew      | MSF                          | 15-28-81 |
| Ato Daniel Keftasa    | ARDU, Asella                 | 92       |
|                       | or Kulumsa                   | 102      |
| Ato Getinet Aklilu    | Sirinka Catchment<br>Project |          |
| Ato Fikre Abera       | Ambo Junior College          |          |
| Ato Kidane W/Yohannes | TLDP                         | 15-10-88 |
| Ato Berhanu Hika      | Forestry & Wildlife<br>(MOA) | 18-29-81 |
| Ato Bekure Yamane     | RRC                          |          |
| Ato Amanuel Teku      | Awassa Jr. College           | 11-01-01 |
|                       | Alemaya College              | 44       |

The forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to The Editors, FNE Newsletter, ILCA, P. O. Box 5689, Addis Ababa, Ethiopia. If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

TO: THE EDITORS  
FNE NEWSLETTER  
P. O. BOX 5689  
ADDIS ABABA

Please include/change my address to:

DATE \_\_\_\_\_

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

# Forage Network in Ethiopia

## Newsletter



International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No 11

Date. February - March 1986

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### 1. INTRODUCTORY MESSAGE

The 1986 Annual General Meeting and Workshop of the Forage Network (FNE) was judged by its participants to be a considerable success. The meeting was held over a two day period, in contrast to previous years when it had been held in one day. The extra time allowed adequate time for representatives of the participating organizations to present their 1985 results and to indicate what their work in 1986 would be. The second day was given over to professional development and talks were given on a wide range of topics by seven lecturers, the most prominent of which was Dr. Ray Jones, Acting Chief of the Tropical Crops and Pastures Division of CSIRO, Australia.

Dr. Jones presented a fascinating talk on the background and research which led up to the discovery of bacteria which break down toxic compounds in Leucaena leucocephala. An important facet of his visit was the successful introduction of these bacteria to animals at ILCA. The opportunity is thus given to allow the feeding of diets of up to 100% Leucaena. These bacteria can now be transferred to other African livestock to allow them to fully benefit from Leucaena.

The large number of organizations represented at the Workshop and the enthusiasm of the seventy-nine participants has indicated that the Network is well established. For the second year a representative was present from Djibouti.



Forage Network activities for the coming year include the planting of FNE trials and the regular field trip which will take place in September or October. This year's new activities include residential "hands-on" training in forage research organized cooperatively between ILCA and the MOA (see article page 7) and a PANESA training course planned to be held at Soddo on plant introduction and initial evaluation from June 4 to 16.

The 1984 and 1985 FNE trials will be continued in 1986. Those requiring seed to replant perennial trials which did not establish well in 1985 are advised to re-order the seeds from Dr. Jean Hanson, FLAG, ILCA as soon as possible to ensure that you get the seed in time.

The annual trials will be sent automatically to the previous years' participants by FLAG.

(Editors: Alemayehu Mengistu, John Lazier)

\* \* \* \*

## 2. THE 1986 FNE TRIALS

The purpose of the FNE trials is to test the breadth of adaptation of promising forages. Organizations and institutions are thus welcome to join in the testing programme and to plant any of the trials in which they are interested.

The 1986 trials will be continuations of those planted in 1985. The FLAG programme of ILCA will prepare seed of the annual trials for replanting in 1986 and will despatch them to the organizations involved.

Those requiring more seed for perennial trials which failed in 1985, observation forms, etc. should request them at least one month in advance from FLAG, ILCA.

Please contact Ato Alemayehu Mengistu of the MOA, or Dr. John Lazier of FLAG, ILCA if there are any problems or questions.

1. Evaluation of 3 annual African Trifolium species under 3 levels of fertilizer - third year, protocol in FNE Newsletter No. 4, January - February 1984.

Sites: Holetta, IAR; Robe, ARDU; Debre Berhan, Shola, ILCA

2. African Trifolium initial evaluation strip trial - second year, protocol in FNE Newsletter No. 8 August 1985.

Sites: Holetta, IAR; Sheno, IAR; Kulumsa, Gobe, ARDU;  
Debre Berhan, ILCA

3. Medicago sativa initial evaluation strip trial - second year, protocol in FNE Newsletter No. 8 August 1985.

Sites: Holetta, IAR; Kulumsa, ARDU; Debre Zeit, ILCA

4. Replicated grass legume mixture trials - second year, protocol in FNE Newsletter No. 8, August 1985
  - a) High altitude > 2400 m  
Sites: Holetta, IAR; Gobe, ARDU; Debre Berhan, ILCA
  - b) Medium altitude < 2400 m  
Sites: Bako, IAR; Kulumsa, ARDU; Debre Zeit, ILCA

Work will also continue on the following trials:

5. Medium and low altitude strip trials  
A wide range of sites, designs and species. These trials are designed by the FNE on the individual requests of organizations and vary with the research goals, the environment, and the management capabilities of the staff.
6. Low altitude grass - legume mixture trial  
- protocol in FNE Newsletter No. 5 August 1984  
Sites: Awassa, IAR; Soddo, ILCA-MOA

\* \* \* \*

### 3. THE 1986 FNE ANNUAL GENERAL MEETING AND WORKSHOP 6 - 7 FEBRUARY 1986, ILCA, ADDIS ABABA

#### 3.1 Welcome Speech

Alemayehu Mengistu, FNE Chairman\*

On behalf of the FNE Steering Committee, I welcome all of you to the 4th Annual General Meeting of the Forage Network in Ethiopia.

As we all know the livestock industry plays an important role in the Ethiopian economy and has a crucial role to play in peasant farming systems. Currently the livestock sector is much weaker than it should be. One of the major constraints in the development of the livestock industry is inadequate feed.

In Ethiopia feed resources at present are almost entirely based on natural pasture, crop residues and agro-industrial by-products. Cultivated pasture crops are infrequent and occur mainly on state and peasant dairy farms.

Pasture and forage crops research in Ethiopia was initiated in the early 1960's. Since then trials on native and cultivated pasture have been conducted in a number of ecological zones in the country. The leading organizations conducting research were initially the College of Agriculture, Alemaya, now called Alemaya Agricultural University, the Institute of Agriculture Research (IAR), Arsi Rural Development Unit (ARDU) and lately the International Livestock Centre for Africa (ILCA) and the Forage Network in Ethiopia (FNE).

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\* Senior Pasture Agronomist (MOA)



Pasture development programmes were also undertaken by the Arsi Rural Development Unit (ARDU), Extension, Promotion and Implementation Department (EPID) and Livestock and Meat Board (LMB). At present the Ministry of Agriculture, Department of Animal Breeding, Feed & Nutrition is responsible for the execution of the national pasture and forage extension/development programme. The Ministry of State Farm's Department of Livestock also undertakes pasture and forage development on their dairy and beef farms.

In the past research and development programmes were not co-ordinated and this lack of co-ordination has been one of the main reasons for the formation of the Forage Network in Ethiopia (FNE).

The Forage Network in Ethiopia was formed in 1980 to improve forage research, development and production in Ethiopia. It hopes to achieve this by organizing research and development programmes on a national scale and by increasing communication between researchers and development workers. Staff of IAR, ARDU, MOA and ILCA were the ones who have been the most active in forming the Forage Network in Ethiopia.

In 1981 the first FNE multi-locational forage trials were planted out at mid and high altitudes. In 1982 the planting and assessment methods were further refined and the trials were replanted. A native pasture survey and strip trials at lowland sites were also undertaken by the Network in 1983. The results were published in the FNE Newsletter numbers 5, 9 and 10.

The formation of the FNE Steering Committee was another important development. This is made up of a representative of each participating organization. The Committee plans activities, designs trials, summarizes results of multi-locational trials, provides advisory services, arranges and executes field trips, meetings and seminars; in the near future the Steering Committee will arrange residential and group training in forages and forage research.

One of the big successes of the FNE is the Forage Network in Ethiopia Newsletter which is published quarterly (March, July, September and December) and distributed to more than 700 interested individuals and organizations both in Ethiopia and world wide. Ten issues have been published so far. The Newsletter contains:

- (i) Introductory messages
- (ii) News of network activities
- (iii) Trial protocols and results
- (iv) Articles related to forages
- (v) Advisory notes

The Forage Network in Ethiopia recently welcomed the formation of the Pasture Network for Eastern and Southern Africa (PANESA) as a major benefit to forage research and development workers in Ethiopia and throughout the region. The Forage Network in Ethiopia has already participated in the first two PANESA Annual Workshops and general meetings including the latest one held in Nairobi, Kenya from 11 - 15 November, 1985.



Dear participants, for the two days FNE Annual Meeting and Workshop, the Steering Committee has gathered researchers and development workers from all parts of the country to brief us on their research and development activities. As well, professionals have been invited to give us the benefit of their research and development experiences which will help us in our future programmes. Therefore, as a Chairman of FNE, I strongly urge all of you present to participate fully. Finally, I now call upon Dr. Kurt Peters, Director of Research, at ILCA to open the 4th FNE Annual General Meeting.

Thank you.

### 3.2 Opening Speech

Dr. K. Peters\*

After welcoming the participants on behalf of ILCA, Dr. Peters discussed the importance of networks in general, and the Forage Network in Ethiopia in particular. He reviewed the objectives and criteria necessary for the success of research networks, stressing the importance of communication within the networks, from the organizers and scientists to the farmers and the farmers to the organizers and scientists.

### 3.3 The Programme

During the rest of the first morning of the Workshop and in the early afternoon the participants presented reports on their forage activities during 1985, followed by the results of the FNE trials. Those presentations which were to the given editors are presented in separate sections of this Newsletter.

The formal papers which were presented in the latter part of the first day, and the second day were:

- |                                                                                                |                          |
|------------------------------------------------------------------------------------------------|--------------------------|
| 1. Forage Networks                                                                             | Dr. John Lazier, ILCA    |
| 2. Training at ILCA                                                                            | Dr. Bob Scholtens, ILCA  |
| 3. Range Ecology Techniques                                                                    | Dr. John Tothill, ILCA   |
| 4. Dairy Technology Development<br>in Rural Ethiopia                                           | Mr. Frank O'Mahony, ILCA |
| 5. <u>Leucaena</u> Toxicity Control<br>through Rumen Macro-<br>organisms                       | Dr. Ray Jones, CSIRO     |
| 6. Nutritive Value of Crop<br>Residues, Hay, Forage<br>Legumes and Fodder Trees<br>in Ethiopia | Dr. Jess Reed, ILCA      |
| 7. Vertisol Management                                                                         | Dr. Samuel Jutzi, ILCA   |
| 8. The Importance of <u>Rhizobium</u>                                                          | Ato Amare Abebe, IAR     |

At the conclusion of the meeting the election of the Steering Committee was held. After some discussion the 1985 Steering Committee

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\* Director of Research, ILCA



was re-elected. As Ato Abate Tedla was too busy to be the Secretary, the Steering Committee was instructed by the General Meeting to select a Secretary for the Committee who would be able to handle the work.

List of Participants in the 4th FNE  
Annual General Meeting  
Held at ILCA on 6 and 7 February, 1986

| <u>Ministry of Agriculture</u> |         | <u>I L C A</u>       |         |
|--------------------------------|---------|----------------------|---------|
| 1. Alemayehu Mengistu          | A.A.    | 1. Aberra Adie       | Soddo   |
| 2. Tesfaye Hailu               | Dessie  | 2. James O'chang     | "       |
| 3. Tessema Halawo              | Jimma   | 3. John Lazier       | A.A.    |
| 4. Gossa Bire                  | Asmara  | 4. James Kahurananga | "       |
| 5. Seifu Mekonnen              | Wolaita | 5. Abate Tedla       | "       |
| 6. Sori Adi                    | A.A.    | 6. Girma Getachew    | Zwai    |
| 7. Tesfaye Meressa             | "       | 7. Jean Hanson       | A.A.    |
| 8. Bisrat Retta                | "       | 8. Abdulkadir Ahmed  | "       |
| 9. Meselech Eyassu             | Jimma   | 9. J.C. Bille        | "       |
| 10. Mengiste Zewge             | A.A.    | 10. J.C. Tothill     | "       |
| 11. Girma Mekonnen             | "       | 11. I. Haque         | "       |
| 12. Negussie W/Michael         | "       | 12. K.J. Peters      | "       |
| 13. Solomon T/Mariam           | "       | 13. Migongo-Bake W.  | "       |
| 14. Lulseged Asfaw             | "       | 14. Asres Tsehay     | "       |
| 15. Tadesse Bekele             | Sidamo  | 15. Kifle Eshete     | "       |
| 16. Teferra Work Beyene        | Assela  | 16. Solomon Mengistu | "       |
| 17. Per-ove Lindeman           | "       | 17. Asfaw Yimeghual  | "       |
| 18. Eskil Brannany             | "       | 18. Taye W/Mariam    | D. Zeit |
| 19. Hailu Abebe                | "       |                      |         |

| <u>I A R</u>           |             | <u>A R D U</u>           |        |
|------------------------|-------------|--------------------------|--------|
| 1. Alemu Tadesse       | Bako        | 1. Getachew W/Agenghu    | Assela |
| 2. Girma Chemedas      | "           | 2. Tesfason Mengesh      | "      |
| 3. Tadesse G.Tsadiq    | Holetta     | 3. Karin Ralsgard        | "      |
| 4. Lulseged G/Hiwot    | "           | 4. Daniel Keftassa       | "      |
| 5. Zinash Sileshi      | "           | 5. Tegegne Alemayehu     | "      |
| 6. Seyoum Bidiye       | "           |                          |        |
| 7. Alemu G/W           | A.A.        |                          |        |
| 8. Lemma Birru         | Holetta     | <u>Asmara University</u> |        |
| 9. Amare Abebe         | Nazareth    |                          |        |
| 10. Gebre Medhin Hagos | Holetta     | 1. Endashaw Bekele       | Asmara |
| 11. Aschalew Tsegahun  | Melka Werer | 2. Endalkachew W/Meskel  | "      |
| 12. Assefa H.Selassie  | Adame Tulu  | 3. Sue Edwards           | "      |
|                        |             | 4. Zere Izaz             | "      |

R. R.C. Alemaya University

|                      |                    |         |
|----------------------|--------------------|---------|
| 1. Beruk Yemane      | 1. Adugana Zerihun | D. Zeit |
| 2. Tesfaye W/Michael |                    |         |

Ambo Junior College

1. Teshome Ynenga Ambo

Jimma Junior College

1. Cony Gerards Jimma
2. Solomon Demeke "

Eth. Seed Corp.

1. Filix Pinto A.A.

Sirinka Project

1. Aberra Oljirra Woldia
2. Getinet Aklilu "

F A O

1. El Kedim Medi Djibouti

\* \* \* \*

Miscellaneous

1. Yohannes Kebede (ONCCP) A.A.
2. Fesseha Gedamu "
3. Mekonnen Worku "
4. Mana Wala "
5. Menwyelet Atsedu (TLDP) SORDU
6. Tesfaye G/Egziabher Shashamene
7. Jussi Ojala A.A.
8. Peter Hililemann "
9. Lissane Work B/M "
10. Worede W/Mariam "
11. Abebe Retta "
12. Solomon Kebede (LUPRD) "

**4. NEWS AND NOTES****4.1 Conference Announcement**

The Institute of Agricultural Research (IAR) is organizing a  
NATIONAL LIVESTOCK IMPROVEMENT CONFERENCE (NLIC).

The Conference is the first of its kind to be held in Ethiopia. Invited and voluntary papers will be presented in the areas of animal production, health, forages, nutrition, etc. by Research and Development Organizations. The Conference is tentatively scheduled for 23 and 24 October, 1986.

Detailed information on NLIC will be released in forthcoming FNE and IAR Newsletters.

**4.2 Residential Training in Soddo**

The MOA and FLAG (ILCA) have commenced residential, hands-on training in forage research techniques for technicians and graduates at the MOA station in Soddo, Wolayta. Up to three trainees can be accommodated in the hostel at one time. They will receive instruction in the broad range of forage species adapted to tropical and sub-tropical environmental conditions, and their management, and in the design and management of simple screening trials. The trainees will also learn about nursery seed production techniques for valuable germplasm at the MOA-FLAG site at Abernosa Ranch (Admi Tulu) and the techniques



of small scale seed production under irrigation at the Ministry of State Farms Horticulture Division - FLAG site at Zwai.

The course lasts for three weeks and ILCA covers expenses for the trainees while they are on the course. Government and non-government organizations who have staff which they would like to have attend the course should send the biodata of the individuals plus some indication of what time period would be convenient to: The Leader, FLAG, ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

#### **4.3 PANESA Training Workshop**

A PANESA Training Workshop on "Forage Germplasm Collection and Initial Evaluation" will be held over the period June 4-16 if funding is received from IDRC. The workshop will be held in the Ministry of Agriculture Training Centre at Soddo, Wolayta. It is designed to train experienced field staff in collection and simple observational initial evaluation techniques. Participants will be from Eastern and Southern Africa. Participation by Ethiopian technicians will be by nomination by the scientists or organizations employing them. Nominations should be sent to Dr. John Lazier, FLAG, ILCA, P.O. Box 5689, Addis Ababa.

#### **4.4 Availability of material from the ILCA Forage Genebank**

The ILCA genebank now holds approximately 10,000 accessions of forage grasses and legumes. These include germplasm, promising experimental material and a limited number of commercial lines.

