LEGUME RESEARCH NETWORK PROJECT NEWSLETTER

KENYA AGRICULTURAL RESEARCH INSTITUTE
P.O. BOX 14733, NAIROBI, TEL. 254-440935, FAX 254-449810
E-MAIL Address: jmureithi@net2000ke.com #

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CONTENTS

ABOUT THE NEWSLETTER

Welcome to the third issue of the LRNP. The last issue focussed on introduction of green manure legumes into the Kenyan small-holder farming systems. This issue reports on performance of green manure legumes on-station and on-farm and also farmers' perceptions of the benefits of green manure legumes. An article on performance of black seeded-mucuna compared to creamy seeded mucuna raises fundamental question on whether we need to continue with more screening of green manure legume germplasm or not. Long experiences with *Dolichos purpureus* as a green manure legume in Kitale has led to the development of its management guidelines, which are reported in an article by EAT-Kitale. This issue will arrive late mainly because most members (contributors) were involved in the preparations for the Second Conference of the Soil Management and Legume Research Network Projects which was held during the last week of June. The highlights of the conference are presented in this issue. We take this opportunity to thank the Rockefeller Foundation for the financial support it has continued to give the Network. We are also grateful to Director KARI for the support he has given the Network since its inception. All those who contributed articles in this issue are indeed thanked.

EDITOR'S NOTE

The LRNP newsletter is published to provide a forum for highlighting Network activities and sharing its findings with other projects involved in similar work in Kenya. The newsletter also publishes short articles on legume research, especially those based on research aimed at integrating legume into small-holder agriculture. This is a biannual newsletter and is published in June and December. Your contributions (short articles) and constructive comments are welcome and they should be addressed to: D.M.G. Njarui, the Editor, LRNP newsletter or Joseph G. Mureithi, LRNP Coordinator, P.O. Box 14733, Nairobi, e-mail address is jmureithi@net 2000ke.com

LEGUME GREEN MANURES AS COMPONENTS OF INTEGRATED SOIL FERTILITY IMPROVEMENT OPTIONS IN WESTERN KENYA.

J. O. Ojiem, and E. A. Okwuosa KARI, RRC-Kakamega

Introduction

Inorganic fertilizers are inaccessible to the majority of the smallholder farmers, mainly due to their high cost. As a result, farmers till their land and produce their crops with little or no mineral fertilizer inputs. This continuous mining of soil nutrients must be stopped and effective and affordable fertility replenishment strategies put in place to reverse the trend of decline in food production. The provision of sufficient N is particularly critical for improved food production to meet the increasing demand. Legume green manures have demonstrated a great potential for supplying N and improving the productivity of N-depleted smallholder systems. By taking advantage of biological N fixation, farmers can reduce their inorganic fertilizer requirements while improving crop yields. For this to become a reality, the green manure potential must be demonstrated to smallholder farmers.

On-farm testing of fertility options

On-farm trials were conducted in collaboration with farmers in Kabras Division, Kaka mega District, to assess the effect of various combinations of green manure, inorganic N, and FYM on maize grain yield. Legume green manure species used were *Crotalaria ochroleuca* and *Mucuna pruriens*. The trials were conducted between October 1997 and August 1999.

Seven options (Table 1) were evaluated against farmer practice as follows; (1) recommended rate inorganic N (60 kg N ha^{-1}) (2) recommended rate farmyard manure (5 t ha^{-1}) (3) Green Manure (GM) (4) GM + 30 kg N ha^{-1} (5) GM + 2.5 t ha^{-1} FYM (6) 30 kg N ha^{-1} + 2.5 t ha^{-1} FYM (7) GM +30 kg N ha^{-1} + 2.5 t ha^{-1} FYM. Green manure plots were established at the beginning of the short rain season and incorporated at the onset of the long rain season. The biomass was left to decompose for about four weeks before planting maize. A blanket application of Phosphorus at 30 kg P ha^{-1} was done using TSP. FYM was applied at maize planting and inorganic N as top-dress at 6th leaf stage.

Highlights of the Results

Maize grain yield

Large treatment differences were observed in maize grain yield both in 1998 and 1999.

Table 1 The design of green manure based fertility management options evaluated by Kabras farmers between 1997 and 1999.

Option	Short rain season	Long rain season
1	-	Inorganic N at 60 kg ha^{-1} (full N)
2	-	FYM at 5 t ha^{-1} (full FYM)
3	Green manure established	Green manure (GM) biomass incorporated
4	Green manure established	GM +Inorganic N at 30 kg ha^{-1} (half N)
5	Green manure established	GM + 2.5 t ha^{-1} FYM (half FYM)
6	-	Half N + half FYM
7	Green manure established	GM + Half N + half FYM
8	-	Farmer practice

Averaged over two years, grain yield was highest with full inorganic N (3.98 t ha^{-1}) followed by GM + half N, and GM +half N + half FYM both at 3.67 t ha^{-1} (Figure 2). These options performed significantly better than the farmer practice, which had a yield of 2.51 t ha^{-1}. Grain yield increase due to these options was between 1.2 and 1.5 t ha^{-1}, equivalent to 13 and 16 bags of maize, respectively. However, three options, GM only, GM + half FYM, and Full FYM did not perform better than the farmer practice. Organic-organic combination (GM + half FYM) performed much poorer than organic-inorganic (GM + half N). This emphasizes the importance of inorganic N in the system.

These results indicate that *Mucuna* and *Crotalaria* GM can be successfully used to improve soil fertility and maize yield in the smallholder, low input systems. By incorporating *Mucuna* or *Crotalaria* biomass, it is possible to reduce the inorganic N requirement of maize by half and still realize yields similar to those obtained with full inorganic N rate. Due to difficulties in timing of legume green manures to synchronize their incorporation and N release with crop growth, a significant proportion of biological N is probably lost. Improving management and optimizing biological N utilization efficiency may therefore result in further reductions in inorganic N requirement. This is an important area for future research in green manures. In the meantime, however, options combining organic (biological N) and inorganic N are probably the best for improving fertility and crop yields in smallholder systems.

Mucuna versus Crotalaria

In general, incorporation of *Mucuna* biomass resulted in slightly higher (0.3 t ha^{-1}) grain yield response than *Crotalaria* biomass (Figure 2). However, the differences between *Mucuna* and *Crotalaria* were more pronounced when the biomass was combined with inorganic N

Figure 1: Mean (1998 and 1999) maize grain yield responses to soil amendments options at Kabras, Western Kenya,

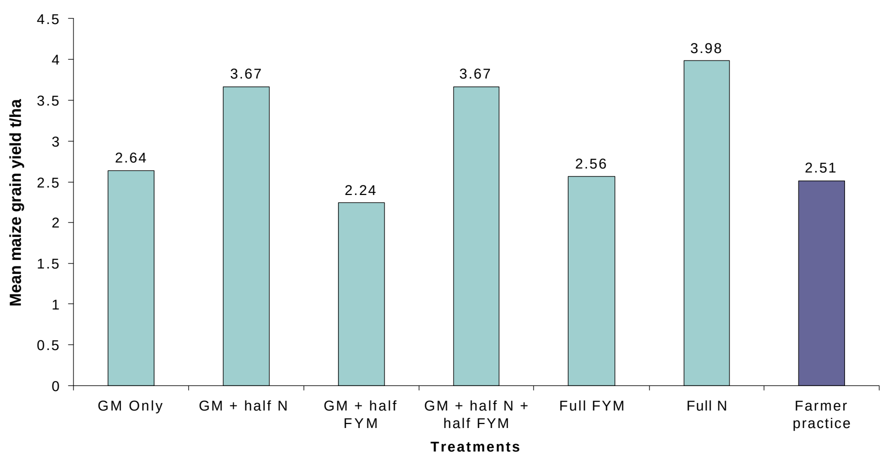
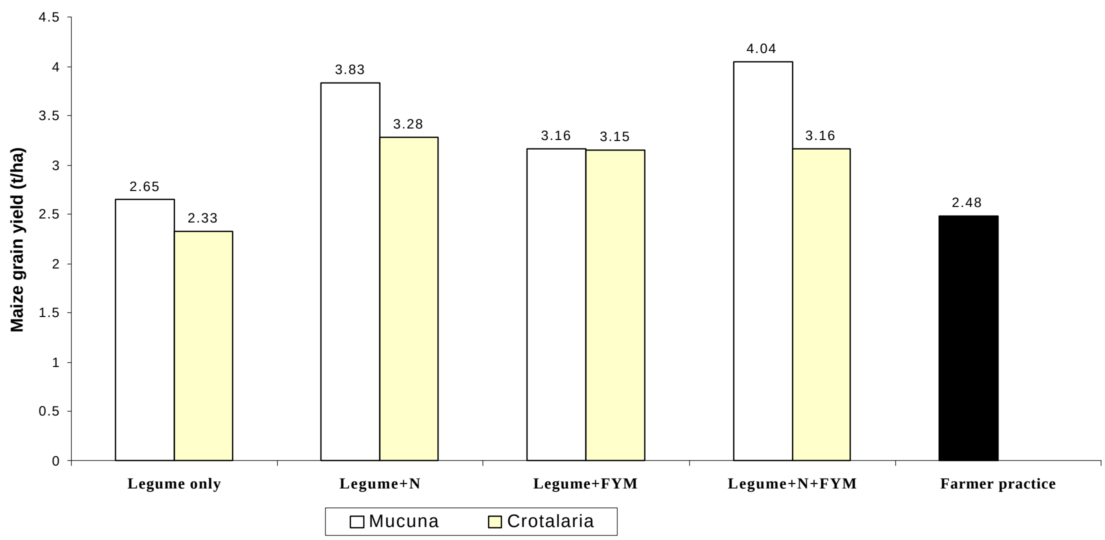


