LEGUME RESEARCH NETWORK PROJECT NEWSLETTER

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Issue No. 5 June 2001

ABOUT THE NEWSLETTER

The current issue includes articles on the use of legume green manure cover crops for erosion control in combination with physical measures, soil fertility improvement in farmers' fields and a success story is highlighted on the adoption and diffusion of GMCC technologies by MAYONI farmers group in western Kenya. Two studies on the utilization of green manure legumes have been reported in this issue. The first is a study evaluating different methods of preparing mucuna for human consumption and the second aims at determining the effect of mucuna forage on the performance of lactating Jersey cows. The work is funded by a Rockefeller Foundation grant awarded to CIEPCA (Centre for Cover Crops Information and Seed Exchange in Africa) and is being carried out in collaboration with LRNP. The LRNP has revived the Matanya site, which is located on the leeward side of Mt Kenya and four research activities have already been initiated at the site. This issue arrives to you late and we regret the delay. We extend our gratitude to all those who contributed articles to make publication of this issue a success. We are grateful to the financial and technical support we have continued to receive from the Rockefeller Foundation and we also sincerely acknowledge the support the LRNP has received from Director KARI since its inception.

........Contents........

EDITOR'S NOTE

LRNP newsletter is published in June and December of each year. The newsletter provides a forum for highlighting Network activities and for sharing research findings with network members and other projects, individual researchers and farmers who are involved in legume research work in Kenya. Your contributions (short articles) and constructive comments should be addressed to the Editors of LRNP Newsletter, D.M.G. Njarui and C.K.K. Gachene or LRNP Coordinator, J.G. Mureithi.

INTRODUCTION OF GREEN MANURE LEGUME COVER CROPS TO SMALLHOLDERS IN KIMUTWA LOCATION, MACHAKOS DISTRICT, KENYA

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Introduction

Kimutwa location is characterised by gently undulating to hilly topography. The mean annual rainfall is below 700 mm. The area has soils derived from gneisses and schists of the Basement System rocks. The soils are mainly luvisols and lixisols and are of low fertility. The area has a bimodal rainfall distribution with long rains (LR) occurring in mid March to May and the short rains (SR) from mid October to December. Population density is relatively high on the hilly areas when compared to the less steep areas. Land sizes are also different with an average of 0.25 to 2.0 ha and 2.5 to 5.0 ha in the hilly and relatively flat areas, respectively. Most of the farmers use ox plough for farm operations. The major constraints to food production are declining soil fertility and unreliable rainfall, both in amount and distribution. Farm yard manure is used for soil fertility improvement although it is hardly adequate. Inorganic fertilizers are used by few farmers due to their high costs.

A study on the use of green manure cover crops for soil fertility improvement was initiated in 1995 at Machakos Farmers Training Centre by the Legume Research Network Project. During the first phase of the project, 24 legumes were screened to assess their suitability in terms of biomass production, tolerance to drought, resistance to pests and diseases, ability to nodulate and fix nitrogen, ground cover and seed production. Four legumes, namely, *Mucuna pruriens* (velvet bean), *Canavalia ensiformis* (jack bean), *Crotalaria ochroleuca* (Tanzanian sunnhemp) and *Phaseolus lunatus* (lima bean) were identified as the most suitable for the area.

On farm trial implementation

During the short rains of 1998, on farm trials were conducted in Kimutwa location, Machakos district. The aim was to assess the effect of green manure cover crops (GMCC) on soil fertility and maize yields. A one day farmer sensitization workshop was held in 1998 short rain season to introduce the potential of GMCC technology for soil fertility improvement to the farmers. During the workshop, soil fertility problems were discussed as well as the available methods which are currently used to address the problem. During the workshop, farmers interested in the study volunteered themselves. A total of 21 farmers volunteered to partici-pate in the trials. These were distributed as follows: Kwa-Kavoo village (4), Kilungu (3), Mwania (3), Kathome (3), Upper Kimutwa (5), and Mbembani (3).

The selected GMCC (mucuna, lima bean, crotalaria and jack bean) were to be intercropped with maize. The selection was carried out with the assistance of the researchers, as the farmers were not familiar with some of the GMCC species. However some of the farmers were familiar with some of the species such as canavalia (to scare those who covets ones farm) and lima bean (used as human food during prolonged drought periods).

During the workshop, it was agreed that the project would provide maize and legume seeds, fertilizers and hire the field assistant to help in the trial layout and implementation. Participating farmers were to provide the land and labour for land preparation, planting and weeding. Farmers were also willing to participate in harvesting as well as monitoring and evaluating the crop performance together with the field assistant. Land preparations and other agronomic practices were carried out according to the prevailing local conditions. A basal P fertilizer was applied at the rate of 50 kg P_2O_5 ha^{-1} to both legumes and maize at the time of planting. The biomass obtained was cut into small pieces, spread on the farm and then incorporated into the soil during the subsequent season. The legumes were intercropped with the maize crop and both crops were planted at the same time. Maize was planted at a spacing of 50 by 75 cm while mucuna, lima and jack bean were planted at a spacing of 25 by 75 cm. Crotalaria was planted at a rate of 30 kg ha^{-1}. Parameters used to test the effectiveness of the GMCC technology were soil colour, maize height and yields, and weed control. During the field trials, visits were made by the technical staff to monitor the performance of the system.

Trial observations

A second workshop was held in January 2000 to evaluate the performance of the maize - legume intercrop system. In terms of preference, mucuna was rated first mainly due to its high biomass and high percent ground cover which the farmers indicated as having an additional advantage of con-serving moisture and weed suppression. Crotalaria was rated lowest by all the farm-ers as it was competing for moisture with maize crop. Only one farmer had preferred lima to any of the other legumes tested. It came out clear that the farmer used the lima beans as food. Canavalia was consid-ered to have certain cultural value, i.e once grown in the farm, no one can interfere with such a farm. Although it performed well - being drought resistance-, farmers were not very keen on it, as biomass production was low.

Unfortunately, the trials coincided with the time the study area, like in most parts of Kenya, was experiencing drought. Farms on the leeward hilly areas tended to receive low rainfall compared with the relatively flat areas. Farmers from these areas participat-ed half-heartedly and tended to pay more attention to lima bean, not as a soil fertility improvement but as a food crop. This resulted in the drop out of 7 farmers.

Of great interest was the farmer's own knowledge of incorporating GMCC into the systems using ox plough for land prepara-tion and weeding. This has been taken by 4 farmers at Kwa - Kavoo village where the land sizes are relatively big (2.0 to 5.0 ha). Only one season, i.e 1999 SR was a success in terms of rainfall and crop growth.
However the effect of GMCC on crop response could not be assessed at this stage, as there was no enough biomass produced during the previous season (1999 LR) due to lack of rainfall. It was agreed that the trial should be repeated again during the 2000 LR. The 2000 LR in some villages were also poor resulting in poor germination. This trend in rainfall greatly affected the performance of the maize crop and it was therefore difficulty to make conclusive remarks on the effect of the GMCC on maize performance. Again this necessitated a repeat of the trials in the 2000 SR season.

A third workshop was held in early March 2001 to evaluate the performance of the 2000 short rain crop. Farmers ranked the performance of the legumes, starting with the best as follows: mucuna, lima bean, jackbean and sunnhemp. All agreed that mucuna had high biomass which is neces-sary for soil fertility improvement once incor-porated into the soil. Again the topsoil under mucuna mulch tended to be darker and softer than in the other plots and that there were hardly any weeds in these plots. Although lima bean produced very little bio-mass, it was more drought resistant than the other GMCC species and farmers were able to harvest some seeds from it. Lima was ranked first by one of the farmers as he had used it as a source of food. This was the same farmer who had previously used lima as source of food during 1999 SR. According to the farmer, the beans were simply boiled twice before eating. None of the farmers was in favour of the jack bean and sunnhemp. The former produced less bio-mass while the maize crop intercropped with sunhemp performed poorly. This was attributed to moisture competition, as the topsoil under this system was dry and hard. The effect of the GMCC residue manage-ment on crop yield will be assessed after harvesting the 2001 LR crop which had ben-efited from the residues obtained during the previous season i.e 2000 SR.