Small quantities of seeds of the germplasm are freely available to all bonafide forage works for screening and seed increase to be used in trials. Many of the accessions in the genebank are collections of germplasm and are represented by very small amounts of seed. Therefore not all accessions are available in sufficient quantity to be immediately dispatched and it may be necessary to wait until seed has been increased by ILCA before all accessions are available.

Handling a diverse collection of different genera and species of this size is very time consuming both for seed conservation and multiplication. A catalogue of the accessions has been prepared in three volumes (Tropical Lowland, Mediterranean/Temperate and Tropical Highland Forages) and this is available on request from the ILCA Forage Legume Agronomy Group. This Catalogue can be used to select accessions for seed requests. In order to process the paperwork and handle the large number of seed requests received by the genebank, it usually takes about one month to fill a request and additional time should be allowed for air mail to overseas projects. Seed requests should therefore reach ILCA in sufficient time and allow at least six weeks before the planting date to ensure material is available in time.

The ILCA genebank will soon be moving to a new building with better seed storage and testing facilities. A new drying room has been purchased with a grant from the International Board for Plant Genetic Resources and a new cold store with money from the aid organisation, World Vision. The building is under construction and it is hoped that it will be complete and the equipment installed by



September 1986. The genebank is being re-organised and will be moved to the new facility as soon as possible. This move and reorganisation will cause some disruption to the distribution of seeds from the genebank. However, it is anticipated that the improved service available in the future will adequately compensate for the inconvenience caused during the next few months.

#### 4.5 An Appreciation

On behalf of the FNE Steering Committee I would like to express my appreciation to the organizations which contributed to making the 4th Annual Meeting and Workshop of the Network in Ethiopia such a success.

Special thanks are due to ILCA (FLAG and Training) and in particular Woy. Hirut Mekonnen, Wzt. Genet Delelegn and Wzt. Frehiwot Gosheme for their efforts in typing and distributing our Newsletters. Without the contribution of our FNE members, both local and international, the annual meeting would not have been such a great success.

Alemayehu Mengistu  
Chairman, FNE

4.6 Woy. Zenash Sileshi rejoined the nutrition section of IAR - Holetta Station in November 1985 after successfully completing her MSc. study at Alemaya University. The title of Zenashi's research was 'Protein quality evaluation of Dagussa (Elusine corocana) and Gibto (Lupinus albus) and the supplementary value of Gibto when added to a Dagussa diet'. Her work was supervised by Dr. Beyene Chichaibelu.

4.7 Ato Girma Getachew, Research Assistant in charge of the FLAG Zwai seed multiplication site has left Addis for a two months course in seed production at CIAT, Cali, Colombia. He will spend a further month working with the CIAT Tropical Pasture Programme on forage seed production of experimental germplasm. He plans to return to Addis on July 6.

\* \* \* \*

### 5. GENERAL FORAGE RESEARCH REPORTS OF FNE PARTICIPATORS

#### 5.1 Research Highlights from IAR - Holetta 1985

Lulseged Gebre Hiwot\*

##### Rainfall

The total annual rainfall for 1985 was 1078 mm which was about

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\* IAR, Holetta



the same as the long term mean (1100 mm). Monthly precipitation for June was only 45.6 mm which was far below the average (111 mm). Since most of the trials were planted during the first two weeks of June germination and seedling growth were seriously affected. The air temperature for July and August was lower than previous years, minimum temperatures less than 5°C were quite frequent. The unfavourable moisture conditions in June and low temperatures in July and August could be the major factors for the failure of most of the forage legumes trials at Holetta in 1985.

#### Plant introduction and variety trials

a) Fodder Oats: 18 varieties of fodder oats (Avena sativa) were tested at Holetta, Debre Zeit and Sheno for forage and grain yields and regrowing ability. Mean forage yields were 10, 13, and 4 t/ha dry matter for Holetta, Debre Zeit and Sheno, respectively when harvested at anthesis. The forage yields were reduced by about 50% for most of the varieties when harvested twice that is, at early stage and later at anthesis. Mean grain yields were 4.4 and 1.2 t/ha for the main harvest and regrowth respectively at Holetta while at Debre Zeit the grain yield was 3.5 t/ha for main harvest and 1.2 t/ha for the regrowth. The best varieties will be further evaluated at more locations.

b) Alfalfa: 24 varieties were planted at Holetta, Debre Zeit and Awassa. All entries failed after germination at Holetta due to damping off and unfavourable weather conditions. At the other two locations the establishment and growth of most entries was very satisfactory. The mean yields were 6 t/ha at Awassa (4 cuts) and 2 t/ha at Debre Zeit for a single harvest.

c) Tropical and Temperate Grasses: At Holetta of 17 temperate grass species planted in 1985, the best entries were Lolium perenne cvs Baroldi, Barwoltra and Barspectra which gave over 5 t/ha dry matter for two harvests. At Debre Zeit the best tropical species were Panicum coloratum, Andropogon abyssinicus and Chloris gayana giving dry matter yields of 5 to 8 t/ha.

d) Forage legumes: 132 tropical legumes belonging to the genera Alysicarpus, Centrosema, Desmanthus, Desmodium, Lablab, Macroptilium, Stylosanthes and Vigna were introduced from Australia (CSIRO) and planted at Awassa. Quite a number of species seemed to be well adapted and had vigorous growth. Seeds have been collected from various entries for further evaluation. At Debre Zeit various legume species (42 entries) were tried. Most species of the genera Trifolium and Medicago had excellent growth. Except for vetch, all legume trials were unsuccessful at Holetta. Alfalfa variety screening, alfalfa and Trifolium strip trials, a P-rate trial on Trifolium and forage legume nursery trials failed to establish and the species had no substantial growth. The major reasons for the failures could be a shortage of moisture during planting and relatively low temperatures in July and August.

#### Intercropping and Rotational Studies

Tall fescue, perennial rye grass and Phalaris had good establishment and gave harvestable yield. The grain yield of the wheat was reduced by about 30% because of the intercropping of the grasses.



A rotational study of wheat with oats, vetch, local clover and snail medic is going on at Holetta and Debre Zeit. Mean dry matter yields were 14, and 0.2 t/ha for oats, vetch and clover respectively at Holetta. At Debre Zeit the oats yielded 17 t/ha DM while vetch and snail medic gave 7 and 4 t/ha DM respectively. The grain yield of wheat was 4.2 t/ha at Debre Zeit and no yield at Holetta because of hail damage. Next year the effect of the forage crops will be assessed by planting all plots to wheat.

#### Pasture Management

Oversowing of various legumes was tried on natural pasture at Holetta. So far no success has been achieved. Another study was carried out to control Pennisetum schimperi on natural grasslands. The proportion of Pennisetum could be significantly reduced by either burning the grass during the dry season and then applying 10 t/ha manure or applying Glyphosate at 4 t/ha (product) during the active growth of Pennisetum.

The persistence of Phalaris tuberosa cvs Australia and Sirocco is being investigated at Holetta under grazing and hay management systems. Annual dry matter production under the hay system was found to be 6-7 t/ha.

#### Seed Production

The seed yields of vetch were found to be much higher when the plants were grown on wooden supports (2.9 t/ha) compared to plants without support (1.6 t/ha). Similar studies are being conducted at Awassa and Debre Zeit.

Seeds of various grass and legume species have also been increased for experiment purposes. Experimental quantities of seeds of the following species are now available at Holetta Research Station.

Grasses: Phalaris aquatica (Australia, Sirocco), Phalaris arundinacea, perennial rye grass, Rhodes grass, Panicums, Cenchrus, and Columbus grass.

Legumes: Barrel medic (Jemalong, Harbinger), Snail medic, vetches (Woolypod, Purple), Siratro, Leucaena and Sesbania.

### **5.2 IAR, Bako Agricultural Research Center**

The center is located 260 km west of Addis Ababa. It has an area of 800 ha and the altitude ranges from 1600 - 1650 m.

The rainfall averages 1200 mm/year with the main rainy season occurring between the months of June and September. The soils are mainly Oxisols and Entisols.

The major research activities carried out by the centre were:

- a) Forage adaptation and variety trials,
- b) Pasture management and improvement.



- 1) Oversowing of legumes on natural pasture, seeding rate trial of different grasses and legumes
- 2) Effect of harvesting stage on DM yield and chemical composition of a number of forage species.
- 3) Effect of harvesting stage on DM yield and nutritive value of Leucaena leucocephala.
- 4) Evaluation of grass-legume mixtures under Bako conditions.
- 5) Evaluation of oats/vetch mixtures in a highland area (Shambu).
- 6) Natural grass land survey of Arjo Awraja.
- c) Feeding trials.
- d) Seed production studies.

### 5.3 IAR, Melka Werer Agricultural Research Centre

This station is at an altitude of 750 m on basic Vertisols formed on flood plains of the middle Awash River. The soils are irrigated and used for cotton production. Increasing soil salinity is a problem. The inhabitants of the region are Afar, traditional herdsmen, for whom a reliable source of fodder year-round would provide an incentive for settlement and a cash economy based on milk and meat production.

Eleven trials were conducted in the station in 1985.

- 1) The effect of spacing on the fodder yield of Leucaena.
- 2) Effect of harvesting stage on the yield and quality of Leucaena.
- 3) Effect of frequency (4, 6, 8, 10 weeks) and height of cutting (30, 50, 100, 150, 200 cm) on Leucaena yield.
- 4) Alfalfa variety screening trial. With and without P.
- 5) Tropical grass and legume nursery for hot irrigated areas.
- 6) Selection of salt tolerant forage species at Melka Sedi.
- 7) Selection of grass legume and shrub sp. for moisture stress areas.
- 8) Intercropping of forage crops with cotton.
- 9) Micro seed increase of selected grasses and legumes at Melka Werer.
- 10) Response of irrigated pasture to nitrogen.
- 11) Determination of the life span of irrigated forage crops.

#### Results

- Harvesting Leucaena at early stage (5% flowering) gave higher dry matter yields than the other treatments (45 t fresh matter (FM)/ha). The crude protein contents of the various treatments were similar.
- Spacings of 80 to 100 cm gave highest Leucaena yields (60 t FM/ha).
- Harvesting of Leucaena every 10 weeks at 100 cm height gave the highest DM yields (about 37 t FM/ha).
- Applying 200 kg/ha of N per year to Leucaena gave higher yields than applications of 8.75, 17.5, 35 and 70 kg N/ha.
- Evaluation of some of the trials was impossible due to a flood of the Awash River.



## 5.4 Highlights of Animal Nutrition Research in IAR

Seyoum Bediye\*

As in the other tropical regions of the world, animal nutrition research in Ethiopia is at an early stage of development. It has been officially included in the duties of the IAR since its foundation in 1966. Except for small scale laboratory analysis of feeds collected from livestock sections of IAR, most of the early work on animal nutrition was restricted to the setting up of lab facilities. Later, in 1977 a long term project entitled "Laboratory and Animal Evaluation and Estimation of Nutritive Value of Ethiopian Feed Stuffs" was launched. The data generated from this project on chemical composition, gross energy and digestibility will be used to formulate least-cost rations for different classes of animals in different ecological zones. Representative feed samples have been collected from six major agroecological zones of the country and the majority of these samples have been evaluated for the major chemical components (dry matter, ether extract, crude protein, acid detergent fiber, neutral detergent fiber, cell soluble matter, ash and lignin) which determine biodegradability. Fractionation of the fiber component into further chemical entities and the estimation of nutritive values from the chemical composition via a summative equation is underway. The results obtained are being tabulated according to NRC nomenclature.

As data from chemical analyses need to be verified by biological evaluation (voluntary intake, ruminal digestion and animal weight gains), it is thus planned to also run animal evaluation of promising feed stuffs.

Crop residues, agro-industrial by-products, and promising forage crops deserve special research attention in Ethiopia. It is strongly felt that as any improvement in livestock productivity can only be attained through improved feeding then an in depth inventory of the available feed resources and a survey of the existing feeding systems is essential.

## 5.5 The Relief and Rehabilitation Commission (RRC)

Beruk Yemane\*\*

The Livestock Production and Veterinary Service Division is involved in the initiation and expansion of livestock raising in the following areas: local and crossbred cattle for beef and dairy, sheep, goats, poultry and bees (both under traditional and modern systems). It is involved in the supply of oxen for rainfed agriculture, and the training of settlers among other activities, to make a full development package.

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\* IAR, Holetta

\*\* Head, Livestock Production and Veterinary Service Division (RRC)



Even though research is not a major component of the livestock programme due consideration is given to management and proper utilization of natural pastures and crop by-products in rainfed agricultural settlements, and improved pasture species such as alfalfa and Rhodes grass where irrigation is available. To date livestock and pasture management activities have been initiated in 20 settlement areas of which Assosa (Wollega), Tedelle and Harake (Shoa), Harawa (Bale) and Godie (Hararge) are the four biggest settlement projects.

Some of the problems that have hindered the livestock and pasture development projects which might interest researchers are:

- 1) Lack of proper forage and crop byproduct preservation techniques for the dry season.
- 2) The prevalence of Tsetse in the south and south-west parts of the country which has hindered livestock production and management, and utilization of the available natural pasture.
- 3) Lack of activity in the introduction and implementation of appropriate technology, particularly in animal traction for particular soil types, as a feasible alternative for expensive, difficult-to-maintain machinery such as tractors.

## **5.6 Ministry of State Farms**

### Ethiopian Seed Corporation (ESC)

Ethiopian Seed Corporation (ESC) has the capacity to process about 50,000 t of seed annually, and currently handles about 45,000 t of which over 70% is for the peasant sector and the balance for the state farms. ESC concentrates on food crops although in forages has handled a little oats (Lampton, Jasari) and vetch (Hama). Horticultural and vegetable crops are handled by the Horticultural Corporation and coffee/tea crops by the Ministry responsible. It appears several organisations are producing small quantities of forage and pasture seeds at present. ESC will be catering to the sustained and planned demand for forage oats and vetch from the Feeds and Forage Project. Other users who may require forage crop seed on a sustained basis may contact ESC. For specific crops that ESC does not presently handle, production may be arranged by contract with other organisations. ESC also provides a seed clearing service at a nominal cost. Besides the large processing units (3.5 t/hr at Lekempt, Asella, Koffele and Awassa) ESC has mobile units of 1.5 - 3.5 t/hr capacity with pre-cleaners, cleaners, indented cylinders, graders, gravity separators, treaters and small packaging machinery for 10, 25, 50 kg bags.

The ESC strategy to meet seed demand from all sectors, is two-tiered. ESC will produce the basic seed on its own proposed seed farms and the certified seed (C1) by contract with registered primary producers. This seed will then move down to secondary producers within each zone, under a proposed "Rural Secondary Seed Production Scheme" under the MOA. This scheme centres on service cooperatives, AISCO, AIDB for procurement/supply and credit.

It is envisaged that ESC will operate within the seed legislation (now in draft) and all seed production will operate under this umbrella,



with realistic rules and standards to be observed for seed growers, seed suppliers, seed imports, quarantine and seed prices.

## 5.7 Sirinka Catchment Project

### Research Activities

Research had been conducted in three sites in ecological zones representing low, medium and high altitude. Due to an acute shortage of rain at the lower altitude site all the species died after emergence.

The 1985 research activities included intercropping of lablab with sorghum and maize and alley cropping of Leucaena and Sesbania with sorghum. P was applied to native pastures but no significant response was obtained. Lines of Lablab purpureus were screened under 0 and 20 kg P/ha. There was no fertilizer response and the ILCA lines 6529, 6636 and 7278 were the best, yielding 15, 14 and 13 t DM/ha respectively. Of four lines of alfalfa tested Hairy Peruvian gave the best yields at the medium altitude site and Hunter River at the high altitude site. Work was also done on the evaluation of native legume species, establishment of forages on bunds, and hillside pasture production.

## 5.8 South Eastern Zone Agricultural Development

The objectives of the zonal research is to screen suitable species and varieties for various soil and climatic conditions, to study and establish knowledge on production techniques, to multiply seeds of most suitable species and to disseminate research findings to farmers.

The 1985 research activities included work on systems of combining grasses and legumes in mixtures and the determination of their nitrogen requirements, on pasture establishment and seed production techniques, and on crop rotation systems.

The results of the trials will be given in detail in the next Newsletter.

## 5.9 Fourth Livestock Development Feed & Forage Project

Alemayehu Mengistu\*

1. Project Title: Feeds and Forage
2. Objectives of the Project:
  - 2.1 Increase the supply of forage available for Ethiopia's ruminant livestock in the peasant sector.
  - 2.2 Decrease soil erosion in catchments and arable areas.