Figure 2: Maize grain yield response to Mucuna and Crotalaria green manure at Kabras, Western Kenya. Figures are means of 1998 and 1999 yield data.



or both inorganic N and FYM. Combining the GM biomass with half recommended inorganic N resulted in 0.6 t ha^{-1} grain yield difference between *Mucuna* and *Crotalaria,* while both half inorganic N and half FYM gave a higher difference of 0.9 t ha^{-1}. These differences are rather marginal and the two legume green manure species seem to have quite similar soil fertility improvement potential. The decision

to use either of the species should therefore be based on other considerations, for example, *Crotalaria* could be used as a vegetable as well, while *Mucuna* has a value as livestock feed.

WHAT THE COASTAL FARMERS SEE IN MUCUNA

Saha, H.M. and M.B. Muli KARI, RRC-Mtwapa

Mucuna *(Mucuna pruriens)* is not a new legume in the coastal region of Kenya. Although most farmers saw the legume for the first time in 1996 when it was used in on-farm trials in various parts of the region, a few farmers had seen the wild relative of the cultivated species of mucuna. The wild type is black-seeded while the introduced one produce grains that are creamy-white or mottled. The wild type has abundant, long stinging hairs on the pod while the cultivated species have silky non-stinging hairs. Human contact with the wild type of mucuna results in an intensely itchy skin irritation caused by a chemical known as *mucunain*.

Farmers at Mpeketoni, in Lamu district, have reported that a black-seeded species of mucuna was introduced in the area in the early 1980's for use as beverage. The seed from this plant were roasted to prepare what the farmers called "cocoa". Reports on use of black-seeded mucuna as "cocoa" have also been received from farmers in Kilifi, Kwale and Taita Taveta districts. During the maize data base survey in 1992, one farmer in Ganze, Kilifi district, showed the survey team a "cocoa" plant that looked far from real. It turned out to be a black-seeded species of mucuna. During a field day held in 1998 at the Jembe farmers' group in Kilifi district, one of the farmers identified mucuna in the trial plots as the "cocoa" plant she had seen growing around her home in Kwale district. Most of the farmers saw the vigorously growing mucuna as a potential vegetable; they were quick to inquire whether

it could be used as a vegetable. Farmers in the region have observed livestock rushing to and feeding on mucuna whenever they came across it. The Mpeketoni farmers observed that mucuna was
very good at suppressing weeds. While some coastal farmers see mucuna as a potential beverage, vegetable, forage and weed suppresser, one farmer located at Rabai (Kilifi district) sees the legume as a cheap source of soil amendment.

This farmer is none other than Mr. Mkoma. Mr. Mkoma participates in the integrated nutrient management (INM) trial. He is also a member of the Jembe farmers group. Mr. Mkoma keeps a local breed of cattle in his homestead. The farmyard manure (FYM) that is used in his trial plots is from his animals. Although the FYM is readily available at his home, the farmer has not used it much in the production of food crops. Use of this manure has been limited to the small piece of land adjacent to the farmer's home. This is because the largest farm, which he relies on most, is situated 2-3 km away from his homestead. Such a long distance between farms and homesteads is quite normal within Kaloleni division. Mr. Mkoma's second farm, which is just about half an acre, is adjacent to his homestead. While the farmer is able to apply FYM on his small piece of land, he cannot afford the cost of its transportation to his large farm. To this farmer, therefore, FYM is not a cheap soil amendment for his most important farm because of the transportation costs. Fortunately, through his involvement in the INM trial, Mr. Mkoma has found the cheap alternative he has been praying for which is mucuna. Our guess is that most farmers in Kaloleni division, and probably the entire Kilifi district, would see the same in mucuna. Such farmers, with one or more pieces of land far away from home, would only be required to carry a few grains of mucuna to their distant farms and multiply it there. This would be manure transported to the distant farms at no cost!

SOIL LOSS AND EROSION - INDUCED NUTRIENT LOSSES IN A MAIZE-LEGUME BASED CROPPING SYSTEM IN CENTRAL KENYA HIGHLANDS

P. W. Khisa[1], C. K. K. Gachene[1], N. K. Karanja[1] and J. G. Mureithi[2]

Background

Sustainable agriculture develops from proper soil and water management practices, which among other things involve the protection of soil from erosion. A wide range of improved soil conservation practices has been suggested for minimizing and controlling soil erosion. Green manure cover crops (GMCC) have been used elsewhere as alternative biological measure of soil erosion control (Flores, 1990). In addition to providing nitrogen and organic carbon to the soil, legume cover crops shade the soil for longer time in a year, a factor, which is extremely important in tropical climates for soil preservation. GMCC can be grown as a soil conservation measure during the off-season when the ground is bare and vulnerable to water erosion. The current study addresses the use of selected cover crops as intercrops with *Zea mays* for erosion control, particularly at the onset of the rainy season when the ground is normally unprotected and most of the nutrients are lost due to erosion.

Approach

The study was initiated in the short rains of 1998 and conducted on six farmers' fields in Gatanga, Kenya. The area experiences bimodal rainfall i.e. long rain (March to May) and short rains (October to December). Workshops involving farmers and researchers were held to select legumes and train the farmers on monitoring erosion and data collection. Farmers selected three legume species for trials. The 4 systems tested consisted of the following: pure stand of maize (*Zea mays*), maize intercropped with *Mucuna pruriens,* maize plus *Vicia benghalensis,* and maize plus *Lablab purpureus*. The layout of runoff plots and soil loss monitoring was designed as outlined in Gachene *et al.*, (1997). Four runoff plots 2 m wide and 4 m long were installed adjacent to each other on a single catenal position on each farm. Measurements taken included soil loss, crop cover and analysis of nutrients in the original soil and eroded sediments. Farmers carried out land preparation and weed control, while both the farmers and researchers were involved in the data collection.

Research Observations

The rainfall during the 1998 short rain season (SR) was very low and there was crop failure. The cumulative soil loss recorded during the 1999 long rain season (LR) ranged from 58.64 to 61.7 t ha^{-1}. Although the plot planted with maize plus mucuna appeared to have lost the least amount of soil (58.64 t ha^{-1}) as compared

Table 1. The composition of the original soil (0-15 cm) and the eroded sediments.

Soil property	Treatment	Maize mucuna	Maize+ vetch	Maize+ dolichos	Maize+	F test	LSD (0.05)
pH-H2O (1:2.5)	Original soil	4.74	4.70	4.72	4.76		
	Sediment	4.80	4.74	4.76	4.78		
	Change in pH	0.06	0.04	0.04	0.02	ns	0.103
% OC	Original soil	2.09	2.11	2.19	2.06		
	Sediment	2.48	2.45	2.34	2.42		
	ER	1.19	1.16	1.07	1.17	**	0.132
% TN	Original soil	0.18	0.19	0.19	0.19		
	Sediment	0.21	0.21	0.22	0.22		
	ER	1.17	1.11	1.16	1.16	**	0.012
P ppm	Original soil	6.70	7.20	6.30	6.80		
	Sediment	21.2	29.9	20.70	26.60		
	ER	3.16	4.15	3.29	3.91	**	4.83
K meq/100g.	Original soil	0.39	0.48	0.45	0.41		
	Sediment	0.58	0.56	0.59	0.56		
	ER	1.49	1.17	1.31	1.37	**	0.051

ns - pH of the eroded sediment was not significantly (P 0.05) different from that of the original soil
** - the nutrient levels in the eroded sediments were significantly different (P 0.01) from the nutrients in the original soil.

to the plot with pure stand of maize (61.7 t ha^{-1}), there were no significant differences (P 0.05) in soil loss between the treatments during the 1999 LR. This was because most of the rains in this season (94% of the rain) fell in the first 3 weeks of the season and upto 81% of the total soil loss occurred during this period when the percentage ground cover development was low. At the onset of the 1999 SR there was post-harvest crop cover from the previous season in the plots planted with legumes i.e. after maize harvest. Two weeks after the onset of the 1999 SR, soil loss was significantly different between treatments (P 0.05). The lowest (0.35 t ha^{-1}) and the highest (3.3 t ha^{-1}) soil losses were recorded from plots planted with maize plus mucuna and with pure maize crop respectively. This was attributed to the post-harvest crop cover provided by the green manure cover crops which in turn minimized soil losses during the onset of the rains of the 1999 SR.

