



CIEPCA NEWSLETTER

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Editorial

CIEPCA is nearing 2 years of age and we hope that our maturity is reflected in our current issue. Highlights for the past six months include the creation of an electronic discussion group in French (called EVECS-L), publication of a new mucuna adoption study for southern Benin, and upgrading of LEXSYS (the Legume Expert SYStem). The need for this third newsletter is evident in the amount of new information that has become available, such as new published and unpublished reports, databases, and Internet websites related to cover crops.

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In this issue, we have given special treatment to the topic of human and animal consumption of grain of cover crops. This is because of a perception that adoption of cover crops will be stimulated if multiple benefits can be realized by farmers. For example, the existence of a demand for mucuna seed (bought from farmers by research and extension organizations) is thought to be partially responsible for high rates of adoption of mucuna by farmers in southern Benin.

We will try to address other special topics, such as insect and disease problems, in future issues

CIEPCA NEWS

Creation of EVECS-L

In the second issue of this Newsletter, we announced the establishment of a French language electronic discussion list on cover crops now known as EVECS-L (list on Green Manures and Cover Crops for Soil). It is an on-line discussion forum about cover crops and green manures, with interdisciplinary information exchange in the following fields: agriculture, animal sciences, economics, geography, environmental sciences, plant pathology, etc.

EVECS-L was set up on 28 October 1998 and is currently managed by the Center for Cover Crops Information and Seed Exchange in Africa (CIEPCA) in collaboration with the MOIST/CIIFAD (Management of Organic Inputs in Soils of the Tropics/Cornell International Institute for Food, Agriculture and Development) programme of Cornell University, USA. The list is hosted by Cornell University and the Moderator is the CIEPCA Co-ordinator.

Summary of the Discussions held on EVECS-L until 31 January 1999

The first topic of discussion was the suggestion of a small "electronic market" where requests could be promptly made. Then these requests would be taken on to producers until the market develops enough to organize itself. One important issue relating to seed production by farmers was recognised to be the need to ensure that funds are made available for plant health inspection on the farms of seed producers, and that the activity is properly managed to avoid the transfer of bad quality seeds from one region to another.

The second topic dealt with the "production of cover crops" as in the case of cash crops in the West African sub-region. Developed countries are very interested in financing export crops like cotton, but this is not yet the case with cover crops. At this stage, we need to focus on sensitising cover crops users and providing them with useful information.

Other issues raised include the protection of cover crop plots against bush fires, how to motivate extension agents to ensure wider dissemination of cover crops, the use of cover crops as animal feed, and human consumption of mucuna. One request that is yet to be satisfied has to do with the search for a source of the 'erect type' mucuna.

Membership and Subscription to EVECS-L

As at 11 January 1999, the list had 46 members including 28 in Africa and 18 outside Africa as follows: 11 members in Benin, 2 in Burkina Faso, 2 in Cameroon, 3 in Canada, 8 in the United States of America, 3 in France, 1 in Haiti, 2 in Norway, 2 in Madagascar, 3 in Mali, 6 in Cote d'Ivoire, 1 in Nigeria and 3 in Senegal.

If you wish to subscribe to EVECS-L, please send an e-mail to Albert Eteka <a.eteke@cgiar.org> giving such details as your first name, surname and e-mail address. You can also register your colleagues or friends.

New mucuna adoption estimates for southern Benin

An intensive study was undertaken by A.N. Honlonkou, Doctoral Student at Centre Ivoirien de Recherches Economiques et Sociales (CIRES) in Abidjan. Data were collected in late 1997 on mucuna adoption in 400 households in 10 villages in southern Benin. The data allow an estimate of adoption of mucuna fallows of approximately 7% of farmers in southern Benin. The adoption estimates are lower than other adoption estimates available because sampling included some villages where mucuna was not intensively tested with farmers and because farmer sampling was random. Previous studies focussed on a small number of villages where mucuna fallow systems were first tested, or they targeted farmers participating in testing activities. The sampling method allows extrapolation of the results to the rest of southern Benin, which gives an estimate of 14,000 farmers. This apparent success is attributable to the large number of governmental and non-governmental research and developmental organizations testing mucuna systems in southern Benin for a decade. The study was supervised by V.M. Manyong of IITA's Resource and Crop Management Division and financed by the CIRES-Katholieke Universiteit Leuven project, IITA, and CIEPCA. CIEPCA is financed by IDRC.