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\* Senior Pasture Agronomist (MOA)



- 2.3 Through 2.1 increase/maintain:
    - a) Livestock production: meat and milk,
    - b) Manure production: for fuel and fertilizer,
    - c) Draught power for cropping,
    - d) Fuel wood and timber supplies, and
    - e) Equine transportation.
  - 2.4 Through 2.3 improve/maintain human nutrition and the quality of life, and
  - 2.5 Increase the supply and quality of animal feed for intensive livestock industries.
3. Project Components:
- 3.1 Forage development on 498,940 ha, and 561,830 km of contour bunds and hedges, through the promotion of low-cost forage development strategies and techniques that are applicable to Ethiopia's peasant farming sector, and complementary to food cropping and soil conservation.
  - 3.2 Forage and pasture seed, and tree seedling production for distribution to the project areas. At peak development 605 tonnes of seed and 223.0 million fodder trees and seedlings would be produced annually with the seed production under contract concentrated in the peasant associations and cooperatives and seedling production in nurseries operated by the Soils and Community Forest Department.
  - 3.3 The establishment of a microbiology laboratory for legume inoculation studies (forage and pulses), and the development of a capacity to produce inoculum.
  - 3.4 The establishment of an extension network meshed with the network to be developed under PADEP.
  - 3.5 Linkage with PADEP's proposed farming systems research programme.
  - 3.6 Forage development monitoring.
  - 3.7 Provision of training courses, study tours and fellowships for project staff. Local training for development workers and farmers.
  - 3.8 Provision of technical assistance and project preparation funds for a second phase, and funds for a mid-term review.
  - 3.9 Assistance to Ethiopia's manufacturing industry, through the Animal Feeds Enterprise (AFE)
  - 3.10 Establishment of Forage System Development Unit (FSDU):-  
This is an applied research unit which will do research and evaluate promising station forage production results at field level with view to the rapid development of technology suitable for extension to Ethiopian farmers. IAR and ILCA will participate as members of a joint consultative committee to provide direction to the unit.
  - 3.11 Establishment of Project Management Unit (PMU) within the Animal Resources Development Department (ARDD) of the Ministry of Agriculture (MOA), to serve as a base for project management. The project would appoint an additional 178 professional staff over five years.
4. Project Areas:- Shoa, Gojam, and Hararge.

5. Strategies for development:

- i) Direct implementation - fodder trees, forage on livestock exclusion areas and forage on soil conservation structures.
- ii) Pilot scale implementation - requires further adaptive research such as over-sowing, under-sowing, annual and perennial fodder crops and perennial pastures.

6. Beneficiaries:

The project would result in improved productivity from a total of 2.367 million cattle and 1.766 million sheep and goats. The annual increase in meat, milk and manure production would be 29,200 tons of beef, 6,300 tons of sheep/goat meat, 37,300 tons of milk and 540,000 tons of manure. Livestock numbers would increase by 294,300 head of cattle and 245,200 head of sheep and goat.

A total of 5,026 peasant associations would participate in and receive benefit from the project. This is equivalent to 396,140 families who would benefit from incremental livestock production from 770 ha and 185,000 km of fodder trees, 377,000 km of contour bunds planted with forage, 200,000 ha of livestock exclusion areas, 5,000 ha of fodder crops, 103,000 ha of legumes over-sown into cereal crops, 11,000 ha of legumes under-sown into cereal crops, 42,000 ha of permanent pasture and 19,000 ha of other fodder crops (over 20 years).

7. Expected external assisting body: - World Bank

8. Expected implementing body (local): Ministry of Agriculture (MOA)

9. Estimated total cost (Birr): 36,490,000

9.1 From Government contributions (Birr): 24,152,600

9.2 From external contributions (Birr): 12,338,000

10. Expected date of commencement: July/August 1986

Project duration: 5 years (with possibility of extension).

### 5.10 ILCA Highland Research Activities

#### The Vertisol Management Project

The major objectives of the research are as follows:

1) To adapt or develop improved Vertisol management techniques in order to improve the agricultural utilization of the soils.

2) To develop techniques for more effective use of the water resource of the Vertisol areas by appropriate land shaping and watershed planning.



3) To improve low input cropping systems for these physically amended soils, with particular consideration being given to the legume component in order to provide soil N levels for sustained crop production.

4) To design and test new techniques, e.g. animal drawn implements for Vertisol cultivation and land shaping.

5) To implement necessary climatic data recording and handling systems to support improved land, water and crop management.

#### Other Research Activities

1) Crop residues: Grain and straw yields and their feed values. The cereals used were barley, wheat, oats triticales and sorghum.

2) Screening of triticales species and varieties.

3) Various trials on improvement of cultural practices:

- Subsequent cropping
- Intercropping
- Relay cropping
- Alley cropping

4) Screening barley varieties for highland ecosystems in conjunction with IAR.

### 5.11 ILCA, FLAG Forage Activities 1985

John Lazier\*

In the highlands at ILCA headquarters, multiplication, screening and agronomic description of the annual native highland Trifolium species was continued as was the replicated dry matter and seed yield trial of elite lines selected in 1983. Screening and seed production were initiated for the first time on out-crossing perennial Trifolium species. Other work included an irrigated browse adaptation trial, a replicated alfalfa yield trial at three sites and fertilizer response pot trials.

In the Rift Valley tropical and sub-tropical seed multiplication was continued at the Zwai Horticulture Farm in co-operation with the Ministry of State Farms. Over 1000 lines were multiplied on the original 2 ha site and a move was begun to shift to a new 4 ha site.

At Abernosa Ranch, where ILCA has a co-operative programme with the MOA, Stylosanthes scabra cvs Fitzroy and Seca, S. fruticosa and S. hamata cv Verano remain the most promising species, although their vigour varies markedly from year to year. The browse trial (160 lines) was replanted using seedlings, but survival was again very low, and a new irrigated (dry season) highland Leucaena trial was established. The trials established in previous years were continued as were the pregermination and pot raising of experimental germplasm for

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\* FLAG, ILCA



multiplication. A doubling of the size of the nursery and screen house allow over 3000 pots to be maintained at one time. Seed cleaning of the Rift Valley-raised germplasm was transferred from Addis to Abernosa Ranch.

In Soddo, Wolayta the joint FLAG - MOA programme established over 1200 introduction/seed multiplication plots. Three, large established Stylosanthes guianensis cv Cook seed production plots were handed over to the MOA. The browse screening trial was replanted by seed with only small success in establishment, and the following new trials were planted: two wet land strip trials, alfalfa vs Cook Stylo, a grass strip trial (3 N rates). Cook stylo still appears to be one of the most vigorous plants followed by S. scabra cvs Fitzroy and Seca, D. intortum, and Macrotyloma axillare. Alfalfa generally failed to establish. New, promising lines and species are showing up in the introduction plots.

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## 6. FNE 1985 TRIAL RESULTS

### 6.1 Institute of Agricultural Research, Holetta

Lulseged G/Hiwot and Tadesse T/Tsadik\*

#### 6.1.1 Grass-Legume Mixture Trial at Holetta

Two grass species namely, Festuca arundinacea (Demeter) and Phalaris aquatica (Sirocco) combined with three legumes (Trifolium quartinianum, T. rueppellianum and Medicago sativa cv Hunter River) were planted under three levels of phosphate fertilizer, on June 7, 1985. The fertilizer rates were 0, 10 and 40 kg P/ha.

The establishment and growth of the three legumes was rather poor, hence there was no harvestable yield. Trifolium quartinianum seemed to be relatively better than the other two. The poor performance of the legumes was not likely to be due to lack of compatibility with the associated grass species but rather due to unfavourable moisture conditions at planting and relatively low temperatures at the seedling growth stage. Most legume trials have failed this year at Holetta.

Plot cover was uneven for both grasses. However, the establishment of Phalaris aquatica was much better than Festuca arundinacea. Mean yields were 0.6 and 1.6 t/ha dry matter for fescue and Phalaris, respectively. The phosphate fertilizer seemed to influence the establishment of the grasses as fertilized plots had better growth and establishment than the the control plots particularly in the case of Phalaris. The application of 10 and 40 P kg/ha improved average dry matter yields by 38 and 81% respectively over the control (Table 1).

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\* IAR, Holetta



TABLE 1

Grass-legume mixture trial under different levels  
of Phosphate fertilizer at Holetta, 1985

| Species*                   | Dry matter yield t/ha<br>P rates kg/ha |     |     | Species mean |
|----------------------------|----------------------------------------|-----|-----|--------------|
|                            | 0                                      | 10  | 40  |              |
| <i>Festuca arundinacea</i> | 0.6                                    | 0.7 | 0.6 | 0.63         |
| <i>Phalaris aquatica</i>   | 1.0                                    | 1.6 | 2.3 | 1.63         |
| Fertilizer mean            | 0.8                                    | 1.1 | 1.5 | 1.13         |

|     | Species   | P-rate    | Interaction |
|-----|-----------|-----------|-------------|
| SE  | 0.23 t/ha | 0.28 t/ha |             |
| CV  | 60%       |           |             |
| LSD | 0.14 t/ha | NS        | NS          |

\* Legume components not included because of poor growth.

#### 6.1.2 The Productivity and Persistence of Forage Legumes with *Chloris gayana* at Awassa.

*Chloris gayana* cv Masaba was planted on 1st June 1985, in pure stand and in combination with 12 legumes. Phosphate fertilizer at the rate of 10 kg P/ha was broadcast and mixed with the soil. The inoculated seeds of the legumes were planted in alternating rows with the Rhodes grass, spaced at 25 cm.

The germination and establishment of most of the stylos were poor and among the stylos *Stylosanthes guianensis* cv Cook was the best. On the other hand, *Desmodium intortum*, *D. sandwichense*, alfalfa and siratro had excellent germination, vigorous growth and establishment. *Leucaena* had good germination but its growth was stunted because of the shading effect of the rapid, vigorous growth of the Rhodes grass. The grass suppressed all the legumes except the vigorous ones (*Desmodium sandwichense*, *D. intortum* and alfalfa). The difference in total dry matter yield among treatments was non-significant. The mean yield was 5.7 t/ha dry matter. According to the dry-weight rank method the proportion of the grass was higher than the legumes in all cases. The highest proportion of legume (about 40%) was recorded in *Desmodium sandwichense*, *D. intortum* and alfalfa plots. The proportion of the legume in the other treatments was less than 10% (Table 2).

#### 6.1.3 Evaluation of three *Trifolium* Species Under Three Levels of P at Holetta

*Trifolium temense*, *T. decorum* and *T. quartianum* were planted under three levels of phosphorus (0, 10 and 30 kg P/ha) on well prepared

red soil. Initial germination of the legumes was poor, those plants which emerged did not make substantial growth, hence no yields were recorded.

TABLE 2  
The performance of *Chloris gayana* and forage legumes  
in mixture at Awassa (1985)

| Species                               | Dry matter<br>yield<br>t/ha | Composition |        |        |
|---------------------------------------|-----------------------------|-------------|--------|--------|
|                                       |                             | Grass       | Legume | Others |
| <i>C. gayana</i> + <i>D. intortum</i> | 5.9                         | 50          | 39     | 11     |
| " + <i>D. sandwichense</i>            | 7.1                         | 43          | 41     | 16     |
| " + <i>leucaena</i> (Peru)            | 5.5                         | 69          | 16     | 15     |
| " + <i>Siratro</i>                    | 5.1                         | 74          | 11     | 15     |
| " + alfalfa (Hunter River)            | 4.5                         | 51          | 39     | 10     |
| " + <i>S. guianensis</i> (Cook)       | 5.6                         | 74          | 11     | 15     |
| " + <i>S. guianensis</i> (Endeavour)  | 5.0                         | 69          | 11     | 20     |
| " + <i>S. guianensis</i> (Graham)     | 5.5                         | 72          | 9      | 19     |
| " + <i>S. hamata</i> (Verano)         | 6.7                         | 70          | 9      | 21     |
| " + <i>S. humilis</i>                 | 5.9                         | 72          | 9      | 19     |
| " + <i>S. scabra</i> (Seca)           | 6.1                         | 73          | 9      | 18     |
| " + <i>S. scabra</i> (Fitzroy)        | 5.2                         | 75          | 10     | 15     |
| <i>Chloris gayana</i> (pure stand)    | 6.0                         | 78          | -      | 22     |

S.E. + 1.1 t/ha

CV = 34%

LSD 0.05 = NS

#### 6.1.4 Alfalfa and Native *Trifolium* Strip Trials

Sixteen alfalfa lines were first planted in June and replanted in July on a black cambered soil at Holetta. Emergence and establishment were extremely poor for both plantings. Twenty *Trifolium* lines were also planted at Holetta and Sheno in cultivated strips in natural grassland. At Holetta though the planting was done twice i.e. in June and July, emergence of all species was nil. At Sheno the emergence of all species was good. There was clear difference on the growth of the *Trifolium* lines under different P levels as growth of the fertilized plots was much better than the control. Final yields were not obtained because all plants died due to prolonged waterlogging.

In general the 1985 crop season was unusually bad for forage legumes in the highlands, particularly at Holetta. This was probably because of dry conditions during planting and low temperatures in July and August which affected seedling growth and development. Though most of the trials were planted in June, the month was relatively dry with only 45.6 mm rainfall as compared to 111 mm in a normal year while the minimum temperatures in July and August were frequently below 5°C.



## 6.2 Forage Legume Strip Trial, Melka Werer

Aschalew Tsegahun\*

### Introduction

Pasture improvement and development programmes can involve the replacement of the existing natural pasture with introduced pasture species, the improving of management in the utilization of existing natural pasture resources or the oversowing of introduced species into existing native pasture. Before initiating these programmes, improved forages especially legumes, should be introduced and evaluated.

### Materials and Methods

Eighteen forage legumes were planted unreplicated in 7 m x 0.5 m strips on July 6, 1983 at Melka Werer. Control strips of Medicago sativa cv Hunter River were planted in each 5th strip, and about the perimeter of the trial.

### Species/varieties used in the trial

Medicago sativa cv. Hairy Peruvian ILCA 6752  
Centrosema pubescens ILCA 6953  
Desmodium discolor ILCA 6988  
Zornia spp. ILCA 9027 CIAT 7547  
Calapogonium mucunoides ILCA 6750  
Macroptilium atropurpureum cv Siratro ILCA 69  
Lotononis bainesii ILCA 6759  
Centrosoma virginianum ILCA 511  
Stylosanthes guianensis cv Endeavour ILCA 2  
Desmodium intortum cv Greenleaf ILCA 104  
Medicago sativa cv Hunter River ILCA 6984  
Stylosanthes scabra cv Seca ILCA 140  
Desmodium canum ILCA 6991  
Desmodium uncinatum ILCA 6765  
Stylosanthes guianensis cv Cook ILCA 4  
Clitoria ternatea ILCA 6767  
Macrotyloma axillare ILCA 6959  
Centrosema haitense ILCA 6772

The plot was fenced with barbed wire in order to protect the plots from wild animals and was irrigated every two weeks with about 10 cms of water.

### Results and Discussion

Until the trial was abruptly terminated by a flood of the Awash River on August 12, 1985, most of the plants performed well in terms of their palatability, regrowth and competition with weeds.

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\* IAR, Melka Werer

Based on the observations made over the two years of the trial the legumes were categorized into four classes according to their performance.

|           |                                                              |
|-----------|--------------------------------------------------------------|
| Group I   | Plants with high ground coverage and palatability.           |
| Group II  | " " " " " " medium palatability                              |
| Group III | " " " " " " medium/low ground coverage and high palatability |
| Group IV  | " " " " " " low palatability                                 |

#### Group I

Macroptilium atropurpureum cv Siratro  
Medicago sativa cv Hairy Peruvian  
Clitoria ternatea  
Desmodium canum  
Medicago sativa cv Hunter River

#### Group II

Macrotyloma axillare  
Stylosanthes guianensis cv Cook  
Desmodium uncinatum  
Stylosanthes scabra cv Seca  
Desmodium intortum cv Greenleaf

#### Group III

Centrosema pubescens  
Desmodium discolor

#### Group IV

Lonotonis bainesii  
Stylosanthes guianensis cv Endeavor

Calopogonium mucunoides, Centrosema haitense, C. virginianum and Zorina spp. failed to germinate.

### 6.3 Asmara University

The University is undertaking research activities 23 km south-west of Asmara at an altitude of 2300 m. The aim of the research is to identify methodologies of improving animal feed in combination with crop production. Forage activities in 1985 consisted of doing initial screening on a range of grasses and legumes. Among the most promising lines were Vicia dasycarpa, Medicago sativa, M. truncatula, Melilotus, Sudan grass and Rhodes grass. Work is planned on such browse species as Acacia albida, Ceratonia siliqua and Leucaena leucocephala.

### 6.4 Jimma Agricultural Junior College

Solomon Demeke and Konrad Gerards\*

Jimma College planted a 52 plot FNE medium altitude strip trial in 1985 at Jimma at an altitude of 1710 m where the average annual rainfall is 1550 mm with a dry season of three or four months between November and February.

The trial was planted in mid-September, late in the rainy season, and 132 mm of rain were received before the dry season commenced. Due

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\* Jimma Agri. Junior College, Jimma



to the low rainfall germination of some species was poor and species adapted to dryer conditions grew best (15 to 30 cm over the three months) including the Stylosanthes species, Medicago sativa and Lablab purpureus. Melinis minutiflora was the best grass while Sesbania and Cajanus grew well. The strips with no or poor growth will be replanted in the 1986 growing season.

#### 6.5 Ambo Junior College

Forty-two species of forage legumes were planted in a strip trial. The species with best ground cover and performance were:

|                       |                     |
|-----------------------|---------------------|
| <u>N. wightii</u>     | <u>S. sesban</u>    |
| <u>D. intortum</u>    | <u>D. uncinatum</u> |
| <u>D. sandicence</u>  | <u>M. sativa</u>    |
| <u>M. lathyroides</u> |                     |

#### 6.6 Arsi Rural Development Unit (ARDU)

Daniel Keftassa\*

In 1985/86 crop season a total of 6 trials were planted at 3 stations in Arsi region.