Conclusions and way forward

The study has identified mucuna as the most promising legume for soil fertility improvement followed by lima bean. Crotalaria suffers from moisture stress while jack bean is a slow grower with low biomass. Due to continued crop failure, there is need to continue with the trials. The first reliable data on the impact of the GMCC on maize yield will be assessed after harvesting the 2001 LR crop. During the 3rd workshop, farmers agreed that mucuna be included in all the sites and that each farmer was free to select one of the other three species. The three drought seasons experienced had led to an acute shortage of seeds and it was agreed that each farmer was to establish a small plot for seed bulking.

Acknowledgements

We would like to thank all the participating farmers of Kimutwa location and the Rockefeller Foundation for providing research grants.

FARMER-LED EFFORTS TO SCALE UP GREEN MANURE TECHNOLOGIES IN WESTERN KENYA

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Introduction

The Legume Research Network Project (LRNP) has been conducting research on green manure species for soil fertility and farm productivity improvement, especially among the resource-poor smallhold farmers. In the last two years, a number of promising species were tested on-farm as part of Integrated Nutrient Management (INM) strategy in Yala (Siaya district) and Kabras (Kakamega district). These INM options, which were tested along side the farmer practice, consisted of combinations of green manure biomass, inorganic nitrogen and FYM.

The on-farm research results were very encouraging and farmers, especially from Yala, became interested in adopting the green manure technology and scaling up their green manure plots. Researchers from KARI-Kakamega were interested in dissemi-nating the information from on-farm tests as widely as possible to enhance the chances of adoption of the technology by smallhold-ers. Researchers had worked with mem-bers of TATRO Women Group in the on-farm trials and realized the potential farmer groups had in dissemination of trial results. This is because of their close networks with other farmer groups and their effectiveness as extension agents, they being farmers them-selves. Discussions that followed between researchers and farmers led to a takeover of scaling up and dissemination activities by a farmer group called MAYONI.

The Evolution of MAYONI

MAYONI emerged from TATRO farmers' close interaction with research team from KARI Kakamega and the participation of the group in testing of green manure tech-nologies in Yala division, Siaya district. The story of evolution of MAYONI is particularly fascinating. Two members of TATRO Women Group participated in the screening of legume species for low P tolerance. They had a chance to learn about different green manure species. Maize was planted in the plots after removal of the green manure species and yields realized in the plots that had *Crotalaria ochroleuca* were very impressive. This encouraged one of the members of TATRO, Mrs Rose Owino, to participate in evaluation of INM options of incorporating *Crotalaria* in the next season. Mrs. Owino's farm was known for poor yields year after year. The performance of the farm after incorporation of Crotalaria was so imp-ressive that TATRO farmers decided to hold a field day to disseminate this information to the community around them. Following the field day, which was also attended by researchers and the local extension personnel, researchers organized a follow up meeting to discuss the way forward.

The follow up meeting took place in November 1999 in one of the farms. The meeting was attended by a team from KARI Kakamega comprising of John Ojiem, Henry Wakhonya and Benjamin Nyabinge, and 9 members of TATRO Women Group. These were the members most convinced of the appropriateness of green manure techno-logy for smallholder farms. It was during this meeting that MAYONI group was formed and the 9 farmers became its founder members.

Having demonstrated to other farmer groups that green manure technology had the potential for alleviating poverty in the area through improvement in farm produc-tivity, the 9 MAYONI group founder members were highly motivated by this belief and had a strong desire to pass this information to other farmer groups around them. To fulfil this desire, they linked up with researchers from KARI Kakamega to write a proposal to facilitate their work. Under the arrangement, KARI Kakamega was to facilitate the exec-ution of the project by providing the nece-ssary technical and accounting back stopping to the group. The funds, which were provided by the LRNP, were to facilitate the dissemination of green manure technology and information to other farmer groups in Yala Division.

The MAYONI group, whose members have a strong self-help tradition as part of the TATRO Women Group, would train the new farmer groups on INM technologies, help them set up legume green manure seed and scaling up plots, hold field days, as well as facilitate the formation of active commit-tees for the new group. It is these commit-tees that would take over the role of coordi-nating scaling up activities when it will be time for the MAYONI group to withdraw.

Current activities of MAYONI group

Scaling up of green manure technology started in September 2000, when members planted crotalaria in plots for incorporation into the soil as green manure. The perfor-mance of the crotalaria was so good that the group decided to hold a field day and invite the neighbouring farmer groups to expose them to the technology. The field day was held in November 2000 and the group, assisted by researchers, demonst-rated various aspects of green manure management to the visiting groups and distributed some green manure seeds. Crotalaria biomass was incorporated and maize planted in April 2001. So far the performance of the maize plots is good and neighbouring farmers continue to visit these plots and to know more about green manure species as well as getting some seeds.

Following the success of the field day and the interest shown by visiting farmer groups, MAYONI group started scaling out the activi ties. They identified 14 new groups interest-ed in trying out the technology. The new groups are spread in 2 locations of Yala divi-sion, i.e. Yala township and North Gem (Table 1). Activities in the new groups mainly involve seed bulking. All the 14 groups have crotalaria seed production plots in place and harvesting is expected to start in August or early September.

The organizational structure for scaling up

To effectively take up the challenge of leading the efforts to scale up green manure technologies, the MAYONI group came up with a structure (Figure 1). Implementation of the project is overseen by the Activities Coordinator, Mr. Paul Okongo'. Mr. Okongo' is quite a dynamic leader, having been instrumental in the set up and implementation of a number of self-help projects by farmer groups in the area. Mr. Okongo' is assisted by 4 ladies- Joyce, Rose, Rhoda and Christine. These are the Group Resource Persons (GRPs). The GRPs have received training on management aspects of green manure species and the application of INM technology. This has pre-pared them to train the new farmer groups on green manure production, draw up scaling up plans with these groups and monitor the progress. Each GRP is in charge of a

Table 1. Farmers groups involved in the scaling up of green manure technologies in two locations of Yala Division, Siyaya District.

Yala township location		North Gem location	
Group name	**Group size**	**Group name**	**Group size**
Kobuong'	30	Uzima development	19
Chamluchi	23	Huluinu Gare	10
Sarika	38	Muhaka	6
Tatro	13	Malanga B	9
Kaluoch	28	Maliera	7
Ulumbi	14	Korungu	31
Anyiko Reflex	13	-	-
Madiri	30	-	-
Total	189	Total	82

number of farmer groups and works with 2 Field Assistants to discharge the functions.

The GRPs work directly with farmer group members in the field. They report to the Activities Coordinator. For sustainability, MAYONI has encouraged the new groups to form committees. The committees will be strengthened through training in order to acquire technical and managerial capacity so that they can takeover the role of coordinating group scaling up activities when MAYONI withdraws. The training and capac-ity building activities have already begun. In each group, two active committee officials have been identified. These individuals will train to become GRPs in the new groups so that the dependency on MAYONI can be gradually scaled down.