Nutrients in sediments were compared with the original soil and the enrichment ratio (ER is the ratio of a plant nutrient element in the eroded sediment to that in the original “field” soil) was found to be greater than 1 for major nutrients, that is, organic C, total N, available P and K (Table 1). This indicated that soil erosion is a selective process that removes finest soil particles that are enriched with plant nutrients thus leaving the soil less fertile. The pH of the eroded sediments was slightly higher than that of the original soil, as the sediments were richer in nutrients than the original soil.

Conclusions and Recommendations

Soil and water management, based on proven conservation strategies, should be designed for the specific needs of smallhold farmers. Management practices that emphasize on soil organic matter and phosphorus replenishment and water conservation should be recommended for the study area. Biological soil conservation measures (such as cover crops) are more effective and less costly in controlling soil erosion than physical measures. However, further study is required to determine the effectiveness of combining biological and physical soil conservation measures.

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Acknowledgements

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COMPARISON OF GREENLEAF DESMODIUM AND MUCUNA AS SOURCES OF GREEN MANURE IN MAIZE PRODUCTION

J.N.Gitari and S.K.Karumba, K.A.R.I.-Embu RRC

Introduction

Maize is the main staple food for people in central Kenya highlands. In most farms maize is grown under continuous cultivation on the same piece of land. Many farmers do not use inorganic fertilizers and the levels of application are far below the recommended rates. The low usage of fertilizers is attributed to the high cost of commercial fertilizers. Low soil fertility is well recognized by farmers who single it out as the most important cause of low yields. The non-recycling of farm residues in the maize enterprise compounds this further. A net removal of plant nutrients is already evident from the decreasing yields of the maize after many seasons of continuous cropping. Animal manure which is a good source of plant nutrients, is rare because most farmers keep one or two head of cattle due to small land sizes. Another low cost alternative to commercial fertilizers and animal manure is nitrogen-fixing legumes as green manure.

A legume screening study was conducted at Embu Regional Research Centre (RRC) in 1995/6 to identify green manure legumes with potential for soil fertility improvement. Mucuna *(Mucuna pruriens),* a long-lived annual, was identified as a suitable candidate for green manuring (GM) for this area. Greenleaf desmodium *(Desmodium intortum),* a perennial legume, was introduced in the region primarily for feeding livestock. The study reported in this article compared the two legumes as a source of green manure to improve soil productivity in a maize-based cropping system in the upper midland agro-ecological zone (UM 2).

Methodology

The study was conducted at Embu, RRC in UM 2 which receives bimodal annual rainfall of 1200 mm with peaks in April and November. Planting was carried out during the long (March) and the short (October) rains seasons of 1997 and 1998 respectively. Maize, hybrid

512 was planted at a spacing of 75 cm by 30 cm. Both mucuna and greenleaf desmodium were planted in one and two rows between the maize rows respectively. An intra-row spacing of 25 cm was used for the two legumes. After establishment, desmodium regenerated from the already existing crop while mucuna was re-planted at the same time with maize. The size of the plots were 4.8 m long by 4.5 m wide. At the end of each season, maize was harvested from the three mid rows. Mucuna and desmodium legume herbage were cut and incorporated into the soil of their respective plots. The soil amendment treatments applied were; incorporation of mucuna and greenleaf desmodium residue, application of cattle manure at the rate of 4 t ha^{-1}, application of inorganic fertilizer at the rate of 20 kg ha^{-1} N and control (no fertilizer or legume applied).

Results

Biomass production of mucuna and desmodium intercropped with maize was about 2 t ha^{-1} in each seasons. During the 1997 cropping seasons, maize yield was higher in the manure and fertilizer plots than in the legume residue incorporated plots and the control plot (Table 1). However, results of 1998 cropping seasons were different. Highest maize yield was achieved where either mucuna or animal manure was used. Maize yield in the desmodium plots was similar to that of the control plot. Thus, intercropping maize with desmodium adversely affected the growth and development of maize plants. Maize in the desmodium plots appeared yellow at the earlier stages of plant growth.

Table 1. Effects of legume green manure, farm yard manure and inorganic fertilizer on maize yield at RRC, Embu.

Treatment	Maize grain yield (t ha^{-1})	
	1997	1998
Mucuna GM	3.0	6.3
Geenleaf desmodium GM	3.0	4.9
Cattle manure	4.8	6.7
Inorganic fertilizer	4.5	6.0
Control	3.3	5.1

Conclusion

Mucuna has proved to be a suitable legume for intercropping with maize. By contrast, greenleaf desmodium is not suitable for its is likely to compete for water and nutrients with maize. The results indicate that maize could be planted at the same time with mucuna without any adverse effect on yield of grain. The resultant legume herbage is incorporated prior to planting the subsequent crop of maize.

EVALUATION OF MUCUNA AND LABLAB AS A SUPPLEMENTARY FEED RESOURCES FOR KDPG IN SEMI-ARID REGION OF EASTERN KENYA

Njarui D.M.G and Wandera, F. (KARI, NDFRC-Katumani) and Muinga, R.W. (KARI, RRC-Mtwapa)

Introduction

Limited adoption of forage legumes in the semi-arid region of Kenya is attributed mainly to lack of seed and information on their utilisation and benefits. This study was therefore initiated to identify the benefits of these legumes as livestock feeds and assess the quality of the manure produced. The study was conducted at NDFRC-Katumani; 1600 m above sea level, and mean temperature is about 19.6^{o}C. Sixteen Kenya Dual-Purpose Goat (KDPG) bucklings were used for the study. They were stratified according to live weight into four groups. The treatments consisted of basal diet (hay made from natural pasture) without supplementation, basal diet supplemented with either mucuna fodder, lablab fodder or leucaena leaf meal.

The total daily dry matter requirements for individual goat was taken as 3.5% of its body weight. Legume supplements were offered at a rate of 30% of total daily requirement and this amount was adjusted weekly with changing body weight. All the goats had free access to mineral block licks and water was provided *ad-libitum*. Stall group feeding was conducted in a randomised complete block design. Data was collected for 84 days between June and September 1999 during which the goats were weighed weekly (fasting weight). Faeces were collected in the morning before feeding and watering during the last 7 days of the experiment for quality analysis.

Table 1. KDPG buckling performance from four fed supplementation

Attribute	Basal diet supplemented with mucuna	Basal diet supplemented with lablab	Basal diet supplemented with leucaena	Basal diet (control)	P<0.05
Number of goats	4	4	4	4	
Experimental period (days)	84	84	84	84	
Final average weight (kg)	19.88	19.75	21.50	17.75	
Initial average weight (kg)	18.75	18.12	18.62	18.38	
Average daily weight change (g)Ns	13.39	19.34	34.23	-7.44	Ns
Total weight gain/loss(kg)	1.13	1.63	2.90	-0.6	Ns

Basal diet consisted of a mixture of buffel grass, themeda, Rhodes grass and star grass
Ns- not significant

Table 2. Composition of manure from goat fed mucuna, lablab, leucaena leaf meal and grass hay.

Feeds	Composition (%)				
	N	P	K	C	C:N
Mucuna	1.45	0.18	0.41	45.3	31:1
Lablab	1.34	0.45	0.69	37.0	28:1
Leucaena	1.61	0.14	1.13	41.5	26:1
Grass hay	0.96	0.15	0.57	42.1	44:1

Results and discussions

Average daily weight gain and total weight gain for goat supplemented with mucuna and lablab were similar and were not significantly different from the control (Table 1). Goats supplemen-ted with leucaena had a higher weight gain than those supplemented with lablab or mucuna but were not significantly different ($P< 0.05$). However goats fed on hay alone lost weight and therefore total weight change at end of experiment was negative. The lack of significance difference on weight changes between goats supplemented with legume and those fed on grass alone was not as expected and it is difficult to explain.

Manure from the goats supplemented with lablab and mucuna had almost similar amount of N, but P and C content were different, with manure from goat fed on mucuna having high C and hence higher C: N ratio (Table 2). Manure from leucaena was of better quality compared to the other legumes. Goats fed on grass alone produced manure of low N and high C, which is likely to take longer time to decompose due to the high C: N ratio.

From the results it is clear that legumes can be a valuable supplement to goats and the manure produced when they are fed to goats is richer in N and often it is of better quality for growing crops than manure produced by goats fed on grass hay alone.

IS BLACK-SEEDED MUCUNA MORE TOLERANT TO DROUGHT THAN THE CREAMY SEEDED MUCUNA?

Clotilda Nekesa and Joseph G. Mureithi,
KARI-NARL

Mucuna *(Mucuna pruriens)* has been identified by the Legume Research Network Project (LRNP) as a promising species for green manuring in many parts of the country (LRNP Newsletter Issue No.1). It grows vigorously and can be a good cover crop on steep slopes and can smoother obnoxious weeds like couch grass and striga. The Network has been using creamy seeded mucuna whose origin can be traced back to Honduras. Dr. C.K.K. Gachene of University of Nairobi had obtained some mucuna seeds from CIDDICO in Honduras in early 1990's and bulked them at University farm in Kabete. When the Network undertook a countrywide green manure cover crop screening trial in 1995 he supplied some of the initial mucuna seeds. The Network got more mucuna seeds from other sources (e.g. CIAT Uganda) which included both the light coloured and black-seeded types. However, the screening study used mainly creamy seeded mucuna. So, little is known on performance of black-seeded type in the network sites.