The trials were:

1. Evaluation of 3 native clovers at 3 P levels - Robe
2. African Trifolium initial evaluation strip trial - Kulumsa and Meraro
3. Medicago sativa initial evaluation strip trial, Kulumsa
4. FNE replicated grass - legume mixture: high altitude - Meraro
5. FNE replicated grass - legume mixture: medium altitude - Kulumsa

TABLE 1

Soil and Climatic Conditions of the Stations

| Station | Altitude<br>m | S o i l |          |         | Climate                     |           |           |
|---------|---------------|---------|----------|---------|-----------------------------|-----------|-----------|
|         |               | pH      | P<br>ppm | Texture | Annual rain-<br>fall (1985) | Temp.     |           |
|         |               |         |          |         |                             | Mean max. | Mean min. |
| Kulumsa | 2200          | 6.1     | 28       | Clay    | 596                         | 23.7      | 9.2       |
| Robe    | 2420          | 5.2     | 25       | "       | 900                         | 23.0      | 7.5       |
| Meraro  | 2980          | 5.1     | 18       | "       | -                           | -         | -         |

\* ARDU, Assela

## Results and Discussions

Two of the trials, the African Trifolium initial evaluation strip trial and the FNE replicated grass - legume mixture high altitude trial which were planted at Meraro were damaged by heavy flooding which occurred a few days after planting. Therefore no yields were obtained. FNE replicated grass-legume mixture medium altitude trial which was planted at Kulumsa showed uneven germination and produced poor stands thus no yields were obtained from the trial in 1985.

### 6.6.1 Evaluation of 3 native clovers at 3 P levels - Robe

The yield data (Table 2) shows that Trifolium quartinianum was superior to T. decorum and T. tembense at all levels of phosphorus on the black clay soil at Robe. The response to phosphorus was high in all species.

TABLE 2  
Yield data of FNE of the Evaluation of 3 Annual Native  
Trifolium sp. with 3 levels of P at Robe

| Species                | P levels<br>kg/ha | Yield kg/ha DM |      |      |      | Mean |
|------------------------|-------------------|----------------|------|------|------|------|
|                        |                   | I              | II   | III  | Mean |      |
| <u>T. quartinianum</u> | 0                 | 1528           | 1296 | 1832 | 1552 | 19.1 |
|                        | 10                | 3440           | 3816 | 4272 | 3843 | 18.7 |
|                        | 30                | 3720           | 3976 | 4776 | 4157 | 19.1 |
| <u>T. decorum</u>      | 0                 | 272            | 1160 | 248  | 560  | 15.3 |
|                        | 10                | 872            | 2304 | 672  | 1283 | 16.7 |
|                        | 30                | 776            | 2056 | 960  | 1264 | 16.6 |
| <u>T. tembense</u>     | 0                 | 736            | 616  | 1640 | 997  | 15.4 |
|                        | 10                | 1528           | 1328 | 2000 | 1619 | 16.6 |
|                        | 30                | 2384           | 2312 | 2928 | 2541 | 17.0 |

Date of planting: 19 July, 1985

Date of harvesting: 25 October, 1985

### 6.6.2 African Trifolium initial evaluation strip trial at Kulumsa

Twenty-one accessions of 5 Trifolium spp. were planted in strips of 7.5 m length. Each strip was divided into 3 parts 2.5 m long on which 3 levels of P (0, 10, and 30 kg/ha) were applied.

Stands and overall performance of the species were uneven and yield figures were quite low. There were quite low and inconsistent responses to phosphorus. Generally the Trifolium quartinianum lines ILCA 6301 and 9675 looked better than others.



### 6.6.3 Medicago sativa initial evaluation strip trial - Kulumsa

In this trial 17 accessions of Medicago sativa were planted in unreplicated strips 7.5 m long. Each strip was sub-divided into three 2.5 m lengths to which levels of P (0, 10, and 40 kg/ha) were applied.

Two harvests were taken from each accession during the season. The stand and overall performance of all accessions were poor and thus dry matter yields were generally lower than what would be expected from alfalfa at Kulumsa. There was poor response to phosphorus without any trend to increased levels.

From the yield data it appears that cv Hunter River was the most productive line followed by cv Springfield (ILCA 9238).

Due to the late planting and low rainfall many of the seeds, particularly the grasses, did not germinate, and the legumes which performed best were those adapted to drier conditions. Generally the Stylosanthes species showed good growth as did Macroptilium atropurpureum and M. lathyroides. Most of the more vigorous lines grew 15 to 30 cm over the three months.

Seeds which did not germinate in 1985 will be replanted in 1986.

## 6.7 Djibouti FNE Strip Trial

The FAO Project in Djibouti in cooperation with the Djibouti Ministry of Agriculture has planted the FNE lowland irrigated strip trial in late November 1985 on a research station with a mean annual rainfall of 120 mm on alluvial sandy and sandy silt soils.

The best lines in the first 5 weeks of growth were Melinis minutiflora, Panicum maximum, Chloris gayana cvs Hunter and Callide, Medicago sativa cv Hairy Peruvian, the stylos, particularly S. scabra, Desmodium sandwicense, D. intortum, D. uncinatum, Neonotonia wightii, and Lablab purpureus.

## 6.8 ILCA Highland Programme FNE Trial Results

### 6.8.1 Debre Berhan

The Debre Berhan Research station of the ILCA Highlands Programme is at 2800 m and has an average annual rainfall of 1000 mm. The soil is mainly a clay loam with vertic properties and a pH of 5.0 to 6.5.

Three FNE trials were planted in 1985:

- 1) African Trifolium initial evaluation
- 2) The grass - legume mixture (high altitude)
- 3) Evaluation of 3 annual Trifolium species with 3 levels of P.

All of the experiments germinated slowly due to lack of rain after planting. Other climatic factors which inhibited growth were: two heavy hail storms (July 10 and 28), high rainfall intensities (particularly on July 10 when 80 mm was recorded in 1.3 hours), low temperatures, with frosts which occurred from mid-October until January ( $-4^{\circ}\text{C}$  was recorded).

#### 6.8.2 Debre Zeit

The ILCA Highlands Programme Debre Zeit Research Station is located at 1800 m and receives 800 mm of rainfall. The soils are mainly Vertisols and have a pH from 5.5 to 6.0.

The FNE replicated grass-legume trial was planted on a well-drained soil. Light flood damage occurred in the plots in August. Weeding was done three times and harvesting on 17/10/85 when M. sativa was in full flower and D. uncinatum and S. guianensis were just beginning to flower.

The M. sativa strip trial were also planted on a light soil. The performance of the species was poor due to flood damage.

\* \* \* \*

### 7. PAPERS FROM THE WORKSHOP

#### 7.1 Rumen Bacteria, The Solution to Leucaena Toxicity

Leucaena leucocephala is probably the leguminous browse species of greatest potential for the higher rainfall, low and medium altitude regions of Africa. It has excellent palatability and grows very rapidly once established.

However Leucaena is toxic to non-ruminants (horses, pigs, rabbits) and should only be fed to ruminants (cattle, sheep, goats) mixed with other feed (less than 30% of the diet) or as a sole feed for a short period of time (three months). Toxicity symptoms in ruminants include reduced appetite, excessive salivation, listlessness, hair loss, and weight loss. Mature animals may die, and calves may be dead on birth or die shortly thereafter. Enlarged thyroid glands and sores on the oesophagus and tongue are internal symptoms.

These problems are caused by the activity of a chemical DHP (3 hydroxy-4(1H) pyridone) which is produced in the rumen by the digestion of mimosine, an amino acid found in Leucaena leaves. The DHP interferes with the use of iodine by the thyroid gland.

Attempts had been made to avoid the toxicity problem by the selection of productive, low mimosine lines of Leucaena and by the provision of mineral supplements to the animals. However these approaches were not successful.



In Hawaii and Indonesia however cattle and goats appeared unaffected by almost pure Leucaena diets. This led Dr. Ray Jones, a speaker at the FNE 4th General Meeting and Workshop, to examine these animals to find out how they managed to handle the mimosene in Leucaena.

Three groups of Hawaiian goats were used in a feeding trial in which they were fed various proportions of Leucaena up to 100% of the diet. None of the goats showed any signs of toxicity and they all had very low DHP levels in the urine, normal thyroid function and thyroxine blood levels. He then took a sample of rumen fluid and introduced macerated Leucaena leaf into it. The fluid rapidly degraded both the mimosine and the DHP. Dr. Jones had thus indicated that the rumen microflora could break down the mimosine and the resultant DHP, presumably to non-toxic products.

The next step was to transfer rumen fluid from animals which were unaffected by Leucaena toxicity to those which were affected. Four Australian goats were fed pure Leucaena for five weeks before being flown to Indonesia where they were fed further Australian Leucaena. They were showing toxicity symptoms and excreting large quantities of DHP in their urine. One of these goats was infused with rumen contents of an Indonesian goat which had been feeding on Leucaena, a second goat received rumen fluid. In 3 days the DHP urine levels of both goats dropped and the toxicity symptoms disappeared. Rumen fluid transferred from one of these recently recovered goats to one of the still affected ones resulted in its recovery as well.

Dr. Jones has since introduced the rumen fluid into Australian animals and has isolated the responsible bacteria. These bacteria have been cultured and are now injected into animals in herds of cattle which have access to large quantities of Leucaena. Toxicity symptoms have not appeared in these animals.

When Dr. Jones visited ILCA in February and gave his talk to the FNE General Meeting, he had brought with him the bacteria which break down DHP. These were introduced into sheep and goats in the ILCA animal barn which had been fed on Leucaena and were excreting large quantities of DHP. Within a few days the levels of DHP dropped dramatically; the animals were now able to digest Leucaena without toxicity problems. The rumen fluid from these animals will be used to provide the bacteria to herds in Africa which have access to large quantities of Leucaena.

One feature of the bacteria which will assist its distribution, is that they apparently transfer between animals in a herd without assistance. The mechanism for this is not known but may be by means of bacteria in saliva on vegetation, in water troughs, or in a spore state in feces.

The work of Dr. Jones and his colleagues in CSIRO, the USA and Indonesia is thus of immense importance to the development of Leucaena based livestock feeding operations. It promises to have a great impact on livestock raising in Africa.



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- Ralph, W. (1984). The key to the Leucaena problem is in the rumen. Rural Research 12, 17-19.

## **7.2 The Introduction of Cultivated Forages and Pastures in the Republic of Djibouti**

Kedim H.\*

The Republic of Djibouti is a small country with an area of 23,000 km<sup>2</sup> situated in the north-east of the African continent, on the Red Sea, the Bab-al-Mandab Strait and the Gulf of Aden (Indian Ocean). It forms the "Horn of Africa" along with Somalia and the extreme east of Ethiopia (the Ogaden). Lying between 10° 55'N and 12° 43'N and 41° 45'E and 43° 25'E, the entire country has an arid tropical environment.

### Climate

The country is noted for its arid climate, the result of weak and irregular precipitation, high temperatures and high evaporation. The annual rainfall varies between 100 and 200 mm over most of the country although some mountainous regions such as Mount Goba and Mount Malba receive relatively abundant rainfall. Randa, for example, receives 300 to 350 mm of rain annually. Most of the country receives rain on less than 30 days annually.

The air temperatures are high throughout the year over the entire country. At lower altitudes (0 to 400 m) the mean daily temperatures in the coolest month (January) are never less than 25°C while those of the warmest month (July) are always higher than 35°C. During the hot season (June to August) absolute maxima are frequently 40° to 45°C. Temperatures moderate with altitude and in the Day region which includes Mount Goba (1500 m) and Mount D'Arta (750 m) the summer maxima are 8° to 10°C and 3° to 4°C respectively, less than those of Djibouti.

Evaporation is high. At Djibouti the mean annual evaporation is 2455 mm, or 6.7 mm day. Evaporation is particularly high in the summer (14.4 mm at Djibouti in July) due to the dry and burning continental wind, the "Khamsein" which stifles the north-north-east region for about 50 days.

The relative humidity is highest along the coast, 70% is the annual mean in Djibouti, and of course, lower in the interior.

### Soils

The topography of Djibouti consists of chains of mountains with plains in the intervening valleys where permanent springs are found. The plains are crossed by wadis which can have violent floods.

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\* United Nations Forestry Volunteer, Djibouti



Mountains and plateaux occupy 80% of the area of the country and are made up mainly of volcanic rocks consisting of basalts which are dominant and phylites. Due to the arid climate the soils are little developed, thin, stoney and often covered with basalt pebbles and large stones.

The plains which cover 20% of the country can be divided into two groups, coastal and interior. Those of the interior are the most extensive with clay or silty-clay compact soils which are often impermeable or poorly drained. The plains of the coast are mainly elevated coral reefs. Decomposition of the surface layers has formed poorly developed calcareous soils with a coarse sandy texture.

### Vegetation

Due to the climate and overgrazing, there are large areas of the country which have little or no vegetation.

The main vegetation types are:

1) Tall woody vegetation: This is very limited in extent and composed principally of forests of Juniperus procera on the higher mountains, Mount Goda and Mount Mabila, of mangroves (Rhizophora mucronata and Avicennia mariner), of Acacia adansonu and A. seyal on the plains, and of Acacia asak and Ziziphus mucronata on the wadi bottoms.

2) Low woody vegetation: This is comprised mainly of Acacia species, Rhigozum somalensis and Caesalpinia erianthera on the slopes and the plateaux. There are also halophytic formations which include Suaeda monoica, Trianthema salsoloides and Limonium cylindrifolium.

3) Herbaceous vegetation: Cymbopogon schoenathus, Panicum turgidum and Chrysopogon aucheri.

### Pastures and cultivated forages

The main vegetation types described above cover 80% of the country and do not supply the feed necessary to cover the normal energy needs of the national herd. They are used by transhumant peoples who must move their herds ceaselessly over large areas to provide sufficient fodder. The movements are organized according to the rains and generally follow precise routes fixed by tradition. The trend to settlement in the south of the country has contributed to degradation of the native pastures and has led researchers to develop cultivated forages and feed resources for the dry season. It is important to note that cultivated forages are little known in Djibouti with the exception of sugar cane, maize and sorghum which have begun to be cultivated by several farmers.

### Activities of the "Project de lutte contre la desertification"

The Project (UN Project UNSO/DES/DJI/82/001 which has been underway since July 1984 is working mainly on the creation of reserve fodder utilizing browse, herbaceous legumes and grasses. Some 40 browse species (Acacia sp., Atriplex sp., Periploca laevigata, Retama raetam, Pithecellobium dulce, Azidarachta indica, etc.) are being tested for their adaptation to the environment.



Some 50 species of legumes and 8 of grasses are being tested under irrigation and some native grass lines are also being tested and multiplied.

A number of farmers are testing the most promising forage species and qualitative and quantitative observations are made regularly in order to aid selection of the best adapted material.

Some 40 species and varieties of grasses and legumes provided by ILCA are also being tested as part of the FNE screening.

\* \* \* \*

## 8. ADVISORY NOTES

### 8.1 *Macrotyloma axillare*

John Lazier\*

*Macrotyloma axillare* (E. Mey) Verdc. is commonly called axillaris, a name which is derived from its former scientific name *Dolichos axillaris*. One cultivar selected in Australia is available, cv Archer.

Native to most of tropical Africa, in Madagascar, Mauritius, Arabia and Sri Lanka it occurs in grassland, bushland and forest margins at altitudes of 1500-2400 m. It is reported as wide spread in Ethiopia and ILCA collectors have noted that it is abundant throughout Sidamo.

A viney, short-lived, self-fertile climbing perennial legume it has glossy, slightly pubescent, oval trifoliate leaves 3 to 5 cm long and 3 cm wide. Greenish - yellow flowers grow in the leaf axils, usually three at a time. The pods are 7 to 8 seeded, slightly curved, hairy, 3 to 5 cm long and 6 cm wide.

Both heat and cold tolerant it is particularly adapted to sub-tropical conditions. Although it is susceptible to frost it recovers quickly. It is one of the earliest growing legumes in the Australian spring and one of the most tolerant of dry, very hot conditions. It can survive dry seasons of 6 to 8 months, the leaves remaining largely on the plant. It performs best however where rainfall is 1000 mm or higher. Intolerant of waterlogging it requires drier areas or well drained soils in areas of good rainfall and a soil pH of 5.5 or higher. One major advantage to *M. axillaris* is that it does not have serious pest or disease problems, although it can be affected by the little leaf virus.

The seed is medium sized, requires no scarification to break dormancy and the seedling nodulates with the common (cowpea) strain of *Rhizobium*. The plant thus spreads readily, both naturally and in animal dung. Responsive to additions of P fertilizer it can produce abundant dry matter (up to 16 t/ha under irrigation).

Due to its climbing habit it combines well with clump grasses

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\* FLAG, ILCA



including Chloris gayana, Paspalum and Panicum spp., growing up their stalks. It has also been reported as combining well with the legumes Siratro, Neonotonia wightii and Desmodium spp. In areas where it is well adapted and grows vigorously, it can smother associated weeds.

Initial palatability is said to be low, however it apparently increases with plant maturity, and once the animals become accustomed to it. One of its particular values is as standing hay in the dry season due to its leaf retention and high protein values.

As with most viney legumes, the plants are damaged by trampling during grazing, particularly when the ground is wet and soft. Recovery after grazing is fairly rapid and again in common with other viney legumes the plant must not be cut back or grazed too severely if rapid regrowth is desired.