EFFECT OF RELAYING GREEN MANURE LEGUMES ON YIELDS OF INTERCROPPED MAIZE AND SOIL FERTILITY IN SMALLHOLDER FARMS OF TRANS NZOIA DISTRICT

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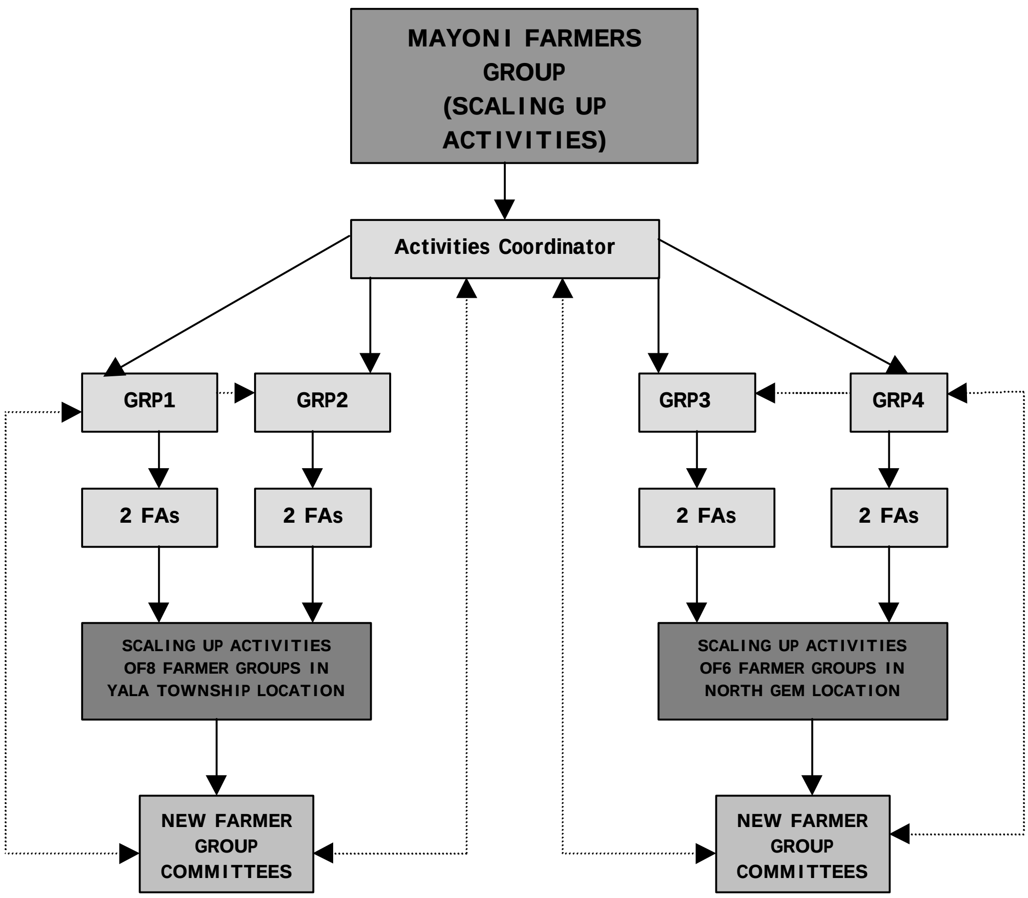
Introduction

An on-farm trial with a major goal of introducing legume green manures in maize based cropping system for increasing food production, maintaining and sustaining soil fertility was designed in 1997. Baseline soil samples were analysed for pH, N, P, K, Mg, Ca and % organic C. The soils were strong

Figure 1 The organizational structure of the project to facilitate technology scale up and dissemination, and training and capacity building



to moderately acidic (pH 5.0 - pH 6.9). Most of the farmers had marginal amounts of exchangeable bases (K, Ca, Mg and Na). Farmers were selected from 3 locations of Cherengani division of Trans Nzoia District. Through a series of workshops farmers were exposed to strategies for improving soil fertility and simplified explanation on research concepts for on-farm experimen-tation. A randomised complete block design was used and each farmer served as a replicate. Maize hybrid H614 was intercropped with either common bean *(Phaseolus spp.)*, soybean *(Glycine max)*, groundnuts *(Arachis hypogea)* and cowpea (*Vigna unguiculata*). After harvesting the food beans, the four plots were relayed with green manure legumes, namely, sunhemp *(Crotalaria brevidens)*, velvet bean *(Mucuna spp.)* and dolichos *(Lablab purpureus)*. The green manure legumes remained in the field after maize was harvested and were incorporated into the soil 2-3 weeks before planting the following season. Maize yields harvested from the plots were compared with yields obtained from non fertilized and fertilized checks.

Legume characteristics

The food legumes intercropped with maize generally gave low yields. The cowpea gave no grain yield at harvest during the three years. Groundnuts, common bean and soybean did not perform well as the yields averaged 90, 225 and 241 kg ha^{-1} respectively. The low yields were probably due to shading by maize. All the legumes however established well and all fixed N as indicated by the pink colour of nodules. There were no severe pest problems but diseases were observed on cowpea, soyabean, common beans, groundnuts and dolichos. The green manure legumes including sunhemp, velvet bean and dolichos were relayed into the maize crop after harvesting the various food legumes. Dry biomass yields were low in both years (Table1).

Maize yields

Maize yields from 10 farmers who intercroped with various food legumes and later relayed with green manures are shown in Table 2. The results indicate that there was significant maize yield differences between 1997 and 1998 (p = 0.0001). There was how-ever no

Table 1. Green manure dry matter yield ($t\ ha^{-1}$) for 1997/1998 and 1998/9

Green manure legume	Year	
	1997/8[a]	1998/9[b]
Velvet bean	0.38	1.20
Sunhemp	1.90	2.80
Dolichos	2.50	0.40
Mean	1.59	1.40
C.V.	28.90	26.84

[a] means are derived from 10 farmers
[b] means are derived from 7 farmers

interaction between the years and the green manure treatments for the same period.

There were significant maize yield differ-ences following the various green manures after one year of incorporation. Maize fol-lowing mucuna gave the highest yield of 9.3 followed by dolichos 7.3 and lastly by Clotalaria at 6.7 t ha^{-1}. These yields were not significantly different from maize fertilized with recommended fertilizer (60 P_2O_5 + 60 N kg ha^{-1}) which yielded 8.5 t ha^{-1}. Maize yields following green manures and the recommended fertilizer rates gave yields that were significantly higher than the control (5.4 t ha^{-1}) .

Farmers observations and comments

In order to evaluate these treatments, farm-ers opinions were sought during field days, work-shops and during inter group visits. Some of the factors they considered includ-ed labour re-quirements during land prepa-ration when establishing and incorporating green manure legumes. Low grain and dry matter yields from the various food and green manure legumes were of concern to them. The food bean yields were low as a result of multiple reasons, that include dis-eases, pests and shading from maize. The green manure legumes were mainly affect-ed by being grazed on by sheep and cattle. After harvesting maize, animals are nor-mally left to graze freely in the fields and this

Table 2. Maize yield* (t ha-1) after intercropping and green manure incorporation

Treatments	Years		Treatment	
Green manure	Intercrop	1997	1998	Mean**
Clotalaria	Beans	7.1	5.2	6.2
	Cowpeas	8.0	5.8	6.9
	Groundnuts	8.6	5.1	6.9
	Soyabean	7.6	5.8	6.7
Clotalaria mean a		7.8	5.5	6.7 (± 1.02)
Dolichos	Beans	7.5	6.7	7.1
	Cowpeas	8.1	6.5	7.3
	Groundnuts	8.5	7.0	7.8
	Soyabean	8.5	5.4	7.0
Dolichos mean a		9.5	7.7	7.3 (± 1.02)
Mucuna	Beans	9.8	8.1	8.9
	Cowpeas	12.3	9.8	11.0
	Groundnuts	10.1	7.2	8.7
	Soyabean	10.2	6.7	8.5
Mucuna mean a		10.6	8.0	9.3 (± 1.44)
60 P_2O_5 + 60 kg N ha^{-1}		10.4	6.6	8.5 (± 0.6) a
No fertilizer		6.2	4.6	5.4 (± 0.7) b

* means are derived from 10 farms

** mean yields down the colomn (for green manure legumes and the two controls) followed by same letter are not significantly different

affected the DM produced for incorpora-tion. During farmer workshops, farmers were adviced to construct live fences or barbed wire to prevent the animals from feeding on the crops.

Farmers were exposed to the use of soy-bean, groundnuts, cowpea and sunnhemp for soil fertility improvement. Participating farmers requested for a few seeds to plant in small areas as sole crops. They even sug-gested planting larger portions of their land with these legumes as sole crops if assured of market availability. From the researchers point of view, this offered an opportunity to introduce to farmers in this region the con-cept of crop rotation with these legumes, as another strategy for improving soil fertility.

Farmers perception of this concept had improved as compared to when the experi-ment was started. The major constraint to the use of these technologies is the small land holdings. Farmers unanimously agreed that the technology was viable if certain issues are given serious considerations.. These include fencing farm areas where green manures are planted to deter animals from grazing on them; early planting of the maize crop to ensure early relaying of the green manure for maximum use of mineral-ized nutrients by the subsequent maize crop.