In 1999 black-seeded and the creamy-seeded mucuna were planted along side each other for bulking at the NARL Network site. They were established on 50 x 20 m plot each and their performance monitored. The soils at the site are Nitisols which have an acidic pH of 5.3 and are low in organic carbon (1.5 %), Nitrogen (0.15%) and P (30 ppm) content. The legumes were planted on 20/4/99 after on-set of the long rains at a spacing of 30 x 60cm. Phosphorus was applied at the rate of 20 kg P ha^{-1} in form of triple super phosphate fertilizer.

After planting rainfall was very low and poorly distributed (Figure 1). Germination percentage assessed two weeks after planting was poor but was higher for black-seeded mucuna (60%) than for creamy-seeded one (40%). Gapping was done on 4th and 5th of May 1999 for creamy and black-seeded mucuna, respectively. After gapping the rains decreased drastically and the gapped seeds did not germinate. The drought conditions continued for six months up to early November 1999 when the short rains started (Figure 1).

After the short rains most of the gapped seeds germinated but the most notable observation was that black seeded mucuna grew more vigorously than the creamy seeded type; a month after the rains it had accumulated more biomass than the creamy type. The photograph shown in Figure 2 was taken on 7th December and it can be seen that mucuna black had better ground cover and more biomass than the creamy type. This was confirmed by biomass yields taken on 10th February 2000, ten months after planting the mucuna. Black-seeded mucuna yield 3100 kg DM ha^{-1} compared to 2500 kg DM ha^{-1} of the creamy type. The amount of seed harvested and threshed

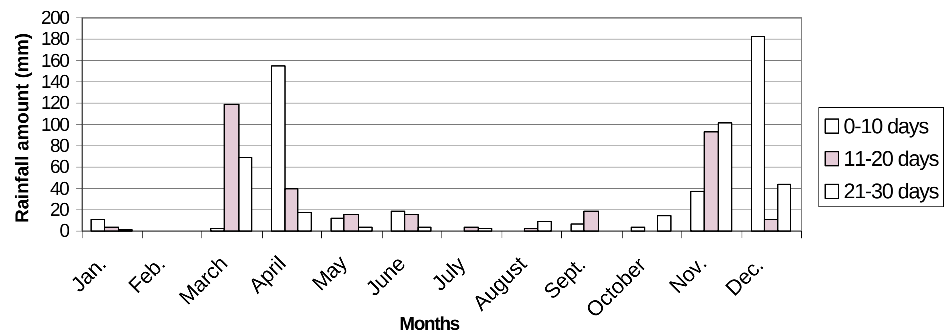

Figure 1: NARL-Kabete rainfall distribution for 1999

by March this year was again higher for black seeded-mucuna (12 kg) than for creamy type (6 kg).

Although in their review Buckles *et al.,* (1998) pointed out that *Mucuna spp.* exhibit reasonable tolerance to a number of abiotic stresses, including drought and low soil fertility, the observations made here strongly suggests that different mucuna species and varieties respond differently to abiotic stresses. The extent to which legumes recover following a drought is an important parameter that should be seriously considered during legume screening trials. We therefore suggest that coordinated trials be undertaken to evaluate tolerance of

Black- seeded mucuna **Creamy-seeded mucuna**

Figure 2: Photograph of black-seeded and creamy-seeded one month after the onset of the short rains in November 1999

different mucuna species and varieties to drought and other stresses like high soil acidity in all Network sites.

Reference

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FACTORS AFFECTING THE PRODUCTIVITY OF THE GREEN MANURE LEGUME, LABLAB PURPUREUS, IN TRANS NZOIA DISTRICT, KENYA

Beth A.M. Kirungu, Environmental Action Team (EAT), Kitale, Kenya

EAT and its farmers have developed a legume green manure system to increase Trans Nzoia small-scale farmers' maize production (see Feb. 2000 issue of Legume Research Network Project Newsletter). The drought tolerant legume, *Lablab purpureus* (Kikuyu: njahi; English: hyacinth bean), is planted in August, grows through the dry season, and is incorporated into the soil, in April, 7 days before planting a subsequent maize crop. It is estimated that farmers need at least 2.0 t of lablab dry matter per hectare in order for the residues to have a significant impact on the yield of a subsequent maize crop. Legume dry matter yields of 4-7 t ha^{-1} are even more desirable, as this results in maize yields as good as or better than the recommended rate of inorganic fertilizers. This article discusses the environmental and management factors that have had a significant impact on lablab productivity in the region.

Rainfall during green manure establishment

Lablab is severely affected by damping off *(Pythium spp.)* if it is subjected to frequent rain within the first 4 weeks after sowing. In normal rainfall years, rainfall intensity usually peaks during the months of July and early August and decreases towards the middle-end of August, when the lablab should be sown.

Rainfall between November and March

Rainfall patterns between November-March have an especially significant impact on the quantity and quality of lablab residues. Approximately 230 mm of rain normally falls between November and March, with at least 21 mm in each of the 5 months. Seasonal variations of this pattern over the past 5 years have enabled us to observe how the legume responds to different rainfall patterns. Under "normal" or wetter than normal conditions, the mean on-farm lablab production ranged from 4-7 t DM ha^{-1} and the legume residues were comprised of a higher proportion of higher quality materials (leaves and tender stems). In the drier years, when there was no rain in December, January and February, mean on-farm lablab dry matter production ranged from 2-4 t DM ha^{-1} and the lowest quality materials, woody stem and litter, predominated. However, when several substantial showers occurred towards the end of the dry season, the plants started to regrow. (Regrowth is highly desirable since the new leaves and stems have a much higher N content than woody stem or litter- 3-3.5 % N vs. 1-1.5 %N- and this significantly improves the quality of the residues available by maize planting time in April.)

Soil chemical properties

In August 1999, more than 120 farmers planted a lablab green manure crop. As would be expected, there was a lot of variability in lablab performance across farms. We were especially interested in those cases where the lablab performed poorly (1-2 t DM ha^{-1}) despite good stand establishment and farmer management. Although not all of the soil tests for these cases have been completed, the available results suggest that poor legume performance may have been related to low soil pH (5.0 and below) and calcium and/or magnesium deficiencies.

Position on the slope

During a drier than normal year, where lablab was planted at different positions on a slope which led down to seasonally water-logged area bordering a river, dry matter production ranged from 1-4 t DM ha^{-1} near the top and middle of the slope compared to 4-10 t DM ha^{-1} near the bottom of the slope. Although soil types were noticeably different along this gradient, we suspect that the height of the water table also had a significant effect on lablab productivity.

Cultivar selection

There are both determinate and indeterminate lablab cultivars. Determinate cultivars normally complete their life cycle in 4 months and produce less dry matter. Since the targeted growing period is 7-8 months, determinate types are unsuitable for use as a green manure in the region. In Kenya, black seeded lablab cultivars with purple flowers are the most commonly available. Indeterminate black seeded cultivars produce a substantial amount of leafy biomass, which is a desirable characteristic for a green manure species. Although black coloured lablab seed is widely available in Kenyan markets, it is impossible to tell the difference between the determinate and indeterminate types on the basis of the seed's appearance alone. The indeterminate cultivar called 'Rongai', which has tan-brown seeds and white flowers, is also a suitable cultivar for green manure use. We have used it most frequently in our trials due to it's superior seed production in the area. However, in Kitale, 'Rongai' tends to produce more grain than herbage in a dry year. Therefore, a mixture of a more vegetative, black seeded indeterminate type and the brown seeded Rongai might be the ideal green manure mixture.

Time of planting

The optimum time for planting the green manure is between August-early September, approximately 120-140 days after planting the maize. The earliest plantings have produced the highest dry matter yields and yield losses of more than 1 t DM ha^{-1} have been observed in September compared to August planted lablab stands.

Green manure relay crop vs. green manure 'pure stand'

When planted on the same day, lablab relayed into an existing maize crop generally produces 1-2 t DM ha^{-1} less than lablab grown as a 'pure stand'.

Shade

When the green manure legume is relayed into an existing maize crop, the degree of shadiness at the soil surface, as well as movement through the field during maize harves-ing, both affect legume productivity. It is better to relay the lablab into maize planted early in the season (late March-early April) than into maize planted late (late April-May). The lower leaves of the early-planted maize will normally have started to dry up by August, whereas they will still be green in late-planted maize. Adequate light penetration is essential for good lablab growth and establishment. When there is too much shade inside the maize canopy, farmers must incur extra labour costs to manually remove the lower maize leaves.

Trampling

Farmers must avoid trampling the legume during maize harvesting as this drastically reduces dry matter production. One can either leave unplanted rows in the field as a place for arranging the maize stooks or leave the maize to dry *in situ* without stooking it. In the latter case, farmers would lay down the stovers as mulch between the lablab rows once they have harvested the cobs.