As seeds are produced year-round in leaf axils which are mainly low on the plant, mechanical harvesting is difficult and seed yields are low (normally 100 - 150 kg/ha).

M. axillare has shown considerable promise in Ethiopia. In two irrigated plots at the Zwai Horticulture Farm it has been very vigorous, persisting for three years and producing seed year-round. The two 25 m<sup>2</sup> plots produced 12.7 kg of hand picked seeds in 1.5 years (1700 kg/ha/year). It also performed well under irrigation at Melka Werer (800 m).

In 1983 it was planted by FLAG in a series of FNE strip trials in the Rift Valley from Soddo to Melka Werer. In the area from Soddo (1850 m, 1200 mm) to Meki and Koka Lake (1700 m, 800 mm) it was one of the most vigorous legumes in the first three years. In Meki its vigour was much reduced in the third dry season perhaps indicating a reduced life span under drought stress. At the nearby Koka site however, where the plant roots can reach the water table, it is very vigorous, climbing the trial fence and spreading beyond the boundary fence.

In drier areas under rainfed conditions (Abernosa Ranch, Nazareth IAR station, Melka Werer) it has grown poorly or disappeared.

In Soddo, Wolayta on red acid soils (Nitosols, pH 5.5 - 6) and a 5 to 6 month dry season it was one of the most vigorous plants of a wide range of germplasm tested. In an FNE strip trial it grew vigorously over the first year growing as tall as the associated grass, Chloris gayana, (about 1.5 m), both climbing up the grass and supported by its own bulk. When grazing of the trial was initiated there was a considerable quantity of plant material consumed, as well as considerable damage to the stems by trampling. However the legume recovered and has continued to be productive under regular grazing each six weeks.

In 1985 a cooperative FLAG - MOA programme in the Soddo area convinced a number of peasant farmers to interplant M. axillare with maize and sorghum. The vigour of the plantings was good producing abundant dry matter in the wet season. In the dry season the plants

retained green leaves and produced some seeds and new growth. In contrast Stylosanthes guianensis cv Cook, another vigorous and promising plant for the area, remained dormant during the dry season.

During the 1985-86 dry season both plants were cut by the farmers and fed to their cattle. On the basis of their palatability the farmers expressed a preference for Cook stylo. However during the 1986 wet season farmers will be encouraged to continue to feed M. axillare to see if the palatability increases with frequent feeding.

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The Forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

Please address any comments or queries to the Editors, FNE Newsletter, ILCA, P.O. Box 5689, Addis Ababa, Ethiopia. If your address is not correct or you do not receive the Newsletter and wish to, please fill in the attached form:

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# Forage Network in Ethiopia

## Newsletter

International Livestock Centre for Africa, P.O. Box 5689, Addis Ababa, Ethiopia. Telephone: 18 32 15

No. 15

February - March 1987

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### 1. INTRODUCTORY MESSAGE

The 1987 FNE Annual General Meeting and Workshop which was held at ILCA on February 5 and 6 was a great success with over 100 people from 14 organizations attending, a 30% increase in attendance over the 1986 meeting. The attendance showed the increasing interest in and awareness of the importance of forage as a key component in Ethiopian farming systems. The initiation of the 4th Livestock Development Project during 1986 has undoubtedly done much to stimulate this awareness.

Papers and information presented at the meeting have already appeared in the previous Newsletter issue (no. 14) and will appear in this issue and next one (no. 16).

This issue also contains instructions on the 1987 network multilocation trials. Information is given on what trials will be planted this year, and where those who would like to plant the trials can obtain information about them and the seed to plant them.

Besides the FNE multilocation trials, forage network activities for the coming year will include the regular field trip which will probably



take place in May or June 1987. Residential, hands-on training in simple forage research techniques which was initiated cooperatively by the MOA and ILCA in 1986 will be continued in 1987 probably in the last 3 or 4 months of the year.

Researchers who require seed for their trials from ILCA are reminded to get their requests to ILCA as soon as possible, as the normal planting season rush of seed requests may mean that you do not receive your seed before the time that you intend to plant.

We would like to remind our readers who are mainly silent members of the FNE that you are welcome to participate more actively in the network by attending meetings, planting multilocation or other trials, and by writing articles for the newsletter.

The editors welcome all articles for the Newsletter whether general, detailed and scientific or personal views.

(Editors: Alemayehu Mengistu, John Lazier)

\* \* \* \*

## 2. THE 1987 FNE MULTILLOCATION TRIALS

The purpose of the FNE multilocation trials is to test the breadth of adaptation of promising forages. In order that recommendations on adapted forages can be developed for the various environments in Ethiopia separate trials are designed for different environmental zones.

Organizations, institutions and individuals are encouraged to join in the testing programmes and to plant any of the trials adapted to their environmental zone. The more sites at which promising germplasm is tested, the greater the reliability of the conclusions drawn.

The Steering Committee has discussed the trials to be planted in 1987 and has come to the following conclusions:

### A. Discontinued

Evaluation of 3 annual African Trifolium species under 3 levels of fertilizer. Protocol in FNE Newsletter no. 4, January - February 1984, pp. 15-21.

Sites: Holetta - IAR; Robe - ARDU; Debre Berhan, Shola - ILCA.

This trial will be discontinued at locations where it has been planted for 3 years. If any trials exist which have not run for 3 years, the trial should be replanted.

### B. To be continued

1. African Trifolium initial evaluation strip trial - third year, protocol in FNE Newsletter no. 8, August 1985, pp 8-10.

Sites: Holetta - IAR; Robe - ARDU; Debre Berhan, Shola - ILCA.

2. Medicago sativa initial evaluation strip trial - third year, protocol in FNE Newsletter no. 8, August 1985, pp 10-12.  
Sites: Holetta - IAR; Kulumsa - ARDU; Debre Zeit - ILCA.
3. Replicated grass-legume mixture trials - third year, protocol in FNE Newsletter no. 8 August 1985, pp 12-15.
  - a) High altitude > 2400 m  
Sites: Holetta - IAR; Gobe - ARDU; Debre Berhan - ILCA.
  - b) Medium altitude < 2400 m  
Sites: Bako - IAR; Kulumsa - ARDU; Debre Zeit - ILCA
4. Medium and low altitude strip trials  
A range of sites, designs and species. These trials are designed by the FNE on the individual requests of organizations, and vary with the research goals, the environment and the management capabilities of the staff.  
- protocol (discussed generally) FNE Newsletter no. 4 January - February 1984, pp 15-21.
5. Low altitude grass-legume mixture trial.  
- protocol in FNE Newsletter no. 5, August 1984, PP 19-22.  
Sites: Awassa, Melka Werer - IAR; Soddo - ILCA/MOA

Those replanting the annual Trifolium initial evaluation trial and the Medicago sativa initial evaluation strip trial, whose research sites are listed under the trials above will automatically be sent seed by ILCA for the 1987 plantings.

Those wishing to plant any new FNE trials this year, or wish to replant perennial trials should inform Dr Jean Hanson at ILCA at least one month before it is planned to plant.

Those wishing to plant strip or other trials not having formal FNE protocols are advised to contact Alemayehu Mengistu of MOA or John Lazier of ILCA before requesting seed.

\* \* \* \*

### 3. THE 1987 FORAGE NETWORK IN ETHIOPIA (FNE) ANNUAL GENERAL MEETING 5 - 6 FEBRUARY 1987, ILCA, ADDIS ABABA

#### 3.1 Welcome Speech

Alemayehu Mengistu\*

On behalf of the FNE Steering Committee, I welcome all of you to the 5th Annual General Meeting of the Forage Network in Ethiopia.

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\* FNE Chairman



As we all know agriculture is the mainstay of the Ethiopian economy. It accounts for about half of the Gross Domestic Production (G.D.P) and employs over 80% of the work force. The sector provides most of the domestic food requirement as well as raw materials for industries and constitutes about 90% of the country's exports. Livestock, despite forming an integral part of nearly all farming systems in the crop producing areas of the country, and being the major occupation in the lowlands, contributes only about 20% of the agricultural G.D.P. and only about 10% to the national G.D.P.

The size and diversity of the major Ethiopian agro-ecological zones make it suitable for the support of large numbers and classes of livestock. The country possesses about 17% of the cattle, 15% of the sheep and goats and about 49% of the equine population of Africa. Ethiopia's livestock population is estimated at 27 million cattle, 24 million sheep, 18 million goats, 7 million equines, 52 million poultry, 1 million camels and 10 million bee colonies.

Livestock play a key role in day to day life especially of the peasant sector that owns more than 95% of the country's livestock. Livestock provide draft power, meat, milk, eggs, transport, manure, hides and skins, honey and other products for farm households. However, relative to the size of the population, production figures and values are low. At present, these low levels of productivity are due to low genetic potential, health problems and most importantly, an acute shortage of feed.

In Ethiopia feed supplies come mainly from rangelands and fallows (90%), crop residues (7%) and other minor sources (3%). Improved pasture crops are uncommon and occur mainly on state farms however they are being used increasingly in recent years on peasant farms.

Over the past 15 years pasture research and development programmes have been conducted by various research institutes and development organizations. The research and development work mentioned above was not coordinated and this lack of coordination has been one of the main reasons for the formation of the Forage Network in Ethiopia (FNE).

The Forage Network in Ethiopia was formed in 1980 to improve forage research, development and production in the country. Staff of the Institute of Agricultural Research, the South-East Zonal Agriculture Office formerly known as ARDU, Ministry of Agriculture and the International Livestock Centre for Africa were the ones who have been the most active in forming the FNE. Other organizations like Ministry of State Farms, Higher Education, Relief and Rehabilitation also participate in network activities.

The first Network trials were planned and conducted in 1981 under the title "multilocal yield assessment trials". In 1982 the assessment methods used in the trials were further refined and the trials were replanted. A native pasture survey and strip trials at lowland sites were also undertaken by the Network in 1983 (for results refer to the FNE Newsletter nos. 5, 9 and 10).

In 1984 the second set Network multilocal forage trials were designed and planted by the Network cooperators. The results of these trials will be presented today.



The formation of a Steering Committee formed of representatives of organizations participating in the FNE is another big development. The Steering Committee plans activities, designs trials, summarizes results of multilocal trials, provides advisory services and arranges and executes field trips, meetings and seminars. In 1986 the Steering Committee in collaboration with ILCA (FLAG) initiated residential and group training for Ethiopian and African researchers at Wolyata, Soddo in the southern region of Ethiopia. The courses given so far have included PANESA and ILCA pasture training courses which were held in October 1986 and January 1987 respectively.

Another big success of the Forage Network in Ethiopia is its Newsletter which is published quarterly and distributed to more than 700 interested individuals and organizations both in Ethiopia and worldwide.

Dear participants for the two days of the Forage Network in Ethiopia's Annual General Meeting the Steering Committee has gathered researchers and development workers to present their research and development activities. The Steering Committee is also honoured for the first time to have Dr John Walsh, the new Director General of ILCA, Dr B.H. Dzwela, PANESA Coordinator, and Dr D. Little, Head of Animal Nutrition Department, ILCA and other invited scientists to give us the benefit of their research and development experience which will help and guide us in building our research and Network programmes. Therefore, as Chairman of FNE, I strongly urge all of you present to participate and communicate in during these two days.

Finally, with great pleasure I will call upon Dr John Walsh, Director General of ILCA, to open the 5th Annual General Meeting of the Forage Network in Ethiopia.

\* \* \* \*

### 3.2 Opening Address

John Walsh\*

Dr Walsh opened the Meeting and Workshop by welcoming the participants to ILCA and wishing them well in their endeavours.

\* \* \* \*

### 3.3 The Programme

The programme for the remainder of the first morning included a keynote address by Dr Doug Little, Head of the Nutrition Department at ILCA. This

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\* Director General, ILCA



address will be published in the next issue of the Newsletter as Dr Little is still polishing his presentation. The morning session also included short reports on the general forage activities undertaken in 1986 by the organizations present. After lunch brief reports on the FNE multilocation trials were presented. The remainder of Thursday and all of Friday were taken up with formal presentations. These have been or will be presented in Newsletter no. 14 (the previous one), no. 15 (this one) and no. 16.

The papers presented were:

- |                                                                                    |                                                           |
|------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 1. PANESA and its activities                                                       | - Dr Ben Dzwela, PANESA/ILCA                              |
| 2. FNE - ILCA training opportunities                                               | - Mr James O'chang, ILCA                                  |
| 3. An economists view of forage production on Ethiopian small-holder farms         | - Mr Guido Gryseels, ILCA                                 |
| 4. Agricultural research and potential in Ethiopia*                                | - Dr Frank Anderson, ILCA                                 |
| 5. The role of forage species in soil conservation                                 | - Dr P.A. Chadokhar, UNDP/FAO                             |
| 6. Some notes on rhizobiology with special reference to forage legumes in Ethiopia | - Dr Desta Beyene, IAR                                    |
| 7. Strategies for the 4th Livestock Development Project                            | - Ato Alemayehu Mengistu, MOA and Mr Alan Robertson, FLDP |
| 8. Anti-nutritional factors in native forages                                      | - Dr Jess Reed, ILCA                                      |
| 9. Forage research in small-holder and pastoral production systems                 | - Drs S. Debrah and J. McIntire, ILCA                     |
| 10. Mycorrhiza and forages**                                                       | - Dr Tekalign Mamo, ILCA                                  |

At the end of the Workshop on Friday the floor was given over to FNE business. The timing of the 1987 field trip was a main item of discussion. The final dates for this and the organization of the year's activities was by unanimous agreement left to the Steering Committee.

\* \* \* \*

\* No written paper available.

\*\* Previously published in the ILCA Newsletter, Vol. 5, no. 3, July 1986.

3.4 List of Participants in the 5th FNE Annual General Meeting  
Held at ILCA on 5 and 6 February, 1987

MINISTRY OF AGRICULTURE

I L C A

|                        |            |                      |         |
|------------------------|------------|----------------------|---------|
| 1. Adugna Negeri       | A.A.       | 1. Abate Tedla       | A.A.    |
| 2. Alemayehu Mengistu  | "          | 2. Almaz H/Selassie  | "       |
| 3. Alemayehu Shishige  | D/Zeit     | 3. Asfaw Yimagnuhal  | D/Zeit  |
| 4. Amanuel Jarso       | Shashemene | 4. Asres Tsehai      | A.A.    |
| 5. Befekadu Dinsa      | Asella     | 5. Debrah, S.        | "       |
| 6. Belayhun Mulugeta   | D/Zeit     | 6. Frehiwot Gosheme  | "       |
| 7. Berhanu Shiferaw    | A.A.       | 7. Ghennet Fesshaye  | "       |
| 8. Bisrat Reta         | "          | 8. Girefe Sahile     | D/Zeit  |
| 9. Daniel Keftasa      | Asella     | 9. Girma Getachew    | A.A.    |
| 10. Dejene Abesha      |            | 10. Hakiza, J.J.H.   | "       |
| 11. Desalegne Maru     | D/Zeit     | 11. Haque, I.        | "       |
| 12. Gemechu Nemie      | Tigrai     | 12. Hanson, J.       | "       |
| 13. Getachew Felleke   | A.A.       | 13. Kabaija, E.      | "       |
| 14. Getnet Damtew      | Shashemene | 14. Kidist Shenkoru  | "       |
| 15. Girma Eshete       | Asella     | 15. Kifle Eshete     | "       |
| 16. Hailu Abebe        | "          | 16. Lazier, J.       | "       |
| 17. Hassen Ali         |            | 17. Little, D.       | "       |
| 18. Helge Nielsen      |            | 18. O'chang, J.      | W/Soddo |
| 19. Karin Ralsgird     | Asella     | 19. Said, A.N.       | A.A.    |
| 20. Kine Tibebe        | Bahr Dar   | 20. Solomon Mengistu | "       |
| 21. Leikun Berhanu     | D/Zeit     | 21. Taye W/Mariam    | D/Zeit  |
| 22. Lilalph Hesling    | A.A.       | 22. Tekalign Mamo    | A.A.    |
| 23. Mengiste Zewge     | "          | 23. Tothill, J.      | "       |
| 24. Nigist Shiferaw    | Asella     | 24. Walsh, J.        | "       |
| 25. Seifu Mekonnen     | A.A.       | 25. Weise, S.        | "       |
| 26. Solomon Kebede     | "          | 26. Worku Mekasha    | "       |
| 27. Tegegnetwork Haile | Dessie     |                      |         |
| 28. Tekle Meskel       | D/Zeit     |                      |         |
| 29. Tesfaye Zegeye     |            |                      |         |
| 30. Tsegai Hagos       | Asella     |                      |         |
| 31. Tsehai Redda       | Awassa     |                      |         |
| 32. Yohannes Alemseged |            |                      |         |
| 33. Zerefu Seifu       | Shashemene |                      |         |

PGRC/E

|                   |      |
|-------------------|------|
| 1. Abebe Demissie | A.A. |
| 2. Hailu Mekbib   | "    |
| 3. Regassa Feyssa | "    |

F.A.O.

|                    |      |
|--------------------|------|
| 1. Chadhokar, P.A. | A.A. |
| 2. Choi, S.K.      | "    |

SCF/U.S.

|               |      |
|---------------|------|
| 1. Kebets, A. | A.A. |
|---------------|------|