Acknowledgement

We would like to acknowledge all the participating farmers of Cherengani division and to the Rockefeller Foundation for finan-cial support to undertake the above study.

GULLY REHABILITATION IN KIAMA VILLAGE, GATANGA DIVISION

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Introduction

Gully erosion poses a serious threat to agricultural production in Kenya. Gullies vary greatly in their characteristics, causal factors, and stage of development and processes involved. Control measures must be site-specific, and a proper understand-ing of the processes of formation and deve-lopment is a precondition for effective control. A variety of problems have been observed in attempts to control gullies, some of which reflect a lack of understanding of the force of water and the processes at work in gully initiation and development.

Reduction of the volume and rate of inflow should be a first priority wherever possible. However, attempts to divert runoff can lead to new gullies if the diversion structure fails. Gully control structures can be classified as temporary or permanent. Temporary structures are intended to function until vegetation becomes well established. They include brushwood check-dams, loose stone check-dams, earth-filled gunny bags check-dams, etc. The objective of the check-dams is to slow down the water and cause deposition of silt, which may allow vegetation growth.

Cost is a major factor in gully control work. It can be extremely difficult and costly to rehabilitate a gully once it has developed. Thus much more attention needs to be given to developing effective procedures and low-cost measures for gully control and reclamation. In particular, more attention needs to be paid to the use of vegetation wherever possible. Our experience in the same area has shown the potential of mucuna in controlling soil erosion especially during the critical time when the ground is bare and prone to erosion (see issue No. 3). Among other several factors, the common causes of gully formation are: runoff concentrating within an unpaved road; stock track or footpath; increased volume and velocity of runoff due to lack of cover in the catchment as a result of clearing for cultivation; runoff discharged from a road through culverts; grazing pressure and development activities.

Methodology

This study was carried out in Kiama village, Mukarara sub-location, Kihumbuini location, Gatanga division, Thika district. The farm belongs to Mr Daniel Ndung'u who had participated in earlier trials involving the use of green manure cover crops (GMCC) for erosion control. During one of the field visits, it was noted that the GMCC, mainly mucuna (*Mucuna pruriens*) could not alone control erosion effectively due to the steepness of the slopes (56%) and the poorly maintained soil physical measures in the farm. Furthermore, the farm was prone to gully erosion as there was runoff discharge from the nearby earth road; there was a gully already forming in the middle of the road.

In 1999 long rain season, a gully had started to form along the boundary which sepa-rates Ndung'u's and one the neighbour's farms, while another had started forming in the middle of Ndung'u's farm. A visit was made by the project team to assess the damage with the ultimate goal of reclaiming the gully. The team had to identify the safest way of discharging the runoff, examine the appropriate conservation measures to be applied and assess the necessary inputs required for healing the gully. It was agreed that the owner of the farm provide some labour and napier grass for stabilizing the embankments while the project was to meet part of the costs for the labour, tree seedlings, wooden pegs and gunny bags.

Gully rehabilitation activities

Field activities were carried out in early March, 2001. The length of the gully was 130 m with an average width and depth of 1.62 and 1.40 m respectively. The work involved planting of grasses (mainly creeping signal grass, *Brachira humidicola*) on the floor and sides of the gully, construction of check dams using gunny bags which were filled with the soil and reinforced with wooden pegs, and brushwoods which were constructed immediately below the check dams. A total of 130 gunny bags were used, of which 110 were provided by the nearby Kiama Coffee Factory whose land also neighbours the gullied road.

Soil Conservation activities in the farm

This involved the construction of a cutoff drain and fanya juu terraces in Ndung'u's farm. Creeping signal grass was planted along the embankments of the cutoff drain. Along the terrace embankments, lines of mucuna, sesbania and napier grass were planted next to each other while grevillea trees were planted in the ditches. This type of ‘macro-contour lines’ offer several advantages to the farmer, namely, erosion control, soil fertility improvement, source of fodder for livestock and building material and firewood. In total, 40 sesbania and 30 grevillia seedlings were planted. Once the planted along on the floor and on the side of the gully.

Impact and the way forward

After seeing the efforts made by the project team and the farmer, Kiama Coffee Factory staff offered 110 gunny bags, which were used for the rehabilitation of the gully. Having visited the site to see the team’s activities, the Soil and Water Conservation extension officer expressed the willingness to collaborate with the project team. In an area already experiencing serious soil ero-sion problems and where extension servic-es are not reaching most of the farmers, this work has already generated a lot of interest to the surrounding farmers. The gully is strategically placed along the road and many farmers have requested for technical assistance. Preliminary observations show that the grasses are already well establish-ed and the gully is already starting to heal. It is anticipated that after the second season, i.e. 2001 short rain, the results will be even more pronounced.

Acknowledgements

Research grants were provided by the Rockefeller Foundation Forum on Agricultural Resource Husbandry. Kiama Coffee Factory is thanked for providing the gunny bags.

REVIVAL OF MATANYA LRNP SITE IN LAIKIPIA DISTRICT

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Introduction

Matanya site was temporary closed in 1998 because the site coordinator, Mr. Josphat M. Kiama (plate 1) went to college and it was difficult to get a suitable replacement. He is now back and the site was opened on February 2001. The site lies in the rain shadow of Mt. Kenya and Aberdares ranges. It is located at latitude 00^{o} 03’ S and longitude 36^{o} 57’ E and at an altitude of 1840 m above sea level. The dominant soil is vertic luvisol. The rainfall pattern is bimodal aver-aging 600 mm p.a. and it is poorly distrib-uted. The area has two seasons per year with the October - January termed as the long rain season contrary to other areas where the March - May is regarded as the long rain. The average minimum and maxi-mum temperatures are 11 and 29^{o} C. Access to the site is through a rough mur-ramed road about 20 km from Nanyuki.

The farmers are resource poor and plot size ranges from 2 - 5 acres per household. The study area has a population of about 11,000 people and it borders Ol Pajeta and Solio ranches on the western side. Farmers prac-tice mixed farming with livestock reared using the extensive method. Crops grown are mainly for subsistence purposes. Intecropping systems are predominant and they include intercropping maize with beans and maize with Irish potatoes. Food short-ages are common and malnutrition is on the increase due to poor rainfall and declining soil fertility. In the past a crop failure was expected after every three years but since the El Nino weather phenomenon, rainfall has become erratic and poor. About 10% of the farmers use farm yard manure and inor-ganic fertilizers in their farms. Green manure legumes can therefore play a great role in soil fertility improvement. Currently the legumes grown mainly for food by most farmers are common beans and field peas.

Legume screening trial

Matanya site was involved in the legume screening trial initiated in 1995 and about 21 legume species were evaluated. Six legumes were identified as promising for incorporation into the smallholder farming systems; *Mucuna pruriens, Neonotonia wightii, Crotalaria ochroleuca*, *Vicia beng-halensis*, *Lablab purpureus* and *Phaseolus lunatus* (Table 1 and Box 1).

New research activities

Four activities were initiated at the beginning of the year as a way of reviving the site. These included (i) incorporating green manure legumes into smallholder maize production, (ii) intercopping purple vetch with Irish potatoes, (iii) response of legumes to phosphorus fertilizer and (iv) seed bulking.

Table 1. Performance of best-bet legumes in Matanya site, Laikipia district

Species	Days to 50% flowering	Days to pod setting	Days to seed set	Days to maturity	Active nodules [a]	Ground cover [b] (%)	Biomass yields [c] (t DM ha $^{-1}$)
Mucuna pruriens	162	178	204	243	100	67	10.8
Neonotonia wightii	162	172	175	m	100	87	6.7
Crotolaria ochroleuca	95	99	104	117	m	m	4.5
Vicia benghalensis	104	108	118	158	94	94	3.7
Lablab purpureus	89	99	102	132	76	76	4.2
Phaseolus lunatus	45	54	62	101	54	54	1.1

a-Percentage of nodules per plant that had pinkish or brownish colour inside; b-Determined after three months of growth; c- Assessed after 6 months of growth; m- Missing data

Box 1: Best-bet legumes in Matanya site

Mucuna pruriens (velvet bean). The plant have high biomass yield and highly adaptable to the region. Seeds are not edible but the crop is good for improving soil fertility. It establishes fast and provides high ground coverage quickly. It is tolerant to common pests in the area.