Spacing/ plant density

Within row spacing for both relayed and pure stand lablab is 25 cms with 2 seeds per hole. For a relayed lablab crop, planting one line of lablab between two lines of maize has given good results in wet years but not in dry ones due to the legume's slow establishment.

Farmers were able to go from producing 2 - 4 t DM ha^{-1} by sowing two lines of lablab between the maize instead of one. The two lines should be 30 cms apart. Between row spacing can be 60, 45 or 30 cms in a pure stand. The 60 cm spacing should be used when planting cowpeas between the lablab lines.

Weed management

Because lablab is slow growing at Kitale's higher elevations, two timely weedings are critical for optimizing dry matter production. A farmer who performs two timely weedings will be able to produce more than twice as much lablab dry matter as one who is either late to weed or fails to do the second weeding at all.

When lablab is grown as a pure stand, farmers can reduce the overall weediness and increase the benefits of timely weedings by sowing a row of cowpeas between the lablab lines. The cowpeas, which establish more quickly than the lablab, are removed just before the lablab canopy closes and sold as a vegetable.

Livestock

In areas where farms are not fenced and livestock are prevalent, lablab fields need to be protected from grazing. In an on-station experiment dealing with legume residue management, the maize yields where the above ground legume biomass was removed one month before planting subsequent maize, to simulate grazing, were not significantly different from maize yields where the legume had not been planted at all.

Table 1: Green manure legumes and sites where planted

Legume species	Common name	Where distributed
Canavalia ensiformis	Jackbean	All sites*
Crotalaria juncea	Sunnhemp	Grail Maseno, Kima
Crotalaria ochroleuca	Tanzanian Sunnhemp	Subukia, Lunga Lunga
Lablab purpureus cv Rongai	Njahi	Ortum, Kipsaraman, Tigania
Macroptilium atropurpureum	Siratro	Ortum, Kipsaraman, Lunga Lunga
Mucuna pruriens	Mucuna	All sites
Neotonia wightii	Glycine	Subukia Tigania
Phaseolus lunatus	Lima bean	Busia, Ortum, Kipsaraman

* - Lunga Lunga, Tigania, Subukia,, Kipsaraman, CREP Programme-Muhoroni, Kima,, Grail Maseno, Busia, Ortum and RODI-Kisumu.

RESOURCE ORIENTED DEVELOPMENT INITIATIVES (RODI): EXPERIENCES WITH GREEN MANURE LEGUMES

For close to ten years RODI and its partners have been promoting organic sources of nutrients for soil fertility improvement. These have mainly included practices such as composting and farm yard manure. However a review conducted in 1997 reported that majority of farmers cannot afford to apply 10 t ha^{-1} of farmyard to their maize field as recommended because it was not available. This review recommended several other soil fertility improving strategies which included planting more agroforestry trees on the farms and introduction of green manure legumes into the cropping system. RODI came to learn about the work of LRNP from one of its members the Environmental Action Team (EAT) based in Kitale. RODI approached the LRNP Co-ordinator for literature on green manure legumes and seeds of legumes suitable for different agro-ecological zones in Kenya. The Network provided the seeds and guidelines for their establishment.

The seeds were distributed to RODI partners who are spread all over the country. They include Lunga Lunga ICDP (Kwale), Tigania IDP (Nyambene), Subukia CBHC (Nakuru), Kipsaraman IDP (Kabarnet), CREP Programme (Muhoroni), Kima CBHC (Vihiga), Grail (Maseno), Busia YMCA (Busia), Ortum PHC (West Pokot) and RODI (Kisumu). The partners planted the seeds during the long rains of 1999 mainly for demonstrations purposes. Table 1 shows the green manure legumes species that were provided and the sites where they were established.

The partners were to monitor growth and make observations on the following aspects: emergence, seedling vigour, percentage ground cover at 4 and 8 weeks, nodulation at 8 weeks, phenology and growth habit, pest and diseases. The key observations and farmers reaction to legumes are presented below.

The lima bean though seeming to do well in terms of germination, establishment and flowering was attacked by a coleopteran insect identified by extension workers as the Diamond fly. It was suspected to cause the abortion of the flowers but interestingly the plant had produced numerous flowers. In Muhoroni and Subukia there was total failure of green manure legumes at the germination stage due to drought. There were high expectations on the performance of the crotalaria, a legume whose relatives are quite well known, mainly as a vegetable, but it performed poorly in terms of growth vigour and dry matter production. Neotonia and siratro did not do well at all; they had poor germination, poor growth and almost no seed was harvested.

The green manure seed yields were very high in Lunga Lunga, 10 kg for Mucuna and 19 kg for Jack bean. The other sites averaged a maximum of 6 kg.

In Ortum and Tigania there was a lot of enthusiasm over dolichos because it is edible and produces high biomass. The farmers have already replanted the seeds again. It was hard to convince some farmers in Busia to plant jack bean and mucuna when they heard that the seeds are not edible. Jack bean in Busia was eaten by moles despite the fact that it is famous for controlling this rodent.

Interestingly mucuna is not so new in Maseno as the farmers have already encountered the ‘wild’ varieties and have used them before for beverage, soil fertility improvement and fodder. In all the projects Mucuna proved to be the best in terms of growth vigour, biomass production and ground cover.

EVALUATION OF HERBACEOUS LEGUMES FOR SOIL FERTILITY IMPROVEMENT IN MAIZE/CASSAVA PRODUCTION SYSTEMS IN COASTAL LOWLAND KENYA

(Michael N. Njunie, KARI, RRC-Mtwapa,

Introduction

Maize and cassava are the most important staple food crops in coastal lowland Kenya. They are often grown as intercrop and often include a legume, mainly cowpea. The average yield of the maize and cassava are low. The main constraints to farming include low soil fertility: low N and P contents, low organic matter, CEC and water holding capacity. Erratic rain-fall distribution is also a major constraint to farming in the region. Legumes have potential to improve soil fertility through biological nitrogen fixation and the recycling of nutrients through the use of legume foliage as green manure and / or ground surface mulch.

Past research results of legume screening for fodder and soil fertility in coastal Kenya identified *Clitoria ternatea* (clitoria) and *Lablab purpureus* (dolichos) among the most productive herbaceous legumes. Dolichos produced high foliage dry matter yields (DM). Clitoria, though not as high yielding as dolichos showed good nitrogen fixing characteristics. However, information on the compatibility of these legumes as intercrop with the main staple food crops (maize and cassava) is scanty. This study evaluates the effects of legume management strategy (harvesting frequency and stage of development) of annual and perennial forage legumes on:

a) Biomass and nutrient accumulation of legume residue
b) Rate of nutrient release from legume residue
c) Availability of residue derived nutrients to maize and / or cassava.
d) Soil water availability during the cropping season

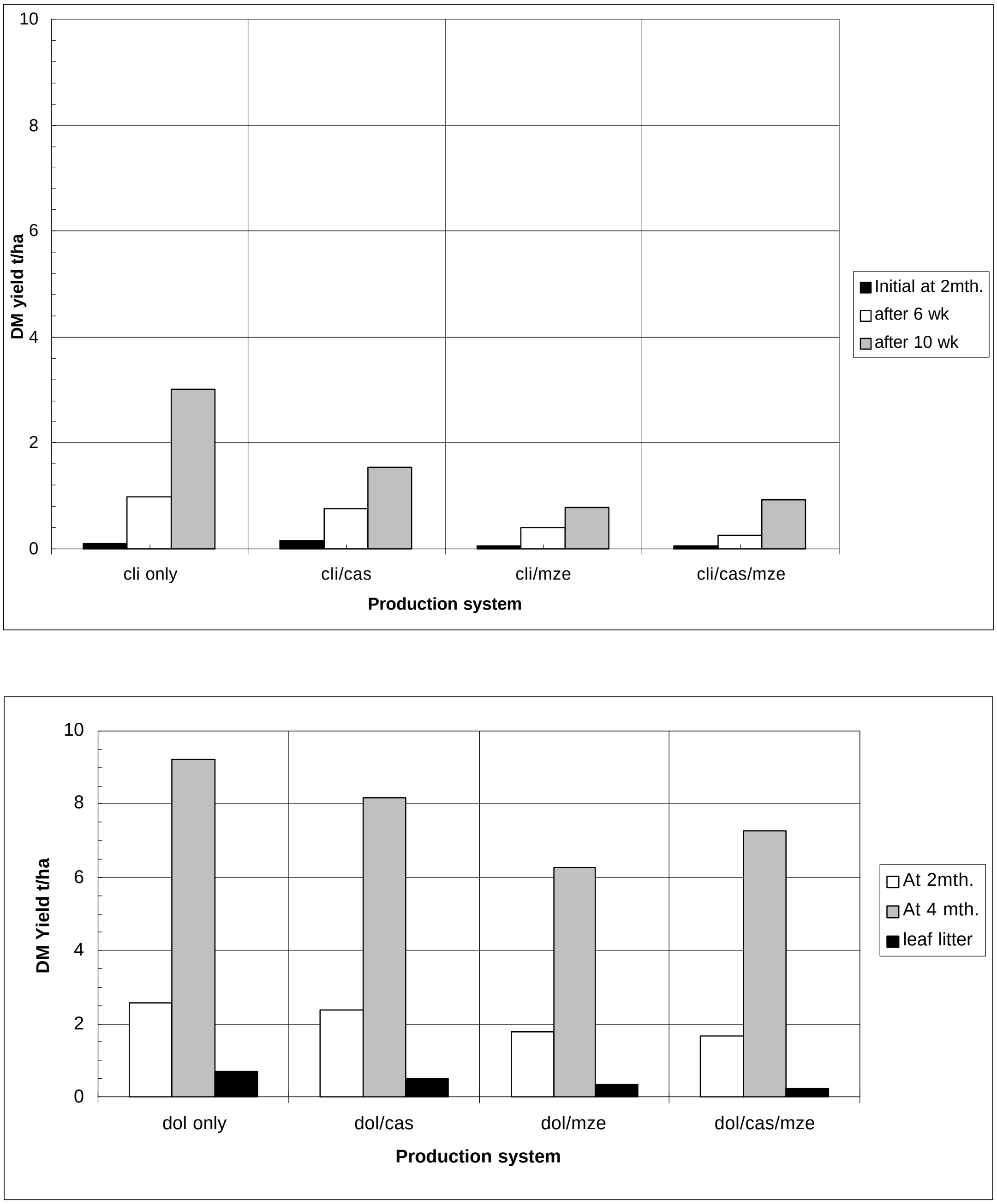
Preliminary results for the legume establishment and biomass production, and the maize grain and stover yields for the first season are hereby reported. Other data collected requires further analysis and synthesis and may be reported in latter LRNP newsletter issues and / or other forums.