REGIONAL PLANNING OFFICE

|                      |          |
|----------------------|----------|
| 1. Getachew Asfaw    | Asmara   |
| 2. Getachew Eshete   | Awassa   |
| 3. Solomon Mamo      | Nazareth |
| 4. Tesfaye W/Michael | Harar    |
| 5. Tesfaye Zegeye    | Awassa   |
| 6. Wiyu Fiyiye       | Jimma    |



I A R

|                         |         |
|-------------------------|---------|
| 1. Alemu Tadesse        | Bako    |
| 2. Anagaw Tsegie        | A.A.    |
| 3. Aschalew Tsegahun    | M/Werer |
| 4. Assefa Deressa       | Holetta |
| 5. Assefa H/Selassie    | A/Tulu  |
| 6. Dereje Fekadu        | Holetta |
| 7. Desta Beyene         | "       |
| 8. Gebre Medhin Hagos   | "       |
| 9. Kassahun Awgichew    | A.A.    |
| 10. Kidane G/Meskel     | M/Werer |
| 11. Lambourne, J.       | A.A.    |
| 12. Lemma Biru          | A/Tulu  |
| 13. Lemma Gizachew      | Bako    |
| 14. Liyusew Ayalew      | "       |
| 15. Lulseged G/Hiwot    | A.A.    |
| 16. Simon Abai          | A/Tulu  |
| 17. Tadesse T/Sadik     | Holetta |
| 18. Teferra Mekonnen    | Sheno   |
| 19. Teshome Yehualashet | Holetta |
| 20. Tilahun Mekonnen    | "       |
| 21. Yohannes Terefe     | "       |
| 22. Zinash Sileshi      | "       |

AAU FVM

|                   |        |
|-------------------|--------|
| 1. Getachew Abebe | D/Zeit |
|-------------------|--------|

F.L.D.P.

|                       |               |
|-----------------------|---------------|
| 1. Getachew W/Agenehu | A.A.          |
| 2. Robertson, A.      | "             |
| 3. Tadesse Tujuba     | Yer. & Kereyu |
| 4. Yewondwossen Adamu | A.A.          |

Asmara University

|                         |        |
|-------------------------|--------|
| 1. Endalkachew W/Meskel | Asmara |
|-------------------------|--------|

Ambo Junior Coll.

|                     |      |
|---------------------|------|
| 1. Teferra Betru    | Ambo |
| 2. Teshome Yizengaw | "    |

O.N.C.C.P.

|                    |      |
|--------------------|------|
| 1. Lissanework D/M | A.A. |
|--------------------|------|

L.D. & M.E.

|                  |      |
|------------------|------|
| 1. Zerihun Worku | A.A. |
|------------------|------|

PANESA

|                  |         |
|------------------|---------|
| 1. Dzowela, B.H. | Nairobi |
|------------------|---------|

\* \* \* \*

**4. GENERAL RESEARCH RESULTS****4.1 Ministry of Agriculture (MOA)**

Berhanu Shiferaw\*

**4.1.1. Status of forage in Ethiopia**

The feed resources available for Ethiopian livestock provide only enough fodder for maintenance plus a low level of productivity. Dry season feed shortages result in weight losses and poor fertility.

**4.1.2 Past activities in feeds and nutrition**

Past activities in feeds and nutrition have been the responsibilities of various government institutions like EPID, IAR, ARDU, DDA, the

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\* Fourth Livestock Development Project, Forage Systems Development Unit.

Agricultural College and high schools. These institutions extend advice and provide inputs, such as seeds, in their immediate vicinity, except in the case of ARDU which assists farmers in its project area, and the former EPID, which operated in selected woredas in the minimum package areas, and therefore had a wider scope.

One of the major steps taken under the organisational set-up of the Ministry of Agriculture was the establishment of Animal Feeds & Nutrition Division within the Animal Resource Development Department in 1979/80.

The activities of the Animal Feeds & Nutrition team include three major areas of animal feeds and nutrition, namely development work related to natural grazing areas, cultivated pasture and forage crops and industrial by-products.

The team has undertaken three major activities to promote the use of fodder crops and pastures within the cooperatives.

- i) Species adaptation trials at 117 sites, classified as low-medium altitude (1500-2500) or high altitude (2500-3000 m).
- ii) Demonstration areas established at 65 fenced sites. Each comprises 0.25 ha of forage species following cultivation, and an adjacent 0.75 ha of native pasture. Yield and other measurements are taken.
- iii) Development: quantities of oats, vetch and fodder beet are distributed to peasant cooperative dairy farms. The areas planted average 0.5 ha for fodder beet and range between 2 and 10 ha for oats.

#### 4.1.3 Forage development activities by Fourth Livestock Development Project (FLDP)

Livestock have a crucial role in the farming systems and in the overall economy, their productivity is currently constrained by inadequate forage. The problem has received little attention in the past; there has been little government emphasis on increasing forage production or on improving grazing/feeding management systems and material and extension support for forage development have generally been confined to state and dairy sectors.

The feeds and Forage Project (FFP) is focused on overcoming the constraint of poor ruminant nutrition.

The animal nutrition component of FLDP is developing forage production on selected service cooperatives in the following ways;

##### 1) Direct implementation

1. intensive use of fodder trees
2. forage development within stock exclusion areas
3. forages on soil conservation structures



ii) Pilot adaptive research (by FSDU\*)

1. over-sowing or reinforcement with legumes,
2. under-sowing of cereal crops with forage legumes,
3. use of annual and perennial fodder crops, and
4. establishment of perennial pastures.

Overlap between strategies is inevitable but this does not affect the overall classification of strategies.

The FSDU, in order to study the possibilities and difficulties of forage development and integration with existing farming systems in different agro-climatic zones will undertake the following activities.

- Intensive on-farm adaptive trials/demonstration programme to test and evaluate a limited range of identified and/or promising forage/crop technologies under suitable agro-climatic conditions.
- Analyse field research data and prepare appropriate farming-systems-based extension packages for farmer implementation.
- Training of project staff in the use of the developed extension packages.
- Strengthening of research-extension linkages through participation in the zonal IAR/MOA Research Extension Liaison committees.
- Liaise closely with national and international research institutions.

The following observation plots/trials were established in July and early August 1986.

- a) Evaluation of a range of pasture legumes oversown on bunds.
- b) Evaluation of forage crops and fodder trees in backyard plots.
- c) Monitoring of the performance of tree legumes established on bunds and in alley cropping systems.
- d) Evaluation of establishment of oversown legumes in contrasting soil conservation/stock exclusion areas.
- f) Evaluation of responses of pasture/forage species to phosphatic fertilizer.
- g) Monitoring herbage growth in fallow areas and wet bottom lands.

Planting was not possible until mid July because the consultants and seed arrived late in the growing season. In July and August the big rains, wet or waterlogged soils and reduced radiation limited seedling growth and the seedlings were not sufficiently well developed to survive the dry season which arrived abruptly last year, in the third week of September. Seedlings of the perennial pasture species failed to survive, and annual forage crops such as oats have made poor growth.

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\* Farming Systems Development Unit of the FLDP.

### 1987 trial programme

- 1) forage tree performance adaptation
- 2) oversowing legumes on soil conservation bunds > 2400 m
- 3) undersowing "Belg" barley > 2400 m
- 4) undersowing legumes in maize and sorghum < 2400 m
- 5) alley cropping
- 6) methods of oversowing in stock exclusion areas
- 7) other activities - legume adaptation
  - monitoring forage production
  - backyard forage production
  - natural pasture improvement

In 1987, the emphasis will be on establishment of trials and observations, with a minimum of yield measurements. The effort on yield measurements will increase in subsequent years.

The proposed programme includes all of the elements suggested for adaptive research; it allows time for the development of the organization of techniques, and of activities, and, for the activities to develop and for the staff to gain experience.

### References

- MOA. Livestock sub-sector review. Annexes, Vol. 2, February 1984.  
MOA. Project preparation project. Feeds & Forage Project. Annexes, Vol. 2, March 1985.

\* \* \* \*

## 4.2 The Livestock Development and Marketing Enterprise

Hiwot Menbere\*

The Enterprise had about 350,000 head of sheep and goats and 30,000 cattle for export on its feed lots and holding ranches in 1986. These are fed mainly by straw collected from State Farms in the Arse and Bale areas (350,000 bales) and by hay from Sululta (250,000 bales). Improved pastures have been developed in two areas. At Nettle in 1986, there were 120 ha of Rhodes grass grown while in the past oats, Columbus grass and Sudan grass have also been planted. The Alemtena Cattle Holding Ranch had about 3 ha of oats and 6 ha of Columbus grass in 1986. Rhodes grass and alfalfa had been grown previously.

The Enterprise intends to make a major effort to improve its hay production. However there are difficulties which include lack of suitable machinery, bailing twine, seeds, rainfall and trained personnel. As well some hay areas are needed for grazing.

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\* Livestock Development & Marketing Enterprise, Addis Ababa, Ethiopia.



#### 4.3 Brief Summary of 1986/87 Forage Research Activities at the IAR Bako Agricultural Research Centre

Alemu Tadesse\*

In the 1986/87 crop season seventeen research activities were undertaken at Bako in five major investigation areas. These are:-

1. Forage introduction and variety trials.
2. Pasture management and improvement studies.
3. Pasture establishment studies.
4. Seed production studies.
5. Feeding trials.

Regarding forage introduction and variety trials, we had nursery row evaluation of forage crops at Bako, Asossa and Abobo (Gambella). One hundred lines of tropical legumes were tested at Bako and 40 lines of grasses and legumes were tested at Asossa and Abobo.

We also had a Stylosanthes guianensis variety trial in which the yield performance of different varieties of S. guianensis were evaluated.

Under pasture management and improvement studies, we had a trial in which we evaluated the compatibility and yield performance of perennial grass-legume mixtures. In this trial mixtures of grasses, Chloris gayana, Panicum coloratum, Setaria sphacelata and Melinis minutiflora and legumes Desmodium uncinatum, Stylosanthes guianensis and Siratro were evaluated.

The yield performance of oat-vetch mixtures were also evaluated at a highland area called Shambu. In this trial mixtures of oats - (I-8237, CI-8251, and Grey Algiers) with the vetches Vicia dasycarpa and V. atropurpurea were tested. These varieties are the ones which performed well in pure stand at the same site.

In addition, we also harvested trials in which we tried to determine the optimum harvesting stage for various improved forage crops and natural pasture.

Seeding rate trials were done on a variety of forage crops. In these trials yield performances of grasses and legumes previously planted using a range of seeding rates were evaluated.

Furthermore, we also did natural grassland survey work to determine the productivity and botanical composition of natural grasslands of Arjo Awraja in Wollega Administrative Region. The aim was to identify the useful indigenous ecotypes of grasses and legumes of this region.

Under pasture establishment studies, we had a trial on Leucaena leucocephala in which the populations of stands of Leucaena established from direct seeding, stem cuttings, seedlings pregerminated in plastic pots and on nursery beds were compared. We also had a trial in which we oversowed improved legumes in natural pasture with minimum soil

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\* Institute of Agricultural Research (IAR), Bako, Ethiopia.

disturbance. The aim was to determine the success of establishment of the improved legumes in the natural pasture in order to improve its productivity and feed value.

We had trials on seed production, in which we tried to assess the effect of seeding rate and row spacing on seed yields of forage crops when planted in rows and by broadcasting. In this study; Chloris gayana, Panicum coloratum, Desmodium uncinatum, Stylosanthes guianensis and Vicia atropurpurea were tested.

We planned to run feeding trials to determine the effect of dried Leucaena leaves on the body weight of sheep when fed as a protein supplement and a feeding trial to assess the effect of supplementary feeding of teff straw and dried Leucaena leaves on body weight maintenance of Horro bulls during the dry season. But we were unable to conduct the trials due to lack of experimental animals.

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#### 4.4 Summary of the 1986/87 Cropping Season Forage Research Activities at Melka Werer

Aschalew Tsegahun\*

##### Introduction

It was planned to execute a total of 14 activities during the year 1986/87 cropping season. One of the trials was not planted due to lack of seed and two others had to be replanted due to flooding.

##### 4.4.1 Selection of grass, legume and shrub spp. for moisture stressed areas

Objective - To select forage crops which could be grown at Alaidege under rainfed conditions.

Results - 25 species and varieties of legumes and 16 species and varieties of grasses were sown, but none of the seeds germinated. This was mainly due to insufficient rainfall and high evapotranspiration.

##### 4.4.2 Tropical grass and legume nursery for hot irrigated areas

Objective - To test and select the best adaptable forage crops for hot irrigated areas.

Results - Desmodium uncinatum, Leucaena diversifolia, L. leucocephala K 8, Stylosanthes hamata cv Verano, Stylosanthes guianensis cvs Cook and Endeavour have been found to be more promising than the others. Seed production is underway for further trials.

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\* Institute of Agricultural Research (IAR), Melka Werer, Ethiopia.



#### 4.4.3 Selection of salt tolerant forage species at Melka Sedi

Objective - To evaluate salt tolerant species of grasses and legumes by means of their general performance and yield of dry matter.

Results - None of the forages sown germinated due to high salinity.

#### 4.4.4 Intercropping of forage crops with cotton

Objective - To select forage crops which can be intercropped with cotton without seriously affecting the yield and quality of cotton and which will produce a reasonable amount of forage after the cotton season is over.

- To minimize the cost of forage establishment.

Results - Planting of Panicum coloratum 15 days before and simultaneously with cotton gave higher yields than other treatments.

- All the forages except Desmodium unicanthum shaded the cotton.

- Cotton which is planted with Desmodium had better yields than when planted with the other legumes.

- The yield of Desmodium was low because it was harvested after the cotton was picked.

#### 4.4.5 Effect of harvesting stage on yield and quality of Leucaena.

Objective - To determine the optimum physiological growth stage of Leucaena for sustained yield.

Results - A total of six cuts from 5% flowering and five cuts from 50% flowering and 5% podding were taken. The mean total dry matter yields of the three treatments were:

| <u>Treatment</u> | <u>Yield tons/ha</u> |
|------------------|----------------------|
| 5% flowering     | 23.74                |
| 50% flowering    | 23.27                |
| 5% podding       | 28.25                |

No significant yield difference between the treatments was observed. Harvesting of Leucaena at an early stage (5% flowering) has the following advantages.

- i) easy to harvest
- ii) higher palatability

#### 4.4.6 Effect of cutting height and cutting interval on the yield of Leucaena fodder

Objective - To determine the optimum cutting height and cutting interval of Leucaena for maximum economic return.

Results - Of all the treatments harvesting Leucaena at 10 week intervals at 200 cm height gave highest dry matter yields. However as it is tedious and cumbersome to harvest Leucaena manually at this height, it suggested that 100 cm or below would be acceptable even though lower yields would be achieved.

Leucaena dry matter yields (t/ha) with varying cutting heights and intervals.

| <u>Interval</u><br>(weeks) | <u>Cutting heights (cm)</u> |           |            |            |            |
|----------------------------|-----------------------------|-----------|------------|------------|------------|
|                            | <u>30</u>                   | <u>50</u> | <u>100</u> | <u>150</u> | <u>200</u> |
| 4                          | 25.74                       | 37.47     | 29.40      | 32.04      | 33.16      |
| 6                          | 41.52                       | 43.75     | 40.99      | 43.49      | 50.19      |
| 8                          | 43.38                       | 46.48     | 38.55      | 43.72      | 41.84      |
| 10                         | 55.76                       | 54.99     | 56.24      | 62.43      | 70.36      |

4.4.7 Micro seed increase of selected grasses and legumes

Objective - To increase seeds of the most promising forage crops.  
 - To maintain planting material of those forage crops which are propagated only by cuttings or root splits.

Results - The following quantities of seeds were collected during the year.

| <u>Forage species</u>                 | <u>Seed collected (kg)</u> |
|---------------------------------------|----------------------------|
| <u>Leucaena leucocephala</u> cv Peru  | 75                         |
| " " cv Cunningham                     | 75                         |
| " <u>diversifolia</u> K - 158         | 2                          |
| <u>Panicum maximum</u> cv Green Panic | 10                         |
| <u>Chloris gayana</u> cv Massaba      | 150                        |
| <u>Lablab purpureus</u>               | 50                         |

Vegetative planting material was also propagated of elephant and Pangola grasses.

4.4.8 Effect of spacing on the fodder yields of Leucaena

Objective - To determine the optimum spacing for the production of high fodder yield.

Results - Leucaena planted at 5-10 cm between plants and 80-120 cm between rows gave higher dry matter yields than other treatments.



The effect of spacing on dry matter  
yields of Leucaena (t/ha)

| <u>Between plants</u><br>(cm) |           | <u>Between rows</u><br>(cm) |            | <u>Mean yield</u> |
|-------------------------------|-----------|-----------------------------|------------|-------------------|
| 5                             | <u>80</u> | <u>120</u>                  | <u>160</u> |                   |
| 5                             | 60.30     | 55.64                       | 74.38      | 47.58             |
| 10                            | 55.31     | 55.79                       | 50.03      | 40.28             |
| 15                            | 54.49     | 57.42                       | 47.74      | 39.91             |
| Mean                          | 56.7      | 56.28                       | 57.38      |                   |

4.4.9 Sesbania variety trial

Objective - To select the best adapted varieties of Sesbania

Results - Due to late planting it was not possible to take harvests of seed or dry matter.  
- The performance of all varieties is promising at Melka Werer and are encouraging at Babile and Meiso.