Neonotonia wightii (glycine). It is a perennial with climbing and twining stems suited to high altitude areas. It establishes slowly but becomes quite vigorous later on. It is suitable for grazing and for short-term improved fallows.

Crotolaria ochroleuca (sunnhemp). Grows well in the site but its growth can be slowed down in wet weather. Its leaves can be used for human food as vegetable. It has good nodulation ability but it is susceptible to insect attacks

Vicia benghalensis (purple vetch). The legume is suited to the high altitude areas. It nodulates well and has potential to fix nitrogen. It produces high biomass yield and after two seasons forms a mart of dead litter which covers the surface and protects it from erosion and also add organic matter to the soil.

Lablab purpureus cv Rongai (hyacinth bean). This is a dual-purpose legume used for food and for green manuring. It can also be used as livestock fodder. The farmers are familiar with black seeded hyacinth bean, which is used as a delicacy during wedding ceremonies. There is a need to create awareness of the brown seeded Rongai variety, which is as good as the black seeded type and can be eaten as food. A few members of the community are familiar with this variety and they refer it as ”Mukondi”.

Phaseolus lunatus (lima bean). The plant can be used for food and green manure. In the USA it is grown for green or shelled beans that are eaten after cooking. It is an annual that is deep-rooted and hence tolerant to drought. Farmers in the site are familiar with it and some have attempted in the past to boil the beans for food.

The first study is an on-farm trial while the others are located at the Matanya seed bulking site, of the Ministry of Agriculture and Rural Development.

(i) Incorporating green manure legumes into smallholder maize production

The aim of this study was to incorporate legumes into smallholder farming systems to improve soil fertility for maize production. Fifteen farmers were selected to participate in this trial. The legumes were *Mucuna pruriens, Lablab purpureus* cv Rongai, *Phaseolus lunatus* and *Vicia benghalensis.* Planting was done on 31 March 2001, 7 days after the onset of the short rains. The legumes were intercropped with maize variety H511. The legumes germinated well in most farms but their growth and that of maize has been seriously affected by a drought that began in early May (Table 2). The data being collected includes emergence, weeding, legume biomass production, maize yields, and pest and disease incidences.

(ii) Evaluating purple vetch as green manure for increasing Irish potatoes production

The objective was to evaluate purple vetch as a green manure for production of Irish potatoes. Planting was carried on 27/3/2001 and the treatments were; (a) Intercropping Irish potato with maize and plus 6 t FYM ha^{-1}, (b) Growing purple vetch and Irish potato in a rotation system whereby the legume acts as a short-term improved fallow, and (c) planting Irish potato with DAP fertilizer. The treatments were replicated three times. The legume in the relay treatment will be planted after earthing up of the potato. After the potatoes are harvested the legume will be left to grow in the field until the following season when it will be harvested and biomass incorporated into the soil as green manure. The trial will be carried out for 4 seasons (i.e. 2 years).

Table 2: Rainfall amount and distribution in Matanya for March, April and May 2001

	Dates						Total (mm)
Month	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 31	
March	4.2	10.5	0.0	52.8	23.7	48.1	139.3
April	38.0	36.0	0.0	1.5	40.9	0.0	116.4
May	9.7	0.0	0.0	0.0	0.0	0.0	9.7
Total							265.4

***Plate 1:** Mr. Josphat M. kiama, site Coordinator. Matanva site*

(iii) Response of legumes to phosphorus fertilizer

The objective of the trial was to study the effect of phosphorus on nodulation and dry matter production of six green manure legumes. Six legumes were involved in the study, namely *Phaseolus vulgaris* (the common bean), *Phaseolus lunatus* (lima bean), *Lablab purpureus* cv Rongai and the black seeded type, and *Phaseolus coccineus* (butter bean), both coloured and white seeded type. Butter bean was included because of its good performance as a grain legume in similar environments in Nyandarua district (Onesmus Kamau, personal communication). Two phosphorus levels were used, 0 and 100 kg P ha^{-1} . The legumes were growing vigorously soon after planting but their growth have been slowed down by the diminishing rainfall

Plate 2: *A plot of lablab purpureus cv Rongai planted for seed bulking*

and aphids attack mainly on the lima bean and *L. purpureus.* The trial is to run for four seasons (2 years).

(iv) Legume seed bulking

In order to sustain LRNP activities, seed bulking is a crucial activity. The following legumes are being bulked at the site, *Phaseolus lunatus, Vicia dyscarpa, Phaseolus coccineus* (white seeded and coloured), *Vicia villosa*, *Lablab purpureus* (cv Rongai and black seeded) plate 2, *Vicia benghalensis, Neontonia wightii, Crotalaria ochroleuca* and *Medicago truncatula.* These were planted between 26 and 31/3/2001. The site targets to produce about 500 kg of legume seeds by the end of the year.

Way forward

Due to farmers' interest and enthusiasm in legume green manure technologies it is recommended that workshops be held to train farmers on green manuring as an option for soil fertility management and utilization of the legumes as human food and livestock feed. In Matanya, farmers are aware that the productivity of their land is declining drastically and it is high time they evaluated available options to address the problem.

IMPROVED FOOD PRODUCTION USING HERBACEOUS LEGUMES IN THE CENTRAL HIGHLANDS OF KENYA

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Introduction

One of the challenges facing Kenya today is the production of adequate food to feed the rapidly growing population and in particular, the inhabitants of the densely populated highlands of central Kenya with over 500 persons km^{-2} (Government of Kenya, 1994). Over time, the soil fertility has declined due to continuous cropping with little nutrient replenishment. Crop yield decline has been a major problem facing smallholder farmers in the area. The use of inorganic fertilizers is generally low, less than 20 kg N and 10 kg P ha^{-1} (Muriithi, *et al*. 1994). The amount is inadequate to meet the crop nutritional requirements for optimum crop yields at the farm level.

Surveys carried out in the area indicate that farmers are fully aware of the declining soil fertility (as expressed by declining crop yields), but in most cases they do not have readily available resources to replenish it (Muriithi *et al*., 1994). The Legume Research Network Project identified mucuna *(Mucuna pruriens*; velvet bean) and crotalaria (*Crotalaria ochroleuca*; Tanzanian sunnhemp) as some of the most promising legumes in the central highlands of Kenya that can be used to mitigate against soil fertility decline (Gitari *et al*., 1997). Therefore there is need to incorporate these legumes in the farming systems (at the farm level) to establish their effects on soil nutrient replenishment and maize grain yield.

The information reported here is from a participatory on-farm trial conducted in the predominantly maize growing zones of Meru South district. The aim is to provide a demonstration on integrated soil fertility management strategies for increased agricultural production by smallholders in central highlands of Kenya. This project sought to address the following objectives: i) to integrate nutrient management practices that will arrest the current nutrient depletion and increase food production, and ii) to encourage farmers to adopt improved nutrient management practices.

Experimental site

The study site is called Chuka and it is located in Meru South district. According to Jaetzold *et al* (1983), the area is in Upper Midlands 1 and 2 (UM2-UM3) agro ecological zones with an altitude of approximately 1500 m above sea level, annual mean temperature of about 20^0 C and annual rainfall of 1200 mm. The rainfall is bimodal, falling in two seasons, the long rains (LR) lasting from March through June and short rains (SR) from October through December. About 65% of the rains come during the long rainy season. The main food crop is maize.

Experimental layout

The experiment was established in March 2000 on a farm with poor and impoverished soils and laid out as a randomized complete block design (RCBD) with 3 replicates. The plot size were 6 x 4.5 m. The test crop, maize, (*Zea mays* L, var. H513) was planted at a spacing of 0.75 m and 0.5 m inter- and intra-row, respectively. Three seeds were sown and thinned at four weeks later to 2 plants per hole. Five external soil fertility amendment inputs were applied as shown in Table 1.