Materials and methods

The study is being conducted at the Kenya Agricultural Research Institute, Regional Research Centre, Mtwapa (RRC Mtwapa). The centre is within the coconut / cassava agro-ecological zone (semi-humid with bimodal annual rainfall of 1050-1230mm). The dominant soils are orthic ferralsols, which are well-drained sandy loam to sandy clay loam. The soils are low in organic matter and major plant nutrients, especially N and P. Two experiments are being carried out concurrently. The first experiment is evaluating the perennial forage legume clitoria in monoculture or as an intercrop with maize, cassava or cassava / maize. After planting, the legume foliage is harvested initially at 2 months growth stage and at 6 or 10 weeks after the initial harvest. The harvested foliage is applied on the ground as surface mulch and, after mineralization, is expected to release nutrients to maize and cassava plants. The design is split-plot, where production systems (i.e. monoculture of legumes, maize and cassava, and combinations of legume with maize and / or cassava) are main plots. The legume harvesting management (every 6 or 10 week) are subplots. Control treatments include application of recommended commercial fertilizer rates to maize, cassava and maize / cassava or no fertilizer or legumes grown. The design of second experiment is similar to the first one but evaluates the annual legume dolichos and legume harvesting frequency at 2 and 4 months after planting the legume. Data collected include yield of above ground biomass (maize, cassava and legume), nutrients removed by the crops and legume, mineralization of legume biomass and ground cover. Soil data include pH, inorganic N, P, K, organic C, soil moisture and soil bulk density. The two experiments were successfully established during the 1999 long rain season. Maize was planted first, then the legumes after maize germination. Cassava was planted one month after planting the maize. Planting of maize, legume and cassava were done concurrently for the two experiments.

RESULTS HIGHLIGHTS

The long rain season precipitation was well distributed and adequate for the growth of maize, legume and cassava. As expected, the legumes in the two experiments exhibited different rates of growth. After planting, dolichos germinated first and covered the ground quickly. Clitoria's establishment was slow and hand weeding was done to avoid smothering of clitoria by aggressive weeds. At 2 months after planting, clitoria and dolichos were well established. Clitoria was weeded three times compared to 2 weeding done on the dolichos plots. The overall mean biomass production irrespective of treatment at 2 months was 0.09 and 1.87 t ha^{-1} for clitoria and dolichos, respectively. The legume DM yields were influenced by the production system and harvesting strategy (Figure 1).



Key: cli-clitoria, dol-dolichos, cas-cassava, mze-maize, wk-week and mth.-month

Figure 1: Foliage production from forage legumes grown in monoculture intercropped with maize and/or cassava in coastal lowlands Kenya:

The monocropped legume produced highest dry matter yield. Compared to cassava, maize appeared to cause more declines in yield of the forage legume DM yield. This would imply that less surface mulch was available in the maize / legume production systems.

Table 1: Effect of legume and cutting dates of the legume on yield of maize grain and stover (t ha^{-1})

Clitoria ternatea

Production system	No legume or commercial fertilizer control	Clitoria first cut at 2months and then after 6wk	clitoria first cut at 2 months and then after 10 wk	Commercial fertilizer applied
Maize	3.74(1.6)*	4.63(2.17)	4.70(2.04)	6.10(2.6)
Cassava / maize	3.14(1.8)	3.22(1.8)	2.25(0.79)	3.34(1.4)

Lablab purpureus

Production system	No legume or commercial fertilizer control	Dolichos cut at 2 months	Dolichos cut at 4 months	Commercial fertilizer applied
Maize	2.81(1.90)	2.06(1.36)	1.46(0.71)	5.0(3.19)
Cassava / maize	1.88(1.08)	1.30(0.92)	1.16(0.88)	2.40(1.26)

* Figures in parenthesis are the maize stover dry matter yields

The presence and management of legume affected maize grain and stover yields (Table 1). The maize monoculture production system that was supplied with commercial fertilizer gave the highest grain and stover yields. However, the yield response to fertilizer application was less drastic where maize was intercropped with cassava. The lowest grain and stover yields were obtained from the control plots where legume mulch and / or fertilizer were not applied. Lower maize grain and stover yields were obtained in all production systems with cassava as an intercrop. This was partly due to the higher maize plant population in maize monoculture plots. Cassava replaced about 50% of the maize plants in the harvested net plot but the decline in grain and maize stover yield was only 32%. This showed that the individual maize plants performed better when intercropped with cassava than in monoculture systems.

During this first season, intercropping maize with clitoria led to higher maize grain and maize-stover yield. Maize grain yield obtained in clitoria subplots that were harvested at 2 months and then after 6 or 10 weeks was about 27% more than the control maize monoculture plots with no legume or fertilizer inputs added. However, the maize grain yield obtained in the maize-cassava-clitoria production system was lower, especially when clitoria was harvested at 2 months and subsequently later than 6 weeks (10 weeks). Similar trends were also observed for the maize stover dry matter production. It appears that clitoria harvesting management becomes important when cassava is included in the production system. In cassava / maize production system where clitoria was 10 weeks after the initial cut at 2 months, the maize and stover yields were 30 and 57 % lower compared to the plots with clitoria after six weeks.

Effect of dolichos

Despite the high foliage dry matter produced by dolichos, intercropping of maize and lablab led to lower maize and stover yield. Maize grain yield obtained from maize dolichos production systems was about 27 and 48% lower than control when dolichos was cut at 2 and 4 months after planting respectively. The lowest maize grain yield was obtained where dolichos was intercropped with maize/cassava and dolichos cut delayed to 4 months after planting.

Conclusion

These preliminary results indicate that the systems studied and legume management strategy of the perennial and annual legumes influenced the maize grain and stover production.

However, final conclusions will be drawn after incorporating yield data of short rain maize crop and cassava, and after the synthesis plant and soil analysis results.

* The research work is funded by a Rockefeller Foundation grant as part of the Ph.D. dissertation research in soil science; the complete study will be presented to the Soil Science department of North Carolina State University (NCSU), U.S.A.

LEGUME RESEARCH WORK AT THE COAST: THE CASE OF A MOTIVATED FARMER

M.B Muli and H.M Saha KARI, RRC-Mtwapa

The LRNP on-farm activities started during the long rains of 1998 and farms were selected from two main clusters: Rabai in Kaloleni division of Kilifi district and Mavirivirini in Samburu division of Kwale district. The Mavirivirini cluster was divided into two sub-clusters: Mwashanga and Kadzandani. In the Mwashanga sub-cluster, six farmers were selected to implement both the integrated nutrient management (INM) and cowpea trials.

Among the Mwashanga farmers is a Mr. Zani Mgalla, popularly known as Zani. This farmer is about 50 years old. He is married to one wife and the couple has six children: four sons and two daughters. Two of these children, a son and a daughter, are grown up and are engaged in casual employment in Mom-basa. Zani and his wife provide most of the labour on their farm. The major food crops grown by the couple are maize, cassava and cowpea. The couple also grows groundnut for sale. In the early 1950s, the young Zani went to primary school but, for some reasons, he could not go beyond class three. Through hard work, he has learnt to write in Kiswahili and can also read numbers and simple English words. He has two children in primary school: one in class six and the other in class three. Zani’s class three child, known as Ndurya, is often out of school because of nonpayment of fees. Despite the many interruptions, Ndurya still does well in his exams.