LEXSYS 3.0 is now Windows95 compatible

LEXSYS is a legume database that was described in the first issue of the CIEPCA Bulletin. It is a decision support tool for researchers and developers who are developing sustainable farming systems with a leguminous crop component. It is also an educational tool that helps the user to think about issues related to integration of leguminous crops into farming systems. LEXSYS 2.1 is a DOS program and therefore CIEPCA supported the work to make it compatible with Windows95. The work was performed by the original programmer of LEXSYS, Mr. A.B.C. Robert, who worked at the CIEPCA secretariat in early January, 1999. Those desiring LEXSYS 3.0 should send four 1.44Mb diskettes or one zip cartridge to CIEPCA. Installation of LEXSYS uses the SETUP file like most Windows programs. After installing LEXSYS 3.0, it is necessary to copy the file 'lexsys3.ini' from the Lexsys3 directory to the root directory. Future plans for LEXSYS include a CD-ROM version with photographs of seed, plantlets, symptoms of disease, and nutrient deficiencies.

NEW WEBSITES ON COVER CROPS

Cover Crops for Sustainable Agriculture

This site contains information on research on cover crops for sustainable agriculture developed or published by the Exploration of Cover Crops for Sustainable Agriculture from the International Development Research Centre (IDRC) in Ottawa, Canada. The address is <http://www.idrc.ca/institution/cover_crop/index_e.html>.

Illustrated Legume Genetic Resource Database

This is an interesting new database being developed for legumes. It is accessible through the Ministry of Agriculture, Forestry, and Fisheries Genebank of Japan. It has photographs of seeds, flowers, and pods as well as some background information on the legumes related to their use in Japan. The address is <<http://www.gene.affrc.go.jp/image/legume.htm>>. The database currently contains one each of *Cicer*, *Lablab*, *Macrotyloma*, *Mucuna*, and *Psophocarpus*, two each *Canavalia* and *Glycine*, three *Phaseolus*, and 22 *Vigna* species.

Thanks to Sheryl Swink of MOIST/CIIFAD for bringing this to our attention through MULCH-L.

SOURCE OF SEEDS OF COVER CROPS

Inland & Foreign Trading Co.

The INLAND & FOREIGN TRADING CO., (PTE) LTD. sells many kinds of seeds, including some of cover crop species such as *Calopogonium caeruleum*, *Calopogonium mucunoides*, *Canavalia ensiformis*, *Centrosema plumerii*, *Centrosema pubescens*, *Crotalaria juncea*, *Crotalaria anagyroides*, *Desmodium ovalifolium*, *Desmodium intortum*, *Mucuna pruriens*, *Psophocarpus palustris*, *Psophocarpus tetragonolobus*, *Pueraria phaseoloides*. Their list of pasture seeds includes several *Desmodium*, *Stylosanthes*, and *Macrotyloma* species as well as *Lablab purpureus* and *Macroptilium atropurpureum*. They also have erect species such as *Crotalaria striata*, *Cajanus cajan*, and *Tephrosia vogelii* and many leguminous trees. The director is Mr. Samuel Ratnam. Their address is : Block 79A, Indus Road #04-418, Singapore 169589. Fax : 271 6118; Tel: 272 2711; E-mail: <iftco@pacific.net.sg>

COVER CROP SEED FOR HUMAN AND ANIMAL CONSUMPTION

Feeding mucuna seed to pigs in southern Benin

There are two reports from southern Benin on the use of mucuna seed to successfully supplement pig rations. The first is from INRAB's farming systems research team in the Mono Province in 1996. Treatments were:

T0 = Control (dominated by cassava and kitchen waste).

T1 = T0 + 100 g/day of unprocessed mucuna seeds.

T2 = T0 + 100 g/day of mucuna seeds that were cracked and soaked in water for 24 hours.

T3 = T0 + 100 g/day of mucuna seeds that were roasted.

Rations were fed to 5 to 6 month-old pigs for 12 months from June 1995 to June 1996. T1 was stopped because 33% of animals had diarrhea. Average weight gain was 34 g/day for T0, 61g/day for T2, and 54 g/day for T3. Furthermore, farmers found cracking and soaking mucuna seed easier than roasting.

For further information, contact Mr. Isidore GBEGO, INRAB-Niaouli, Tel (229) 37.11.50, 01 BP 884 Cotonou République du Bénin <inrab@cgiar.org> Tél (229) 30.02.64

The second report is from the extension service in Oueme Province, also in southern Benin. They chose to process the mucuna seed by soaking overnight, then drying and cracking. The ration was 3.6 kg/pig during 4 months (100 g/day). The average weight gain was 5 kg more than the control (no supplementation). The average weight gain with mucuna was similar to supplementation with fish meal or soybean, but mucuna supplementation was considered to be cheaper.

For further information contact Mr. Ludovic LANTONKPODE, Agent Spécialisé en Zootechnie, CARDER-Ouémé or Mr. Grégoire. HOUNGNIBO, Chef Service Vulgarisation et Recherche-Developpement, CARDER-Ouémé, B.P. 81 Porto Novo, Republique du Bénin.