4.4.10 Effect of cutting stage on the leaf yield of groundnut

Objective - To determine the optimum time of harvesting groundnut tops without excessively affecting pod yield and to assess the palatability of the leaves for animal feed.

Results - Since the trial was started this year and was not replicated, it cannot be determined which treatment was better. However at both locations (Melka Werer and Babile), the harvesting of groundnut leaves and nuts 140 days after planting appears to produce higher yields than the other treatments. The protein content of the leaves was not available at the time of reporting.

Yields of groundnuts at Melka Werer

| <u>Time to harvest</u><br>(days) | <u>Leaf yield</u><br>t/ha | <u>Pod yield</u><br>t/ha |
|----------------------------------|---------------------------|--------------------------|
| 120                              | 8.34                      | 33.6                     |
| 130                              | 7.78                      | 42.50                    |
| 140                              | 8.33                      | 63.30                    |
| 150                              | 8.20                      | 71.75                    |
| Control                          | 8.70                      | 77.31                    |
| Mean                             |                           | 57.69                    |

Yields at Babile

|         |      |       |
|---------|------|-------|
| 120     | 5.64 | 6.90  |
| 130     | 4.67 | 8.60  |
| 140     | 4.36 | 11.40 |
| 150     | 2.60 | 10.70 |
| Control |      | 12.10 |
| Mean    |      | 9.94  |

#### 4.4.11 Response of irrigated pasture to nitrogen

- Objective - To determine the optimum nitrogenous fertilizer level to sustain high yield and quality in Rhodes grass.
- To establish if phosphorus becomes a limiting factor under continuous herbage removal.
- Results - Increasing N produced higher DM yields.
- There was no significant P response.
- The density of the grass decreased with time.

#### The dry matter yields at Rhodes grass receiving various levels of N and P fertilizer (kg/ha)

| <u>Nitrogen</u> | <u>Phosphorous</u> |            | <u>Mean</u> |
|-----------------|--------------------|------------|-------------|
|                 | <u>0</u>           | <u>200</u> |             |
| 0               | 13.03              | 11.42      | 12.23       |
| 8.75            | 10.94              | 9.46       | 10.20       |
| 17.5            | 12.11              | 12.85      | 12.48       |
| 35.0            | 16.74              | 14.37      | 15.56       |
| 70.0            | 18.74              | 23.49      | 21.12       |
| 200.0           | 25.22              | 22.72      | 23.97       |
| Mean            | 16.13              | 15.72      |             |

\* \* \* \*

#### 4.5 Short report on fodder crops research and developmental activities in 1986 at the South-Eastern Zonal Office for Agricultural Development

Daniel Keftasa\*

Forage crops research in the South-Eastern (Arsi-Bale) Zonal Office for Agricultural Development is mainly engaged in forage agronomy and collaborative activities in forage seed production, livestock husbandry and soil conservation.

##### 1. Research

- Effects of different levels of nitrogen fertilization on pure stands of oats and Sudan grass and their mixtures with vetch were studied. Preliminary results indicate that higher seeding rates (about 35 kg/ha vetch) are required with 75 kg/ha oats in the highland if a higher proportion of vetch in the herbage (hence higher protein content) is desired.

Sudan grass at the seeding rate of 50 kg/ha produced higher yields than the previous recommendation which was 30 kg/ha.

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\* Office for Agricultural Development, South-Eastern Zone, MOA.



- Effects of levels of nitrogen on mixtures of Rhodes grass and alfalfa under different harvesting systems were studied. Determination of growth rates and associated changes in the quality of Rhodes grass was made.
- Single plant selection on fodder beet for better seed productivity and uniformity in maturity was conducted.
- Trials on vicia (V. dasycarpa) for green manuring to improve yields of subsequent cereal crops (wheat and barley) were conducted. Green manuring with vicia improved the chemical and physical condition of the soil and as a result of this vigor, tillering capacity, yield and protein contents of wheat and barley were improved.
- Crop rotation trials in which oat-vetch mixtures were put in rotation cycles to improve yields of wheat and barley are being continued.
- Studies on methods of grass establishment were conducted. Results from 3 consecutive years indicate that Rhodes grass can be safely established under barley and wheat without any reduction in grain yields.
- A study on the evaluation of fodder crops for their relative suitability for green feeding, hay or silage making are being conducted. This study investigates practical problems associated with conservation of fodder crops either for hay or silage and changes in quality which occur during the course of conservation processes.

## 2. Seed production

- Seeds of oats, Rhodes, Sudan and Columbus grasses were produced on about 80 ha of land during the 1986 crop season. Vetch seeds are produced on farmers fields. This approach has been found to be a good way of making fodder seeds available at lower prices.

## 3. Extension

- A number of fodder crops are becoming popular among which oat-vetch mixtures, fodder beet and Rhodes grass are most widely planted. Rhodes grass has become the most popular perennial grass in medium altitude areas of Arsi region.
- Alfalfa was planted at two producers' cooperative farms at Asasa under irrigation. It was planned to serve as a fodder bank of green feed to be used to supplement the diets of cross-bred calves. It was harvested daily in a rotation system so that each plot was harvested every 3rd week. Yield estimates indicate that 5 ton/ha dry matter can be obtained every month. The system has potential for local farmers.

## 4. Soil conservation

- Observation trials on tropical grasses, (Panicum spp. Cenchrus ciliaris) and fodder shrubs (Leucaena, Sesbania, pigeon pea and tree-lucerne) were conducted. Sesbania sesban and tree lucerne grew vigorously at medium altitudes (2200 m).

- Seeds of fodder grasses, legumes and fodder tree seedlings were distributed for planting on terraces. The seeds and seedlings were produced on nursery sites of the Community Forest and Soil Conservation Programme.
- One large scale seed production farm of tropical grasses and fodder trees was established under irrigation at Abomsa. The farm is supervised by the Community Forest and Soil Conservation team, the Forage Crops Research Unit and the Department of Livestock and Fisheries Development.

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## 5. SOME NOTES ON RHIZO BIOLOGY WITH SPECIAL REFERENCE TO FORAGE LEGUMES IN ETHIOPIA

Desta Beyene\*

### Introduction

In addition to forage legumes serving as rich sources of proteins for animals, there is currently a great interest in the use of leguminous forages in cropping systems for maintaining soil fertility. In particular, there is great interest in the use of biological nitrogen fixation (BNF) as a means of reducing the dependence by farmers on the use of the expensive nitrogenous fertilizers. The importance of BNF is becoming more evident especially in developing countries like Ethiopia.

This short presentation will briefly describe the legume Rhizobium symbiosis in general and then discuss the state of forage legume research in Ethiopia.

### Legume-Rhizobium Symbiosis

In the symbiotic system there are three components - the legume, the Rhizobium and the nodule. Each has its interactive role and specific requirements. There are three special advantages to be gained from the legume - Rhizobium symbiosis:

- 1) Protein is provided for humans and animals,
- 2) The soil is enriched in nitrogen,
- 3) The farmer saves money instead of spending it on nitrogenous fertilizers.

The value of nitrogen fixation by the forage legumes' symbiotic system in intercropping and alley cropping is a well known fact in temperate and tropical environments. According to Jones (1972) nitrogen fixation by pasture legumes in the tropics is in the order of 100 to 300 kg N/ha a year. It has been established that the amount of nitrogen fixed by forage legumes is highly correlated with the total dry matter content of the legume tops.

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In general there are four major factors which determine the quantities of N fixed by rhizobia. These are:-

1. Environmental factors - temperature, water stress/light, humidity and CO<sub>2</sub> concentration.
2. Biological factors - The natural Rhizobium population and its effectiveness, pests and diseases.
3. Nutritional factors - soil reaction, organic matter and plant nutrients (N, P, K, Mo and Mn).
4. Host factors - plant species and varieties.

The effect of these factors on N fixation have been discussed in detail by Haque and Jutzi (1985).

The generic terms Rhizobium and Bradyrhizobium now represent fast and slow growing rhizobia respectively. I here use the common term rhizobia or rhizobium for both since the generic terms are unnecessary. The list of the commonly used improved tropical legume species and the types of rhizobium used are shown in the following table.

List of commonly used improved tropical legume species found in Ethiopia

| Scientific name                   | Common name                            | Rhizobium type |
|-----------------------------------|----------------------------------------|----------------|
| <i>Stylosanthes guianensis</i>    | Stylo                                  | Cowpea         |
| <i>Stylosanthes humilis</i>       | Townsville lucerne<br>Townsville Stylo | Cowpea         |
| <i>Pueraria phaseoloides</i>      | Kudzu, Puero                           | Cowpea         |
| <i>Centrosema pubescens</i>       | Centro                                 | Specific       |
| <i>Desmodium intortum</i>         | Greenleaf desmodium,<br>pega-pega      | Desmodium      |
| <i>Desmodium uncinatum</i>        | Silverleaf                             | Desmodium      |
| <i>Calopogonium mucunoides</i>    | Calopo                                 | Cowpea         |
| <i>Macroptilium lathyroides</i>   | Murray lathyroides                     | Cowpea         |
| <i>Lotononis bainesii</i>         | Miles lotononis                        | Specific       |
| <i>Macroptilium atropurpureum</i> | Siratro                                | Cowpea         |
| <i>Leucaena leucocephala</i>      | Ipil-ipil, Koa-haole,<br>Leucaena      | Specific       |
| <i>Neonotonia wightii</i>         | Perennial soybean                      | Cowpea         |
| <i>Trifolium repens</i>           | White clover                           | Clover         |
| <i>Medicago sativa</i>            | Alfalfa, lucerne                       | Alfalfa        |



Most tropical legume species that are tolerant to soil acidity and low phosphorus availability enter into symbiosis with the slow growing cowpea - type Rhizobium strains. Species such as stylo, kudzu and calopo are apparently able to establish effective symbiosis under extreme acidity and high temperatures and thus require no inoculation (Norris, 1967). Rhizobium inoculation is definitely needed, however, for the aluminium - tolerant species that require specific strains, such as Centrosema pubescens, Desmodium intortum, Desmodium uncinatum, and Lotononis bainesii. Inoculation is almost universally needed for aluminium - sensitive legume species such as alfalfa, the clovers, Neonotonia wightii and Leucaena leucocephala in acid soils (Norris 1967, 1973). The Rhizobium strains associated with these forage species exude acid substances that further aggravate the situation. In alfalfa and the clovers, lime pelleting will help to lengthen the viability of the inoculum under such unfavourable conditions. The practice of pelleting with superphosphate or rock phosphate is recommended by Norris (1967) and by Graham and Hubbel (1975) for acid-tolerant tropical legumes.

### The potential of symbiotic nitrogen fixation

The potential symbiotic N fixation by a given legume is defined as the maximum activity of that legume when nodulated with the most effective Rhizobium strain when grown under the most favourable environmental conditions (Gibson et al. 1982). It has been concluded that tropical pasture legumes in Africa, under good management, can reach N fixation levels similar to those obtained in temperate regions (Kenya, 1977).

In Kenya, an average of 178 kg N/ha has been fixed by Desmodium uncinatum (Anon, 1969). Average rates of 110 kg N/ha have also been fixed by Leucaena grown in Tanzania (Hogberg and Kvarnstorm, 1982). It is expected that this organic N accumulated in the soil will be released over several years to non-legume crops if the soil is cultivated, or to companion grasses in pasture land. The direct transfer of nitrogen fixed by the legumes to the associated grass species ranges from 0 to 53%, calculated by differences of legumes (Jones et al 1967; Whitney, 1970). The presumed mechanisms are legume leaf fall and root and nodule decomposition.

It is clear from the experimental results reported here, that there is a great potential for the use of forage legumes as a component of cropping systems in Ethiopia.

### Research on forage legumes in Ethiopia

#### Present Status of Research

Most of the research work on forage legumes has concentrated on variety screening and adaptation trials. Astatke (1977) has compiled the agronomic studies on vetches, clovers and alfalfa carried out during a period of five years. Similar work on many forage legumes is still being carried out at the Institute of Agricultural Research (IAR), International Livestock Center for Africa (ILCA) and Ministry of Agriculture (MOA).

Some of the forage legumes that have been found to be adapted to Ethiopian conditions are listed below (Alemayehu Mengistu, 1986).



#### A. Annual Forage Legumes

1. Forage vetch (Vicia dasycarpa)
  - Proved to be useful mixture with forage oats at mid-high altitudes. This crop can be grown in pure stand and be used as green fodder and hay.
2. Sweet Clover (Melilotus altissimus) - can be grown in pure stand and in mixture with Sudan grass at medium altitude. It can be used as green feed and hay.
3. Lupin (Lupinus sp.) - can be used as green feed and silage crop at mid-altitudes.
4. Native clovers (Trifolium spp.)
  - Almost all are indigenous legumes which can easily establish themselves in newly sown swards.

#### B. Perennial Forage Legumes

1. Alfalfa (Medicago sativa) - can grow in pure stand and in mixture with Rhodes grass and colored Guinea grass.
2. Neonotonia (Neonotonia wightii)
  - can grow in mixture with elephant grass.
3. Lablab (Lablab purpureus) - can be grown in association with Sudan grass.
4. Stylos (Stylosanthes spp.) - promising for use in mixture with tropical grasses.
5. Siratro (Macroptilium atropurpureum) - promising for use in mixture with tropical grasses.
6. Leucaena (Leucaena leucocephala) - a tree that can be used as green fodder and browse for dry periods.
7. Sesbania (Sesbania sp.) - good browse plant for dry areas.
8. Tree lucerne (Chamaecytisus palmensis) - a hardy shrub that can be used as a green fodder.

Unlike the experimental work on the agronomy of forage legumes, research work on the symbiotic relations between rhizobia and forage legumes is at an early stage of development. Several factors have contributed to this state of affairs, notably a serious lack of trained manpower, funds and related resources. Recently, the emphasis given to biological nitrogen fixation by the IAR and donor agencies like IAEA, FAO, ICARDA and IFS has accelerated the development of research programmes in rhizobia and forage legume symbiosis. Presently, the IAR is setting up a microbiology laboratory at the Holetta Agricultural Research Center (HARC) to handle nitrogen fixation studies on food grain and forage legumes. It is encouraging to know that the laboratory now has an emission spectrometer for N-15 analysis, a laminar flow hood and all other laboratory facilities necessary to carry out routine rhizobiological studies.

#### Future Research Direction

Exploitation of the BNF technology, especially rhizobiology, is an endeavour that will be receiving great attention in the country. A nation wide programme for collecting and preserving the effective indigenous rhizobium strains must be launched by the IAR, MOA and ILCA.

The future research activities that should be encompassed within the national BNF programme can be outlined as follows:-



1. Collection of rhizobium strains from forage legumes grown in different agro-ecological regions of the country.
2. Selection of strains of rhizobium.
  - 2.1 Survey and characterization of the native strains.
  - 2.2 Measure the effectiveness of the native strains.
3. Study the dynamics of inoculants.
  - 3.1 Study the survival of commercial rhizobium strains in peat inoculants.
  - 3.2 Evaluate the performance of the inoculants.
4. Production and use of inoculants.
5. Quality control of the commercial inoculants.

Given adequate national and international support for the development of BNF technology, it is feasible that rapid progress can be made in the next few years in the production of sufficient amounts of commercial inoculants to meet the demands in Ethiopia for the major forage legumes. This will help avoid recurrent food shortages by increasing food production through the application of biofertilizers and the subsequent beneficial effects on the N economy of the soils.

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## 6. COMPOSITION OF NATIVE MINERAL SUPPLEMENTS IN ETHIOPIA

Ephraim Kabaija and Douglas Little\*

### Introduction

Under nutrition is a major factor contributing to low animal productivity in Ethiopia. Available feed for grazing ruminants is almost invariably of very poor quality and in the form of hays and crop residues. Though the usefulness of forages is basically determined by the daily net energy intake, maximum performance of livestock is only possible if the diet contains sufficient protein, minerals and vitamins. It is common knowledge that animals require certain essential minerals for maintenance and production. Animals in most tropical areas rarely receive mineral supplements except occasionally for common salt and therefore generally rely on forages for their mineral needs. Only rarely can forages completely satisfy all of the mineral requirements in these areas (Miles and McDowell, 1983).

Studies in the past (Faye *et al.* 1983) have revealed widespread copper (Cu) and zinc (Zn) deficiencies in Ethiopia. A study of forages in the southern rangelands of Ethiopia (Kabaija and Little, unpublished results) indicated that forage sodium (Na), phosphorus (P) and Cu levels were on the average 0.01%, 0.16% and 5.6 ppm. respectively, levels which are marginal to deficient for cattle.

In Ethiopia, most livestock owners use various types of local mineral supplements such as rock salt and soil licks obtained from craters and lakes. The composition of these supplements is not known and their adequacy in terms of mineral supply to cattle can not be fully ascertained. This investigation was carried out with the aim of providing data on the composition of such local mineral supplements.

### Materials and methods

Salt and soil lick (called 'haya' in Borana) samples were obtained from Chobeti, Did Hara, Medacho and Megado, areas situated in the southern rangelands of Ethiopia, and lake soils (called bole) from Lakes Zeway and Shala in the Rift Valley. A red soil which is normally mixed with 'bole' soils as a diluent was taken from Asella. The samples were dried in an oven at 100°C and ground with pestle and mortar. The organic matter (DM) was determined by difference after ashing 1 g of each sample at 500°C for 12 hours, and the pH was determined with an ion electrode pH meter in KCl solution.