Throughout the time we have interacted with him, Zani has shown a lot interest in the technologies being tried on his farm. He has gained a lot of technical knowledge within the short period the LRNP has been in operation in the sub-cluster. During the short rains of 1999, Zani arranged for the harvesting of cowpea experimental plots at all the farms in his sub-cluster. The harvest from both the net plot and the outer rows were kept separately and were very well labelled. Zani also visits all the other farms in his sub-cluster, and occasionally the entire cluster, to monitor progress of the trials. On several occasions, he has sent notes to us to report progress of the trials and any problems that need our urgent attention. Zani also organizes for the control of maize stalkborer and spraying of cowpea on experimental plots.

At the start of the long rains this year, Zani demonstrated yet another skill he has learnt from us. When we went to his farm to plant the trials with him, we were surprised to find that he had already laid out his INM and cowpea trial plots. In addition, he had also planted a whole cowpea experiment using seeds from the previous season's harvest. Through such efforts, Zani has contributed a lot in cutting down the time we spend in his sub-cluster. What impresses us most about Zani is the way he has displayed leadership qualities. He is a member of the committee that runs the primary school attended by his children. He has managed to organize the other participating farmers into a social group, which moves from one farm to another carrying out some farm activities such as planting and harvesting. He once mobilized his group to tour our Centre to familiarize with the on-going research activities. Because of his good leadership Mwashanga on-farm trials have been more successful than those of the other sub-cluster. No farmer has ever dropped out of the project in Mwashanga instead three new farmers have joined the project.

Zani has encouraged neighbouring farmers to visit the trials and learn something about the technologies being tried. On two occasions, we found him explaining to a neighbour about the trials on his farm. It is through such visits that a number of his neighbours acquired the cowpea varieties being tried on-farm. Zani would rather give out seed of the improved cowpea to interested neighbours than save it for his home consumption. During the recent assessment of the potential for the adoption of LRNP technologies, Zani played a crucial role in explaining to non-participating farmers the purpose of the exercise. He elaborated questions, both in Kiswahili and in his vernacular, whenever he felt that a farmer had not understood. Early in the long rain season, Zani organized his fellow farmers to purchase some insecticide, when the chemical we had provided run out. If only we had many Zanis in the coastal region, on-farm research would not only be enjoyable but also cheap!

PHD RESEARCH PROPOSAL

Effects of Secondary Plant metabolites in Tropical legumes on the Utilization, Excretion and Decomposition of Nutrients Consumed by Ruminants

David M. Mbugua: Ithaca, New York 14853

Alleviation of the perennial food shortages in Africa will require an understanding of the root-causes and identification of sustainable remedies that can be readily adopted by farmers. Soil fertility degradation has been identified as an important factor affecting both crop and livestock productivity. Integrated nutrient management (INM) is envisioned as a means to improve food productivity at both farm and watershed levels. Increased use of legumes and adoption of mixed crop-livestock production for better nutrient cycling will form part of the INM strategy, particularly in the sub-humid and highland areas of Africa. It is envisioned that as population pressure increases on a fixed land resource, people will move from specialized crop and livestock production systems to mixed crop-livestock systems. The latter systems are viewed as more efficient and sustainable ways of food production due to complementarities between crops and livestock. However, to realize high productivities on the mixed crop-livestock systems, there will be need for increased use of improved technology (superior germplasm, integrated pest management) and increased use of inputs (organic and inorganic fertilizers). This will entail increased use of leguminous plant species.

While the importance of increased legume use is well known (e.g. nitrogen fixation, higher crude protein), little information is available on the consequences of the presence of anti-nutritive factors in these plants on their feed and manure value. Most of the tropical legumes contain mixtures of anti-nutritive factors such as tannins, alkaloids, lectins, saponins and enzyme inhibitors like antitrypsin. These compounds play an important role of protecting these plants against herbivory. Our goal in the proposed studies is to better understand the interactions between tannins and alkaloids in forage legumes and their implications on feed utilization by ruminants and on decomposition in the soil of manure from these animals. This information will be important to farmers feeding or intending to feed mixtures of these legumes to their livestock and thus predisposing them to the negative effects of the anti-nutritive factors. It will also be important in modeling nutrient use and excretion by ruminants and study of the dynamics of nutrients decomposition in soils.

To achieve the above-stated goal, studies with the following objectives will be carried out:

(1) Determine the effects of interactions between tannins and alkaloids on the rates and extents of digestion of various feed fractions in tropical legumes;

(2) Explore the effects of interactions between tannins and alkaloids on feed intake, rumen metabolism, feed digestibility and nutrient excretion by ruminants;

(3) Study the mineralization patterns of animal manures, feeds and their combinations containing different levels of tannins and alkaloids, in tropical soils and

(4) Study the effects of litter bag pore size on decomposition of animal manure, feed and their combinations incubated in soils.

The first part of the studies will aim to characterize the types of tannins, alkaloids and other phenolic compounds in various tropical forage and shrub legumes that have potential for use by livestock and as green manures in Kenya. The effects of the presence of these chemical compounds on the extent and rate of degradation of various feed fractions will be studied using in vitro systems. Data on rates of degradation will be used to model the effects of the presence of anti-nutritive factors in feeds on microbial protein synthesis, milk production and nutrient excretion using the Cornell Net Carbohydrate and Protein System (CNCPS). Using well-known tannin-containing and alkaloid-containing forages, the effects of interactions between these compounds on rumen metabolism, nutrient utilization and excretion will be studied *in vivo* using sheep. Animal manure is an important factor in African agriculture and in many parts of the world. We intend to study the consequences of the presence of tannins and alkaloids on manure quality by assessing their nutrient content and ability to release such nutrients in the soil. The effects of mixing such manure and feed materials, a practice common with many farmers in Kenya, on nutrient release will also be studied. The expected outputs from the research are presented here,

1. Information on nutrient and secondary plant metabolites content of tropical legumes commonly used for feeding livestock and as green manure resources in Kenya.

2. Information on the implications of the presence of tannins and alkaloids in forages on forage rumen degradation parameters (rates and extent of degradation).

3. Information on the consequences of the presence and interaction of tannins and alkaloids on feed intake, nutrient utilization and excretion by ruminants.

4. Information on manure decomposition in the presence of tannins and alkaloids.

5. Information on the effects of using litter bags with different pore sizes on manure decomposition.

6. Information on the impact of the presence of anti-nutritive factors in forages on rumen ammonia balance, peptide balance, micro-bial protein synthesis and animal production based on simulations using the tropical version of the Cornell Net Carbohydrate and Protein System (CNCPS).

7. Some recommendations on appropriate use of fodders containing different anti-nutritive factors.

BOOK REVIEW

Soil Fertility Management Handbook for Extension Staff and Farmers in Kenya Authored by

S. Kanyanjua, J.G. Mureithi, C.K.K. Gachene and Saha H.M.

Reviewed by Peter N. Macharia (KSS)

Background

The Handbook was developed by the Legume Research Network Project of KARI and addresses the key topic of soil fertility management in respect to small holder agriculture in Kenya for enhanced crop and livestock production. This was after most rural appraisal exercises conducted to assess constraints to small holder agriculture in Kenya identified soil fertility decline as among the most important constraints.

Objective of the manual

To provide basic, simple information about soils and their management in order to maintain or improve their fertility.

Target group

The information in the handbook is targeted to front-line extension workers, farmers with elementary education, NGOs involved with soil management and secondary schools' agriculture classes.

Chapter 1: Composition and Formation of Soils

This chapter covers the composition of soils in terms of mineral and organic components, the soil formation process through weathering and the factors influencing soil formation and how they interact. These factors are parent materials, climate, topography, plant and animal life in the soil, time and man through land use activities. Lastly, the chapter deals with soil physical properties i.e. texture, structure and colour.

The information presented is basic and very useful to the target groups as they can easily understand the soil forming process and the factors influencing soil formation. The information is also important particularly to the farmers who usually differentiate their soils mainly in terms of soil physical properties (texture, structure and colour). It is also important for the farmer to understand how long it takes to regain an inch of soil lost from his farm through erosion after reckless farming practices.

Chapter 2: Soil Fertility

The chapter begins with highlighting the parameters that soil scientists use to measure soil fertility. These are soil pH (acidity or alkalinity), plant nutrients (major nutrients and trace elements) and soil organic matter. The chapter describes further the function of the major nutrients (N, P, K) in the plant, the symptoms that manifest on the leaves when each nutrient is in low or excessive supply; basic information which is very essential to the farmer and extension workers.

Section 2.5 further enumerates the factors that contribute to declining soil fertility e.g. leaching, use of wrong fertilizers and erosion. Section 2.6 describes how farmers can diagonise soil fertility status through observation of soil colour, crop performance and plant indicators e.g. some weeds. The other method is through laboratory analysis whereby recommendations given provide guidance to the farmer on the correct fertilizer type and rates to apply. Section 2.7 gives guidance to the farmer on first hand detection of nutrient disorders (deficiencies or toxicities) that manifest themselves through leaves, stems, roots or declining crop yields.