During the 2000 LR (first season), one row of herbaceous legumes was planted while two rows were intercropped between maize rows in the 2000 SR (second season). The herbaceous legumes were planted two weeks after planting maize during the first season but in the second season, maize and herbaceous legumes were planted at the same time. The legumes were left in the field after harvesting maize till land preparation for the next season when they were harvested, weighed, chopped and incorporated into the soil to a depth of 15 cm. The weight of the herbaceous legume biomass obtained in the first and second season is shown in Table 2.

Compound fertilizer (23:23:0) was applied during sowing. Other agronomic procedures for maize production were appropriately followed after planting. The plots were hand weeded twice and stalk borers were controlled by use of borericide (Buldock dust) four weeks after crop emergence. During the first season, a general P deficiency was noted, thus a uniform top dressing for P, as TSP, was applied in the second season.

Sampling and analyses

Maize was harvested at maturity from a net area of 21.0 m^2. This was after leaving out one row on each side of the plot and the first and the last plants of each row in order to minimize the edge effect. At the end of the second season soil samples were taken at 0-30 cm. For determination of ammonium and nitrate, about 20 g of field moist soil was extracted with 100 ml 2 M KCl. Ammonium in the extract was determined by a calorimetric method (Anderson and Ingram, 1993) and nitrate was determined by cadmium reduction (ICRAF, 1995). Biophysical data was statistically analyzed using Genstat program (1995).

Results and Discussions

Grain Yield

Maize grain yield for the long and short rain seasons are shown in Table 3. During the first season, biomass from the herbaceous legumes was not applied (needed one season for biomass to be produced for use in the subsequent season). Average maize grain yield across the treatments was 1.1 t ha^{-1} in season 1. Application of recommended inorganic fertilizer (60 kg N and P ha-1) gave the highest yield with an average maize grain yield of 1.6 t ha^{-1}. This was followed by the herbaceous legume treatments while the control had the lowest maize grain yield of 0.3 t ha^{-1}. The additional benefits in the treatments with herbaceous legumes in contrast to the control therefore, may have been from the nitrogen fixation by the legumes and shading that could have reduced soil moisture loss from the soil. The low maize grain yield in this season could be associated with the very low precipitation (average 126 mm) with most of it being recorded within the first three weeks of the season.

The second season (short rains) had higher maize grain yield with an average of 3.4 t ha^{-1} across the treatments. During this season, recommended rate of inorganic fertilizer (60 kg N and P ha^{-1}) gave the highest yield of 5.4 t ha^{-1}. Intercropping with crotalaria without the addition of N fertilizer had the lowest maize grain yield (1.6 t ha^{-1}). This could be as a result of competition from the herbaceous legumes (which comprised of two rows between the maize plants as opposed to one row in the first season). The herbaceous legumes were also planted at the same time with the maize and this could have exacerbated the competition

Table 1 Organic and inorganic inputs used at the experimental site, Chuka

Treatment. No.	Organic input	Inorganic input
1	Mucuna	_
2	Crotalaria	_
3	Mucuna	30 kg N and P ha^{-1}
4	Crotalaria	30 kg N and P ha^{-1}
5	_	60 kg N and P ha^{-1}
6 (control)	_	_

Table 2: Herbaceous legume biomass incorporated in the second and third season at Chuka

Treatment	Amount of herbaceous legume incorporated (t ha^{-1})		Equivalence of N (kg ha^{-1})	
	2nd season	3rd season	2nd season	3rd season
1 Mucuna	0.2	3.7	5.9	110
2 Crotalaria	0.3	5.6	9.0	168
3 Mucuna + 30 kg N & P ha^{-1}	0.3	4.1	8.8	120
4 Crotalaria + 30 kg N & P ha^{-1}	0.1	5.4	3.0	162

between the herbaceous legumes and the maize plants. The herbaceous legume biomass incorporated during this season was very low (Table 2) as a result of the low rainfall during the first season. The high maize grain yield during this season could be associated with the high precipitation (average 698 mm) received during the season. The integration of herbaceous legume biomass and inorganic nutrient sources gave higher yields as compared to the sole application of the herbaceous legumes biomass in both seasons. However, these differences were not significant ($P<0.05$).

Residual mineral N

Maize plots intercropped with crotalaria and without N fertlizer had the highest (89.3 kg N ha^{-1}) residual mineral N while recommended level of inorganic fertilizer had the lowest (51.4 kg N ha^{-1}) residual mineral N at 0-30 cm depth. There was a significant difference ($P<0.05$) of mineral residual N between treatments (Table 4) at the end of the second season.

In all treatments residual N was higher than the control with the exception of the recommended level of inorganic fertilizer. This trend could be attributed to the beneficial ability of the herbaceous legume biomass to release N gradually unlike the inorganic fertilizers, which release N drastically after application. No significant differences for ammonium between the treatments at 0-30 cm depth were observed. However nitrate concentration was significant ($P<0.05$). Lower levels of ammonia-N were noted in comparison with nitrate-N in all the treatments (Table 4). This could be due to rapid conversion of ammonia to nitrate following mineralization of inputs in the soil.

Acknowledgements

The authors wish to thank the Rockefeller Foundation for providing financial support for the field experimentation. The cooperation and contributions made by Kirege community members are acknowledged.

Table 3: maize grain yields (t ha-1) under different organic and inorganic inputs in Chuka during the long and short growing seasons of 2000

Treatment	Long season	Short season
Mucuna	1.1	3.1
Crotalaria	0.9	1.6
Mucuna + 30 kg N & P ha-1	1.4	3.7
Crotalaria + 30 kg N & P ha-1	1.2	3.6
60 kg N & P ha-1	1.6	5.4
Control	0.3	3.1
Mean	1.1	3.4
SED	0.2	1.2

Note: The 3rd season crop is still in the field at the time of reporting (the legume incorporated was harvested during the season

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Table 4: Treatment effects on soil residual mineral N (mg/kg) at the end of the second season. 2000

Treatment	Ammonia	Nitrate	Mineral N
Mucuna	5.6	47.1	52.7
Crotalaria	9.3	80.0	89.3
Mucuna + 30 kg N & P ha^{-1}	6.4	52.5	58.9
Crotalaria + 30 kg N & P ha^{-1}	8.5	70.4	78.9
60 kg N & P ha^{-1}	3.6	47.8	51.4
Control	5.0	46.7	51.7
Mean	6.4	57.4	63.8
SED	4.4	10.1	10.6

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EVALUATION OF PROCESSING METHODS FOR MUCUNA (MUCUNA PRURIENS) AS FOOD TO ENHANCE ADOPTION FOR SOIL FERTILITY IMPROVEMENT.

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Velvet bean *(Mucuna Pruriens),* KARI, Kitale

Introduction:

Mucuna (*Mucuna pruriens*) is one of the green manure legumes that has been intro-duced into the farming systems communities of coast, central, western, north-western and south-western regions of Kenya by the Legume Research Network Project (LRNP) for soil fertility improvement (Mureithi *et al*., 2000). Despite this high potential for soil fertility improvement, wider adoption of mucuna is not certain unless farmers can use it for other purposes that contribute to family welfare either as food, animal feed or cash. Experiences with green manure legumes by the Resource Oriented Development Initiatives project in Busia (RODI, 2000) show that farmers were reluctant to plant mucuna and jackbean when they heard that the seeds are not edible but were enthusiastic over dolichos because they could utilize the seeds as food.

Mucuna produces high amounts of seed (1-2 t ha $^{-1}$) whose nutritional value compares closely with that of beans and other com-mon food legumes (FAO, 1972, Bressani, 2000). It can therefore contribute as an additional protein source for a majority of communities who rely on starch based diets. Poor health, much like soil infertility is a fundamental part of the continuous cycle of poverty. Mucuna seed has been used as food in many countries where the crop has been introduced as green manure (Versteeg *et al*., 1998). In Kenya, there has been very limited use of mucuna only as a beverage or 'cocoa' after roasting the seed (Saha and Muli, 2000).