To determine the solubility of the samples in water, 2 g of each sample were placed in a plastic bottle, 20 ml of distilled deionized hot (60°C) water added and the contents shaken on an orbital shaker for 15 minutes. The suspension was filtered using Whatman filter paper no. 40, the residue dried in an oven at 100°C for 4 hours and then weighed. To determine the solubility in 0.1 M HCl, a 1 g sample was placed in a pyrex beaker, 20 ml of 0.1 M HCl added and the contents boiled for 10 minutes. The suspension was filtered and the residue weighed after treatment as was described above for water. The mineral (K, Na, Ca, Mg, Fe, Mn, Zn and Cu) concentrations in the salts and soil licks were determined using an atomic absorption spectrophotometer

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(Perkin Elmer model 2380) after extraction with 0.5 M  $\text{HNO}_3$ . The phosphorus concentration in the extracts was determined by the autoanalyser using the ascorbic acid calorimetric reaction, while sulphur was determined by the turbidimetric method (Cottenie et al 1982).

## Results and discussion

The OM content of the salts and soil licks ranged from only 0.5% in partially cleaned salt from Chobeti crater to 30% in the Megado salt. The partially cleaned salt differs from the crude type, in that the former was washed and sieved to render it suitable for human consumption. The crude salt was left to dry as it was mined. The salts with high OM content had a darker appearance. The crater salts had higher solubility than soil licks, both in hot water and in 0.1 M HCl (Table 1). All the samples were more soluble in HCl. Except for the haya soil from Did Harra which had a neutral pH and the red soil which was acidic (pH 4.9), all the other samples were alkaline.

TABLE 1  
Solubility and pH values of various salt and soil licks

| Sample Description                 | Organic matter (%) | Solubility in water (%) | Solubility in 0.1 M HCl (%) | pH  |
|------------------------------------|--------------------|-------------------------|-----------------------------|-----|
| Soil lick from L. Shala            | 11.3               | 29.7                    | 39.7                        | 9.5 |
| Soil lick from L. Zeway            | 7.0                | 10.6                    | 14.5                        | 9.9 |
| Soil lick from Did Harra           | 11.0               | 6.3                     | 15.2                        | 6.8 |
| Soil lick from Medacho             | 14.8               | 18.6                    | 30.4                        | 7.7 |
| Chobeti crater salt (crude)        | 10.2               | 30.4                    | 47.0                        | 9.3 |
| Chobeti crater salt (partly clean) | 0.5                | 76.5                    | 87.8                        | 9.0 |
| Megado crater salt                 | 30.6               | 55.2                    | 71.9                        | 9.4 |
| Red soil from Assela               | 9.4                | 5.5                     | 6.3                         | 4.9 |

The low solubility of most of the soil licks implies they have a high content of minerals likely to be unavailable to animals. High consumption of such mineral supplements on a daily basis could limit the animal's feed intake through increased gut fill and could cause problems such as tooth wear and erosion of the digestive tract epithelium (McDowell, 1985). Studies on the severity of teeth wear due to excessive soil consumption have been done elsewhere (McDowell, 1985) and it may be appropriate to undertake similar investigations in Ethiopia. This could be of economic importance because the cattle not only consume soil licks offered as mineral supplements, but in addition significant quantities of soil are ingested during the dry season as a result of low grazing. High soil consumption by sheep in Costa Rica interfered with P utilization resulting from lowered P retention, (Valadao, 1980) and this was suspected to be due to large amounts of iron and aluminium in the soil. On the contrary, Grace and Healy (1974) found increased retention of P, Ca and Mg following soil ingestion. Suttle et al (1975) reported a 50% reduction in Cu absorption due to soil ingestion. The consumption of



soil licks in Ethiopia may thus be of great economic importance in livestock production since forages and local mineral supplements consumed by livestock have low P and Cu contents. The alkaline nature of most licks may affect their palatability since research elsewhere has indicated that cattle prefer acid to alkaline supplements (McDowell, 1985). In addition, the lake soils when consumed undiluted have been reported to cause sloughing of the oral mucosa (Mukasa, pers. comm.). The red soil which is added to the alkaline supplements may have the effect of lowering pH as well as slowing the rate of consumption of the supplement (desired due to its cost). This soil in addition reduces the amount of minerals consumed per unit weight of the mix except for Fe and P. The P in the soil could be of very low availability and this needs to be investigated.

The composition of the soil and salt licks (Table 2) indicate Na to be the main constituent; other elements were present in low concentration. McDowell et al (1983) recommended that an appropriate mineral supplement should contain at least 30 to 40% NaCl (11.7-15.6% Na) and 8-10% P. Based on this criterion the salt licks were satisfactory as sources of Na. The soil licks from Medacho and Lake Shala were just about adequate in Na provided they are fed not mixed with the red soil as is commonly done. Since the lick from Medacho had fair levels of Na and its pH was not very high compared to the other soil licks, it may be suitable for use as a supplement without further dilution.

Based on the recommendations shown in Table 3 and the analytical data, it may be concluded that none of these materials can supply adequate quantities of Cu, Mn and Zn, but all soils and the clean Chobeti salt are high in Fe; clearly none of them is a significant source of P.

The feeding of local mineral licks whose Na content is below 10% in the 'as is' form or after dilution with soil should be discouraged. The salt licks with Na content above 10% should be fed in combination with bone meal to correct P deficiencies. Bone meal currently costs about 45 cents per kg and if an efficient processing and distribution system is instituted, its use by pastoralists could easily be adopted. To correct deficiencies of Cu and Zn, as well as others like cobalt (Co) and selenium (Se) which were not examined in this study, the relevant government departments could encourage the formulation of a trace mineral premix which could be mixed with salt and bone meal. It could also be possible to encourage the use of mineral injectables and rumen preparations (e.g. Co pellets, Cu oxide needles, soluble glass bullets containing various trace elements). The latter methods are generally economical since such preparations once administered to an animal may be effective for 6 to 12 months. There are mineral supplements from other parts of Ethiopia which were unobtainable for this study, and a more comprehensive investigation obviously would be beneficial. Further studies are required to ascertain the beneficial and detrimental effects associated with the feeding of such soil licks.

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TABLE 2

## Mineral composition of local soil and salt licks

| Description                        | K                                                                                                | Na    | Ca    | Mg   | P     | S    | Fe   | Mn                                                                                                | Zn  | Cu   |
|------------------------------------|--------------------------------------------------------------------------------------------------|-------|-------|------|-------|------|------|---------------------------------------------------------------------------------------------------|-----|------|
|                                    | O/D. <span style="display: inline-block; width: 100px; border-bottom: 1px dashed black;"></span> |       |       |      |       |      |      | mg/kg <span style="display: inline-block; width: 100px; border-bottom: 1px dashed black;"></span> |     |      |
| Soil lick from L. Shala            | 0.73                                                                                             | 10.3  | 1.70  | 1.50 | 0.02  | 0.23 | 0.65 | 471                                                                                               | 62  | 13.5 |
| Soil lick from L. Zeway            | 0.59                                                                                             | 3.5   | 0.35  | 0.20 | 0.02  | 0.03 | 0.60 | 635                                                                                               | 83  | 15.0 |
| Soil lick from Did Harra           | Trace                                                                                            | Trace | 1.70  | 0.05 | Trace | 0.71 | 1.90 | 0.7                                                                                               | 0.6 | 0.4  |
| Soil lick from Medacho             | 0.34                                                                                             | 10.6  | 0.50  | 0.06 | 0.01  | 1.09 | 0.54 | 9.1                                                                                               | 1.1 | 1.1  |
| Red soil from Assela               | 0.01                                                                                             | 0.01  | 0.20  | 0.03 | 1.9   | 0.91 | 1.90 | 8.9                                                                                               | 0.5 | 0.07 |
| Chobeti crater salt (crude)        | 1.53                                                                                             | 16.0  | 0.13  | 0.81 | 0.02  | 2.15 | 0.30 | 680                                                                                               | 100 | 32   |
| Chobeti crater salt (partly clean) | 0.31                                                                                             | 35.5  | 0.93  | 0.11 | 0.11  | 1.52 | 0.54 | 51                                                                                                | 24  | 7    |
| Megado crater salt                 | 0.34                                                                                             | 10.8  | Trace | 0.13 | 0.01  | 0.89 | 0.02 | 0.6                                                                                               | 0.2 | 0.9  |



**TABLE 3**  
**Percentage of trace minerals required in an**  
**adequate mineral supplement<sup>1</sup>**

| Element   | Estimated maximum<br>dietary requirement<br>(ppm) | % of minerals in<br>mixture for the following<br>% of the requirement |       |
|-----------|---------------------------------------------------|-----------------------------------------------------------------------|-------|
|           |                                                   | 50%                                                                   | 100%  |
| Cobalt    | 0.1                                               | 0.001                                                                 | 0.002 |
| Copper    | 10                                                | 0.10                                                                  | 0.20  |
| Iodine    | 0.8                                               | 0.008                                                                 | 0.016 |
| Manganese | 25                                                | 0.25                                                                  | 0.50  |
| Zinc      | 50                                                | 0.50                                                                  | 1.0   |
| Iron      | 50                                                | 0.50                                                                  | 1.0   |
| Selenium  | 0.2                                               | 0.002                                                                 | 0.004 |

<sup>1</sup>Source: McDowell, 1985

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## 7. THE SYMPOSIUM ON FORAGE PRODUCTION IN SOMALIA

A.H. Shirwa and Vecchio Vincenzo\*

It is the tradition of the Faculty of the Agriculture, Somali National University to hold a 2-3 days symposium every year on an agricultural sub-sector or crops.

A year ahead of time the Faculty Council usually formulates and proposes a number of topics for the symposium based on national problems and priorities in the field of crop production, animal husbandry and nutrition, range management, agro-pastoral systems, etc.

The Faculty Council also finalizes selection of the topics after several meetings and discussions with ministries, agencies and other Faculty members of the Somali National University who are involved in those particular fields.

Italian professors, whose contributions are traditional and important are always informed a year ahead, through the Technical Committee of the Faculty of Florence, Italy.

The media of communications of the symposium is in English and Italian, since most of the participants are fluent in either English or Italian.

The forage production symposium held on 1-2 November, 1986, based on the above mentioned procedures included such topics as natural pastures, planted grasses and legumes, browse and fodder as well as edible crop residues and their economics.

Such closely related to the symposium as Somali pastoral systems, agroclimatology of Somalia, medicinal plants, land uses, water resources, etc. were also presented.

The main objectives of the symposium were:

- to facilitate the exchange of information among institutions involved in the development and research of forage production and related fields;
- to evaluate the manpower involved in this sub-sector;
- to collect the available literature resources in this subject;
- to establish better coordination among the institutions involved.

All but the last of these objectives were more or less achieved and the papers presented at the symposium demonstrated the existence of relatively abundant literature in forage production and related fields (Table 1).

Coordination of the more than 10 institutions participating in the symposium is difficult. It needs further and careful contacts and common programmes.

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\* Somali National University, Somalia.



The symposium had:

- staff from 10 scientific and technical institutions present.
- 41 teaching staff, researchers and technicians as panelists.
- 28 papers presented and discussed.

Most of the panels (more than 2/3) were papers authored and presented by a group, while the remaining were single authored and presented papers.

Most of the contributions came from the Faculty of Agriculture (7 papers, single authored and 6 group authored) followed by the National Range Agency (5 papers single authored and 3 group authored) and the Faculty of Animal Husbandry and Veterinary Science (4 papers single authored and 4 group authored).

A little more than half of the panels (16) were written, presented and discussed in Italian, while the others (12) were written, presented and discussed in English.

The proceeding of the symposium which are expected to come out soon will be published in both Italian and English.

The papers presented are given in the accompanying table.

**TABLE 1**  
**Authors and Topics discussed on November 1-2, 1986**  
**Forage Production Symposium**

| A u t h o r s                                                        | T o p i c s                                                                                                    |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 1. Abdirizak Mohamed Ali;<br>Abdurahaman Nur Deileye;<br>W.A. Hargus | Livestock Management Techniques in<br>the Bullo Burte District (Somalia).                                      |
| 2. Abdullahi Omar Farah;<br>Mario Manotti                            | Review of Research done in the Faculty<br>of Animal Husbandry and Veterinary<br>Science in Forage Production*. |
| 3. Ahmed Abdi Elmi                                                   | Feeding Behaviour of Free Ranging Camels<br>in Somalia.                                                        |
| 4. Ahmed Hassen Nur;<br>Abdulwali Yusuf Omar                         | Importance of Agrozootechnic Project in<br>Afgoi*.                                                             |
| 5. Ahmed Mohamed Hashi                                               | Myths and facts about the Productivity<br>of Pastoral Systems.                                                 |

\* Papers presented in Italian language.

| A u t h o r s                                   | T o p i c s                                                                                               |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 6. Ahmed Mohamed Hashi                          | Supplementary Feeding of Pastoral Livestock.                                                              |
| 7. Ali S.F.; A.C. Warfa                         | Therapeutic Effects of <u>Vernonia mogadoxensis</u> *.                                                    |
| 8. Asha Hagi Yahye;<br>Cocucci Mario            | Metabolic Responses of Plants in Limiting Conditions of Reduced Water Availability and High Temperature*. |
| 9. Barbagallo, C.;<br>Furnari, F.; A.M. Warfa   | Growth of Somali Pastures: Corological and Phytosociological Aspects*.                                    |
| 10. Barbagallo, C.; Ali, S.F.;<br>Abdullahi, E. | Current Knowledge of Medicinal Plants of Somalia Pastures*.                                               |
| 11. Carmignani C. Ali Kassim M.;                | Use of Aerial and Satellite Photos for Geological and Geomorphological Surveys of Somalia*.               |
| 12. Castellani L.; M. Khalif.                   | Consideration of Use, Economic and Marketing Aspects Related to Cultivated Forages*.                      |
| 13. Dennis Herlocker                            | Some Grass Structural Characteristics of Vegetation of Ceel Dheere District, Central Somalia.             |
| 14. Dorre A.S.; Ahmed Nur;<br>Rapolla A.        | Examples of Application of Geophysical Prospecting Techniques to Water Research in Somalia.               |
| 15. Jerry R. Barker;<br>Dennis L. Herlocker     | The Response of Forage Species to Grazing Intensity.                                                      |
| 16. Kadija M.; Nuh Hussein<br>Scek.             | Comparative Trials Among Different Varieties of <u>Medicago sativa</u> (Alfalfa) in Somalia*.             |
| 17. Nuh Hussein Scek                            | Use of Crop Residues for Livestock Feeding*.                                                              |
| 18. Peter Hutchinson;<br>Olga Polishchouk       | The Climate of Somalia in Relation to Forage Production.                                                  |
| 19. Peter Kuchar;<br>Mohamed Dahir Abdi         | The Significance of Browse in the Livestock Economy of Central Somalia.                                   |
| 20. Richard Holt                                | Increasing Fodder Production in Arid and Semi-Arid Central Somalia: Preliminary Results and Observations. |

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\* Papers presented in Italian language.



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|----------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 21. Richard Holt                                   | Managing Rangeland Resources: Developing Pastoral Producer Associations in Central Somalia.     |
| 22. Salerno A.                                     | Prospects of Scientific Research Development in the Field of Animal Production*.                |
| 23. Salerno A.                                     | Relationship between Pasture Fertility, Chemical Composition of Forages and Animal Production*. |
| 24. Shirwa' A.H.; Farah A.O.H.; Vecchio V.         | Sources of Fodder Crops Utilized in Urban Area of Mogadishu*.                                   |
| 25. Shirwa' A.H.; Farah A.O.H.; Vecchio V.         | Techniques of Hay-Making of Herbaceous Biomass of somali Pasture*.                              |
| 26. Shirwa' A.H.; Vecchio V.; Kadija M.; Casini P. | Experimental Contribution on Forage Sorghum Cultivation in Somalia*.                            |
| 27. Thurow T.; Herlocker D. Shabanni M.; Bush B.   | Dietary Comparison of Large Herbivores of the Coastal Plain of Central Somalia.                 |
| 28. Vecchio V.; A.H. Shirwa                        | Agronomical Prospectives of Artificial Forage Production in Somalia*.                           |

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## FNE ADVISORY SERVICES

The Forage Network in Ethiopia offers advice to individuals and organizations involved or wishing to become involved in forage research or development. It also organizes multilocation trials in the region for a range of environments. Those interested in receiving more information should contact members of the Executive Committee listed above, or write to the FNE Editors, ILCA, POB 5689, Addis Ababa.

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## FORAGE SEEDS AVAILABLE FROM ILCA

Seeds of forage species (grasses, legumes, browse) for temperate, Mediterranean, sub-tropical and tropical environments are available in experimental quantities (a few seeds to a few grams) for researchers, development workers, and farmers from the Genetic Resources Section of the FLAG Unit. Enquires including details of the climate, soils, and intended management system should be sent to the Genebank Manager, FLAG, ILCA, POB 5689, Addis Ababa, Ethiopia.

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The Forage Network in Ethiopia is open to all individuals and organizations interested in the development of forage production in Ethiopia. All are welcome to attend the meetings, which are announced in this Newsletter. The Newsletter is obtained by writing to "The Editors".

Any news, notes, notices, research results and advisory information for the Newsletter will be welcomed.

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