Unfortunately, work has stopped in southern Benin because of an outbreak of swine fever in mid-1997. Work to date suggests that mucuna supplementation is a promising way to increase pig production and to stimulate the market for mucuna seed as pig raising takes off again in the region.

Interested researchers

Several individuals are interested in human and animal consumption of mucuna and canavalia grain. They are :

- 1) Rolf Myrman, 1151 North State St., Elgin Illinois, 60123, USA, Tel: (847) 6952500 ext. 3740, Fax: (847) 695-0407, <rmyhrman@nslsilus.org>
- 2) J. Arnason, Department of Biology, Professor of Biology, University of Ottawa, Ottawa, Canada K1N 6N5 <jarnason@science.uottawa.ca> (working on phytochemistry of mucuna).
- 3) Ike Ezeagu, UNU Fellow, CFTRI, Mysore 570013, India <ikezeagu@cscftri.res.nic.in> (working on nutritional potential of mucuna seeds)
- 4) M. Egounlety, Faculté des Sciences Agronomiques <egoumout@syfed.bj.refer.org>, Republic of Benin
- 5) Lyndon Carew, Professor of Animal Sciences and Professor of Nutrition and Food Sciences, 207 Terrill Hall, University of Vermont, Burlington, VT 05405 USA <lcarew@zoo.uvm.edu> (working on mucuna and monogastric animal nutrition, mostly chickens)
- 6) A.B.I. Udedibie, Professor, Department of Animal Production, Federal University of Technology, PMB 1526 Owerri, Nigeria. (working on *Canavalia ensiformis* and poultry)
- 7) Abel Gernat, Panamerican School of Agriculture, Zamorano, Apartado Postal 93 Tegucigalpa, Honduras <agernat@zamorano.edu.hn> (working with mucuna and poultry)
- 8) Sylvain Coffi Dossa, Vétérinaire, Entomologiste, PhD, Unité de Recherche Zootechnique et Vétérinaire, Institut National de Recherche Agricole du Benin, Benin Republic, <inrabdg4@bow.intnet.bj> (working on mucuna and poultry and rabbits)
- 9) Robert Gilbert, P.O. Box 30721; Lilongwe 3, Malawi <rgilbert@malawi.net> (Testing Mucuna recipes for human consumption)
- 10) T. Berhe, SG2000, BP 5348, Conakry, Republic of Guinea, W. Africa, Tel : 224- 45-10-44, Telefax : 224-45-10-45, <t.berhe@cgnet.com> (Testing Mucuna recipes for human consumption)



PUBLISHED REPORTS ON COVER CROPS

Cover crops in West Africa: Contributing to Sustainable Agriculture

Edited by D. Buckles, A. Eteka, O. Osiname, M. Galiba, and N.

Galiano.

A limited number of copies are available from CIEPCA. Write to the coordinator. Also available from IDRC and on-line at

<<http://www.idrc.ca/books/focus/852/index.html>> .

Effects of soil fertility and fertilizer application on biomass and chemical compositions of leguminous cover crops in *Nutrient Cycling Agroecosystems* 51: 231-238 (1998)

G. Tian and B. T. Kang, International Institute of Tropical Agriculture (IITA), P.M.B. 5320, Ibadan, Nigeria., c/o L.W. Lambourn & Co., 26 Dingwall Road, Croydon CR9 3EE, England. Email: <G.Tian@cgiar.org>

Abstract

The biomass and chemical compositions of selected leguminous cover crops *Aeschynomene histrix*, *Cajanus cajan*, *Centrosema brasilianum*, *Centrosema pascuorum*, *Chamaecrista rotundifolia*, *Crotalaria verrucosa*, *Lablab purpureus*, *Psophocarpus palustris*, *Pseudovigna argentea*, *Mucuna pruriens*, *Pueraria phaseoloides*, and *Stylosanthes hamata* were studied in a pot experiment, using soil with two fertility levels. Biomass yield responded to soil fertility levels and fertilizer application. The highest response to soil fertility was observed with *C. brasilianum* (340%, 200%, and 310% more shoots, roots, and nodules in high fertility soil than low fertility soil without fertilizer application). The highest response to fertilizer application was with *P. palustris* (500% more shoots with fertilizer than without in high fertility soil), with *C. rotundifolia* (410% more root with fertilizer than without in low fertility soil), and with *L. purpureus* (1330% more nodules with fertilizer than without on high fertility soil). Legumes grown without fertilizer application allocated more biomass to roots than those with fertilizer application. *Chamaecrista rotundifolia*, *L. purpureus*, *P. argentea*, *M. pruriens* and *C. cajan* showed higher N content in roots than in shoots. Soil fertility levels did not affect N content of shoot, while fertilizer application increased it by 30%. Except for *C. cajan* (only shrub species), all the herbaceous legumes had lower lignin content (6% – 10%) in the shoots. The mean lignin content in roots was above 20% with no fertilizer, and decreased with fertilizer application compared to the no fertilizer treatment. The polyphenol concentration in shoots was higher than in roots.