Use of mucuna as food is limited by the presence of several anti-nutrients, which have to be removed by processing before consumption. These include tannins, phytic acid, trypsin inhibitors and polyphenolics among others. These substances are heat labile and therefore easily removed by cooking. The anti-nutrient of greater concern is L-DOPA (L- 3,4 dihydroxyphenylalanine), a non-protein amino acid that can have ill effects in humans if consumed in large amounts (Szabo, 2000). In controlled doses, L-DOPA is used as a drug in humans to control Parkinson's disease. Removal of L-DOPA requires longer cooking time than the other anti-nutrients. For example a recipe from Malawi requires 8 to 9 hours of boiling to reduce the content to safe levels (G. Gilbert, 2000). Other researchers have combined several treatments like soaking, boiling (with frequent changes of water) and roasting, also requiring long processing time to achieve low levels of L-DOPA. Lengthy cooking is costly in terms of fuel and water besides the fact that with the changing lifestyles, consumers now prefer convenience or easy-to-prepare foods. In addition, long cooking time may rid mucuna of its beneficial nutrients resulting in a product that is not very different from the starchy staples.

In view of the above constraint to the use of mucuna as food, this project has been formulated with the main objective of identifying cheaper and acceptable methods for processing both dry and immature mucuna seed, which are also effective in reducing L-DOPA to safe levels (below 0.1%) while enhancing nutritional quality and consumer acceptability.

Materials and Methods

The study is being conducted at the Kenya Agricultural Research Institute, National Agricultural Research Center, Kitale with funds from IITA and the Center for Cover Crops Information and Seed Exchange in Africa (CIEPCA) and in collaboration with the Legume Research Network Project (LNRP). Mucuna has been planted at the research centre to provide immature beans for the study while dry mature seed has been provided by the LRNP. So far, 2 experiments have been carried out using the cream and mottled seed variety.

Effect of soaking time and soaking medium on cooking time of dry mucuna beans.

20 gm mucuna beans were soaked in 400 ml of either plain water, 0.25% "magadi soda" or 0.25% citric acid solutions for 12 or 24 hrs at room temperature (19.6^{o} C). The soaking solution was discarded and the samples boiled in water while changing the cooking water at half hour intervals until the seed was cooked. Cooking time was measured from the time boiling started to the time the texture of the beans was soft or easily mashed between the fingers.

Effect of alkaline and acid on cooking time of dry mucuna seed

120 gm of dry seed was soaked in 1 litre of water for 24 hrs at room temperature (19.6^{o} C). The soaking solution was discarded and the samples boiled in either 0.25 or 0.5% citric acid, 0.25 or 0.5% "magadi soda", and filtered maize cob ash solution diluted with water in ratios of 1:1 and 1:3. Maize cob ash solution was prepared using the traditional method used by farmer preparing the solution for cooking vegetables and other foods to make them tender and / or enhance their flavour. 20 gm of the ash was measured into a container with holes at the bottom. The ash was pressed down slightly to form a filtering bed. 400 ml of water was added slowly making sure that the ash layer is not disturbed. The filtrate was collected in a beaker and used for cooking the bean samples after dilution. The cooking time was noted.

Preliminary results

Table 1 shows the cooking time of dry mucuna seeds without soaking or soaking for different times in either water, dilute acid or alkaline solution. Soaking in water for 24 hrs before boiling in plain water reduced cooking time from 6 to 2.5 hrs. But soaking in water for 12 hrs was not adequate to reduce the cooking time. Soaking the seed in dilute alkaline or acid solutions did not have an appreciable effect on reducing cooking time. A major observation during soaking was that the seeds did not all absorb water at the same rate. This was shown by the difference in the extent of swelling of the seeds. Generally, the mottled seeds absorbed water faster than the cream seeds, some of which remained unchanged even after 24 hrs. This had an influence on the cooking time as not all seeds cooked uniformly particularly when cooking in plain water.

Cooking in alkaline solutions not only reduced the cooking time appreciably (Table 2) but also improved uniformity of cooking. Both magadi soda and maize cob ash solution act as tenderisers and when combined with soaking improve cell membrane permeability and therefore reduce cooking time. Permeation of the seed body with hot water, alkaline or acid extracts over 70 % of soluble compounds (Sathe and Salunkhe 1984) . It is therefore expected that L-DOPA and other anti-nutrients, which are soluble in these solutions, will be extracted hence reducing them to potentially safe

Table 1: Effect of soaking time and soaking medium on cooking time of dry mucuna seed boiled in plain water

Soaking time and medium time	Cooking (hours)
No soaking	6.0
12 hrs- Water	4.5
24 hrs- Water	2.5
12 hrs - 0.25% "Magadi soda"	3.2
24 hrs - 0.25% "Magadi soda"	2.6
12 hrs - 0.25% Citric acid	3.4
24 hrs - 0.25% Citric acid	2.5

levels. Some interesting observations were noted during cooking in alkaline and acid solutions. When alkaline was used, the cooking water turned dark brown within half an hour of boiling indicating that some oxidative reactions took place. Szabo, (2000), has reported the formation of melanin compounds which are dark coloured, during oxidation of L-DOPA.

Oxidation also affects other amino acids. Without discarding the cooking water, the resulting cooked seed had a very undesir-able dark colour. In acid solution however, the cooking water remained colourless. This may have been due to the effect of citric acid as an anti-oxidant, which prevents the formation of melanin compounds. The effect of this on L-DOPA removal from the seed needs further investigation. Also observed was the softening of the seed coat, which was easily removed from the cotyledons within half an hour of boiling.

Table 2 Effect of boiling in alkaline and acid on cooking time of dry mucuna seed

Treatment	Cooking time (hours)
0.25% Magadi soda	1.7
0.5 % Magadi soda	1.4
0.25% Citric acid	2.0
0.5% Citric acid	2.0
Maize cob ash solution, 1:1 dilution with water	1.0
Maize cob ash solution 1:3 dilution with water	1.8

This is advantageous as the seed coat contains 30 - 40% of the L-DOPA, most of the tannins, and phytic acid which has been implicated in the “hard to cook” phenome-na of grain legumes (Giami and Wachuku, 1997) and is therefore an important factor in the utilisation of mucuna from the point of view of

saving of the valuable cooking fuel. This research is continuing and further tests will be done to determine the extent of loss of both desirable and undesirable nutrients including L-DOPA, effect on nutrient bio-availability and the eating quality of the seed due to processing with the above methods before recommendations can be made. Other processing methods to be evaluated will include cooking under pres-sure, extrusion, and germination and drying before flour production.

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THE EFFECT VELVET BEAN FORAGE ON THE PERFORMANCE OF LACTATING COWS OVER A SIX MONTHS PERIOD

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Introduction

Scientists based at KARI’s coastal lowland research centre at Mtwapa are carrying out a study to evaluate the long term effect of feeding velvet bean forage to lactating cows (Muinga *et al,* 2001). The study is a follow up on earlier results (Muinga *et al*., 2000), which showed that milk production using fresh velvet bean forage was similar to that of other legume forages like gliricidia (*Gliricidia sepium*), clitoria (*Clitoria ternatea*) and hyacinth bean *(Lab lab purpureus*). However, during the 12th week of experimentation, cows fed on velvet bean forage produced one litre of milk less than those fed on the other legumes. It is likely that the cumulative effect of L-dopa reported in mucuna, caused the drop in milk production. However, levels of L-dopa in the forage and in the cows’ blood were not determined. The current study has therefore the following objectives:

To determine the long-term effect (6 months) of L-dopa on lactation performance.

To determine the fate of L-dopa in the body through determination of L-dopa concentration in faeces, urine, milk and blood.

To determine the relationship between animal performance and L-dopa levels in the blood.

Procedure

Velvet bean (*Mucuna pruriens*) was established between April and June 2001 on two hectares at the Regional Research Centre Mtwapa. The legume was established at fortnightly intervals to ensure continuous supply of fresh fodder. Napier grass was cut back in May 2001 and Calcium Ammonium Nitrate (CAN) applied. Re-growth from gliricidia established during previous experiments will be used.