Section 2.8 deals with maintenance of soil fertility through traditional methods, application of fertilizers and through good husbandry practices. The section also highlights the advantages of mixed cropping systems by the farmer since different species remove different soil nutrients and from different rooting depths.

The chapter ends with a coloured illustration of nutrient deficiency symptoms in maize leaves, which is a very useful method to extension workers and farmers as a simple way to detect major nutrient anomalies in maize.

Chapter 3: Inorganic Fertilizers

Inorganic (chemical) fertilizers are either natural or synthetic. Section 3.3 highlights the need to diagonise the fertility status of the soil for the farmer to apply the correct grade of fertilizer to avoid high costs and wastage. Section 3.4 dwells on the type of fertilizers i.e. nitrogen, phosphate, potassium and compound fertilizers common in the Kenyan market and the crops that are best suited for the various grades of fertilizers.

Section 3.5 provides useful information to the farmer on the timing and placement of fertilizers for maximum utilization by the crops. The reason is that nitrogen fertilizers behave differently from the phosphate and potassium fertilizers once they are applied in the soil. The nitrogen fertilizers are immediately converted to other forms which are lost quickly through leaching or in gaseous form and they should be applied when the crops needs them e.g. after emergence as a topdress.

Chapter 4: Organic Manures

This chapter is about organic manures such as farmyard manure, compost, straw and green manure and their function in soil improvement. The information provided in Section 4.2 demonstrates to the farmers the best manure production, storage and application methods to avoid nutrient losses from the animal manures. It further enumerates the various advantages and disadvantages of using manures in terms of availability, cost, labor, weeds and soil improvement.

Section 4.3 is mainly targeted to farmers with small farm holdings on methods of composting and compost application. It deals with the usefulness of compost as an alternative source of manure for those farmers who do not possess animals to provide manure or no money to buy commercial fertilizers. The section provides a detailed systematic method of preparing a compost heap and the main disadvantages of compost production being labour and availability of organic materials.

Section 4.4 dwells with green manure crops (legumes) as an alternative source of nutrients for soil improvement after they decay on being incorporated into the soil, and also as sources of human food and livestock fodder. Some legumes are also known to control crop pests such as nematodes and moles. The number of advantages of using green manures out number the disadvantages and attractiveness of such useful information to farmers can easily lead to the adoption of green manure technologies in wet areas and for rehabilitation of degraded lands. Small seed quantities of promising green manure legumes for most agroecological zones in the country are available from the LRNP office at NARL, Nairobi.

Section 4.5 deals with use of organic mulches and highlights the advantages of their uses, type of mulches, handling and time of application. The chapter ends (section 4.6) by demonstrating the advantages of combinations of organic and inorganic fertilizers for better effects to crop production than when fertilizers are applied alone. The data provided on Table 4.2 is a clear indication, of such effects of combinations on maize production;, information that can be easily applied by farmers and extension workers.

Chapter 5: Soil Erosion and Conservation

The chapter deals with soil erosion and conservation methods so as to reduce the loss of fertility from the soils. Section 5.3 describes the most commonly used methods of conserving the soil through use of unploughed strips of land, grass strips, trash lines, stone lines, terraces, cut-off drains and gully control methods. The benefits of utilizing some of the methods as possible areas to grow livestock fodder and useful trees is also stressed. The diagrammatic illustrations of the various conservation methods makes it easy for the farmers and extension workers to understand the various methods of which the farmers can easily adopt in their farms.

Chapter 6: Cropping Systems and Cultural Practices

Being the last chapter of the Handbook, it deals with various cropping systems and cultural practices that ensure maintenance of soil fertility and food security. Section 6.2 dwells on effective crop rotation systems between cereals, legumes, solanaceous crops, root crops and leaf crops. Crop rotations are done to avoid excessive mining of nutrients in different soil layers and to avoid accumulation of specific pests and diseases. Section 6.3 deals with intercropping systems such as row, strip and relay cropping methods while highlighting the advantages of intercropping.

Such information and illustrations are very useful to farmers who do not practice such cropping systems, and if they do, they may not understand the advantages and disadvantages of such methods. The extension workers will also find such information very useful in their day to day interactions and roles in advising the farmers.

Conclusions

The simplicity of the Handbook in terms of language and technical expression makes it a very valuable book to the target groups, as it is very easy to understand and implement the contents therein. Infact the target groups should be widened to include researchers as the information in the Handbook widens their scope of knowledge as they conduct on-farm experiments through farmer participatory research methods.

The well illustrated figures makes it even more easier for farmers with elementary education to understand the text, and easily implement some of the methods on soil fertility management with little advice from the extension workers. Because of the simplicity of the text, it would be advisable to produce a Kiswahili edition as well to cater for the many farmers who are better versed in the language. The Handbook will definitely have a big positive impact on the target groups as they focus on the goal to a better soil fertility management in Kenya.

SECOND SCIENTIFIC CONFERENCE OF THE SOIL MANAGEMENT PROJECT (SMP) AND LEGUME RESEARCH NETWORK PROJECT (LRNP)

The joint SMP and LRNP was held in Mombasa from 26th-30th June 2000 to mark the end of the first phase of the Projects and herald initiation of the second phase. The conference title was **'Participatory technology development for soil management by smallholders in Kenya'.** The theme was **"Better soil management for improved small-holder crops and livestock production".** About 130 participants attended; 60% came from RRC-Kisii and NARC-Kitale while the rest came from other KARI centres, MOARD and some from IARCS. Two NGOs, Environmental Action Team (EAT) and Community Mobilization Against Desertification (CMAD) that collaborates with the Projects were represented. It was officially opened by Dr. Stanely M. Wokabi (CD / NARL) on behalf of the Director, KARI. The conference was organized into 9 sessions as presented here.

1. Overview of the Soil Management and Legume Research Network Project
2. Organic-inorganic fertilizer combination
3. Soil improving legumes
4. Soil conservation

5. Variety screening and local technical knowledge
6. Introduction and utilization of forage/fodder crops
7. Technology diffusion, social and other considerations
8. Experiences with farmers participatory research methodologies and stakeholder involvement in technology development and transfer
9. Planning the way forward/Adaptive research needs

Over 75 papers were presented. The conference was officially closed by Dr. John Lynam. He congratulated the group for being cohesive, well-integrated and for displaying good teamwork spirit. He noted that the group was working with broad range of technologies and had good linkage with NGOs and extensionists. He said the challenge that lay ahead for the group was to scale up the use of the FPR approach and technologies that have been developed, to demonstrate impact at the farm level.

ANNOUNCEMENTS

The Soil Science Society of East Africa is planning to hold the 18th Conference and end of millenium celebrations from 20th to 24th November 2000 at a venue in Mombasa. For further information contact Dr. Daniel Mugendi, Kenyatta University at mugendi@yahoo.com. or Dr. J.G. Mureithi at the above address.

An international symposium on balanced nutrient management systems for the moist savanna and humid forest zones of Africa. Cotonou, Republic of Benin, October 9 -12, 2000. Contact persons Drs. N Sanginga/B. Vanlauwe. N.Sanginga@cgiarorg., #B.Vanlauwe@cgiar.org.

The 12th World Fertilizer Congress: Fertilization in the third millenium, Fertilizers, Food security and Ecology. Venue- the International Convention Centre, Beijing, China, August 3rd to 9th, 2001. For more information, please write CIEC20001@iae.syb.ac.cn #or Fax +86 24 2384 3313.

The 17th World Congress of soil science, 14th - 20th August 2002, Bangkok, Thailand, For more information write to the office of the 17th World Congress of soil Science Kasetsart Golden Jubilee Administration and Information centre (1st Floor) Kasetsart University, P.O. Box 1048, Bangkok 10903, Thailand. E-mail: o.sft@nontri.ku.ac.th
http://www.17wcss.ku.ac.th

International Conference on Managing Soil Resources of the Tropics for Sustainable Agricultural Productivity. Soil Science Society of Ghana. 26th February to 2nd March 2001. Contact E-mail address sari@africaonline.com.gh

CGIAR Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation. III International Seminar & Small Grants Workshop. The CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA Program) will hold its III International Seminar from November 5 - 9, 2000 and its Small Grants Workshop from November 10 - 11, 2000 in Nairobi, Kenya. Kathryn Laing, Assistant Coordinator, PRGA Program, CIAT, AA 6713 Cali, Colombia, Tel: (57 2) 445 0131, Fax: (57 2) 445 0073, Email: prga@cgiar.org

The 7th KARI Biannual scientific Conference. Conference theme; Collaboration and participatory research for sustainably improved livelihoods. KARI Headquarters conference hall. 13-17th November 2000. For further information contact, The Secretariat, the 7th KARI Biannual Conference, KARI headquarters, P.O. Box 57811 Nairobi, Tel. 0254-2-583301-20,
E-mail address Resource.Centre@KARI.ORG