Twelve Jersey cows in their 2nd or 3rd month of lactation were selected from a Jersey herd grazing natural pastures in the research Centre. The cows are housed in stalls with individual feeding facilities. They are fed on a napier grass basal diet *ad lib-itum* together with 3 kg maize bran and a mineral lick during milking. The cows were divided into two groups balanced for parity, initial milk yield and live weight. One group is supplemented with 8 kg fresh velvet bean forage while the control group is supplemented with 8 kg fresh gliricidia forage daily. The supplements are offered in two equal amounts in the morning and after-noon. The velvet bean forage is chopped into small pieces of about 20 mm long. Leaves and twigs less than 5 mm diameter are fed to cows. Napier grass is harvested daily and chopped to about 20 mm pieces to avoid selection of leaves from stems. The grass is weighed and offered in the morning and added during the day to ensure contin-uous availability. Refusals are removed and weighed the following day before fresh
feed is given. The cows are offered five kilograms more grass than the previous days intake to ensure *ad libitum* feeding. The cows are hand milked twice per day in the morning and evening and the yield recorded.

The cows are weighed and sprayed with an acaricide to control ticks fortnightly. Blood samples from the caudal vein are taken every fortnight to screen for try-panosomes. L-dopa degradability will be determined over a 24 hours digestion period in the rumen of fistulated steers fed to the treatment diet. Water is provided at all times.

Two weeks were allowed for the cows to aclimatize in the stalls before data collec-tion, which started on 21 June 2001. Treatment diets will be offered for 180 days.

Sampling

Forage samples will be collected weekly and divided into two portions:

Oven dried at 105^{o}C to a constant weight for dry matter (DM) determination

Oven dried at 65^{o}C and stored for nutritive value determination.

Samples of urine, milk, faeces, blood serum, fresh and dried velvet bean forage will be taken every fortnight for L-dopa determination at the University of Nairobi.
Ash and nitrogen in the forages will be determined according to the official method of the Association of Analytical Chemists (AOAC, 1984) while Neutral Detergent Fibre (NDF) will be determined by using the method of Georing and Van Soest (1970).

Data analyses

Data will be stored in Excel files and treatment differences determined through SAS (1987).

References:

Association of Official Analytical Chemists. AOAC 1984. Official methods of analysis: 14th Edition, Association of official analytical chemists. Washington, D.C.

Goering, H.K. and Van Soest, P.J. 1970. Forage and Fibre Analysis. US Dept. of Agriculture Hand book No. 3

Muinga, R.W., Saha, H.M, Njunie, M.N. and Bimbuzi S.2000. The effect of Mucuna, Lab lab, Clitoria and Gliricidia on lactation performance of jersey cows fed Napier grass and maize bran. Paper presented during the 2nd Scientific Conference of the SMP and LRNP on 26-30 June 2000 in Mombasa, Kenya.

Muinga, R. W., Saha, H. M. and Mureithi, J. G. 2001. Effect of L-dopa in Velvet bean forage on the performance of lactating cows. A project proposal.

LEGUME RESEARCH NETWORK PROJECT - RESEARCH THEMES FOR PHASE II (2001-2005)

Introduction

The Legume Research Network Project was initiated in 1994 and its' broad goal is to improve smallholder agriculture in Kenya by developing low-cost and sustainable technologies for maintaining soil fertility and increasing crop production, and hence contribute to food security of the rural communities. The first phase of the project came to an end in December 2000 and a scientific conference was held in June 2000 to mark the end of the phase. The second Phase II began in 2001 and will run for five years. The activities for this Phase are grouped in research themes, which are presented here.

Research Themes

1 Capacity of GM legumes to fix N

2 Green manure legume residue management and nitrogen release studies

- 2.1 The relationship between the quality of legumes and N release patterns and recovery
- 2.2 Residual effects of legume GM after incorporation or mulching
- 2.3 Time and method of legume residue incorporation
- 2.4 Potential of GM legumes for suppressingweeds

3 Legume green manure as a component of Integrated Nutrient Management

- 3.1 Combined use of organic and inorganic nutrient sources

4 Compatibility of different legume species with food crops

- 4.1 Growth habits
- 4.2 Competition for growth resources

5 Inter and intra-species diversification and performance of best-bets under on- farm conditions

- 5.1 Species diversification
- 5.2 Performance of the best-bet species under on-farm conditions
- 5.3 Introduction of grain legumes on-farm

6 Appropriate spatial and temporal nich-es for efficient resource use and for optimal legume and crop productivity

7 The role of green manure legumes inlivestock feeding and as human food

- 7.1 Utilization of GM legumes for food and fodder
- 7.2 Tradeoffs between human food needs, livestock needs and soil fertility improvement.

8 Suitable GM technologies for improving productivity in marginal areas

9 Dissemination of green manure technologies

9.1 Technology diffusion

9.2 Dissemination strategies

9.3 LRNP newsletter

10 Availability of GM legume seed

Implementation

Implementation of the proposed research will be done by Network members in their respective sites while collaboration will be sought from national and regional institutions involved in similar work. Six network members are exploring the possibility of conducting Network research as part of their Ph.D. studies. The Project embraces these efforts and has created provisions to support their studies in the local universities.

ANNOUNCEMENTS

Dr. Charles Karanja Kabiru Gachene joins the LRNP as an Assistant Coordinator

I am pleased to announce that Dr. Gachene joined the Network as an Assistant Coord-inator from 15th September 2001 for a one-year term. He will assist in the implementation of Phase II research activities. Speci-fically, his main responsibilities will be (a) to provide technical backstopping support to six Network members who will be conducting detailed studies that will lead to award of Ph.D. degrees, (b) facilitate publication of Network research results in scientific journals and synthesize them into extension/farmer messages, (c) coordinate publication of this Newsletter, and (d) foster collaboration with institutions in the region involved in similar work.

Dr. Gachene brings to the Network a wide experience in soils research having worked as a soil surveyor in the Kenya Soil Survey for 10 years from 1978 and as lecturer in the Department of Soil Science, University of Nairobi from 1988 till now. He completed his Ph.D. studies in 1995 and was awarded a degree by the Swedish University of Agricultural Sciences, Uppsala, Sweden. The title of his Ph.D. thesis was "Effect of soil erosion on soil properties and crop response in central Kenya". His main teaching assignments includes teaching under-graduate and post graduates on soil genesis, soil survey, soil classification and land evaluation. He has participated in the supervision of 9 MSc. and 6 Ph.D. students. He is a prolific writer and has authored over 60 scientific publications; 15 among them are refereed journal papers and articles. In 1997 he was promoted to the position of a senior lecturer. He is a renowned expert in the area of soil erosion control in Kenya and in 1993 he was appointed by the Soil and Water Conservation Branch of the Ministry of Agriculture to a Task Force that was mandated with writing a manual on "Soil Conservation in Kenya" for use by extension officers. The manual is already in use. He is a member of several professional bodies among them, International Union of Soil Science, World Association of Soil and Water Conservation and Geo-scientists Association for International Development.

Please join me in welcoming him to the coordination of Network activities.

Dr. Joseph G. Mureithi
LRNP, Coordinator

Regional and International Conferences

The Soil Science Society of East Africa will hold the 19th Conference from 2nd - 7th December, 2001, Arusha, Tanzania. For further information, contact Prof J.M. Semoka, Sokoine University of Agriculture, P.O. Box 3008, Morogoro, Tanzania. Email: jsemoka@suanet.ac.tz #or Dr J.P. Mrema, Sokoine University of Agriculture, P.O. Box 3008, Morogoro, Tanzania.:Email: soil@sua.ac.tz
7th Eastern and Southern Africa Regional Maize Conference and Symposium on Low-Nitrogen and Drought Tolerance will be held on 11-15th February 2002 in Nairobi. For more information please contact Dr. Dennis Friesen, P.O. Box 25171, Nairobi, Kenya, email: cmmyt-kenya@cgiar.org

12th International Soil Conservation Organization Conference, 26 - 31, May, 2002, Beijing, China. Contact Secretariat of the 12th ISCO Conference, E-mail: isco2002@swcc.org.cn, paper@swcc.org.cn or http://www.swcc.org.cn/isco2002, http:www.isco2002.org

The 17th World Congress of Soil Science, 14th - 20th August 2002, Bangkok, Thailand. For more information, write to: World Congress of Soil Science, Information Centre, Kasetsart University, P.O. Box 1048, Bangkok 10903, Thailand or Email: o.sft@nontri.ku.ac.th, http://www.17wcss.ku.ac.th