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Mucuna - herbaceous cover legume with potential for multiple uses

R.J. Carsky, S.A. Tarawali, M. Becker, D. Chikoye, G. Tian, and N. Sangina. 1998. Resource and Crop Management Research Monograph No. 25, International Institute of Tropical Agriculture, Ibadan, Nigeria. 52 pp. Available from the CIEPCA¹ or IITA-Ibadan (The Director, Resource and Crop Management Division, International Institute of Tropical Agriculture, PMB 5320, Nigeria)

Summary

Mucuna is one of the most promising fallow species for soil improvement and weed suppression. Research on *mucuna* has been scattered throughout the tropics and over a long time period. Thus, this review attempts to synthesize the available information for those contemplating the use of *mucuna* or already using it to improve farming systems. An important outcome of this review is that *mucuna* does not grow well under all conditions, and therefore can not contribute to farming systems in all environments. For example, *mucuna* does not grow well in acid soils, waterlogged soils, low-P soils, and short growing season zones. *Mucuna* is adapted to the humid and subhumid zones but only marginally to the semi-arid zone.

There are many cropping system niches (temporal and spatial) in which *mucuna* can be grown to provide the desired benefits. Temporal niches (sole *mucuna* fallows) appear most promising because *mucuna*'s aggressive nature results in substantial competition when intercropped with many crops. *Mucuna* fallow systems must be tested locally with farmers as was done in southern Benin where the most successful adoption has taken place. Benefits in addition to soil improvement and weed suppression, include animal feed and human food. These additional benefits will influence farmers' perception and adoption of *mucuna* and therefore should be explored.

Another important outcome of this review is that there are several distinct varieties of *mucuna* and therefore information on adaptability, crop management, benefits, and cropping systems niches must be extrapolated with some caution. *M. pruriens* vars. *utilis* and *cochinchinensis* are best known and can be tested under a range of biophysical conditions and systems niches. At the same time research is needed to encourage biodiversity of *mucuna*, identify and optimize its benefits in farming systems, and identify determinants of adoption in order to better target *mucuna* fallow technology to farming systems.

¹ See the address on the last page

Farmers' adoptability of mucuna fallowing and agroforestry technologies in the coastal savanna of Benin *in Agricultural Systems* 56: 269-287 (1998)

M.N. Versteeg, F. Amadji, A. Eteka, A. Gogan, and V. Koudokpon, International Institute of Tropical Agriculture, Institut National des Recherches Agricoles du Bénin, and Projet Gestion des Ressources Naturelles.

Summary (Contributed by R.J. Carsky)

Soil fertility decline is occurring in southern Benin because of very high population density. The farming systems research team of the national agricultural research service (called INRAB) tested several technologies to counter soil fertility decline. Part of the work from 1987 to early 1995 is reported in this paper. The technologies included 1) alley farming with *Leucaena leucocephala* and *Gliricida sepium*, 2) cover cropping with *Mucuna pruriens* var. *Utilis*, and 3) woodlots of *Acacia auriculiformis*. This work was an outreach activity of the International Institute of Tropical Agriculture, which had worked on these resource management systems in Nigeria, mostly on-station, during the 1970's and 80's.

Results of the alley farming tests have shown that timely pruning of the trees is a critical element in farmers' capacity to match previous on-station results. For example, in 1994, more than half of collaborating farmers did not follow the recommended pruning regime and obtained maize yields that were 60% lower than a no-tree control. To avoid tree/crop competition, collaborating farmers began testing a new spatial arrangement called alley bands, in which trees are grown in 4m wide bands and crops occupy 20m between bands.

Acacia auriculiformis woodlots were popular because they regenerate exhausted soils in 3 or 4 years while producing a harvest of good quality wood for fuel or construction. The number of farmers testing this system rose from 8 in 1989 to well over 100 in 1993, with other research and extension teams contributing their effort.

The most interesting system during the short period reported was cover cropping. After a 1987 demonstration for soil fertility management, mucuna was subsequently targeted to fields infested with speargrass (*Imperata cylindrica*) by farmers in association with several research and extension organisations. In spite of this apparent success, an adoption study indicated that there was slightly more rejection of the technology than adoption. Major reasons for rejection were related to the fact that mucuna is little known as food. This led to research on processing mucuna grain to detoxify it and to incorporate the resulting flour into local recipes.

A major point of this report is that interaction with farmers was necessary to keep research oriented toward solving farmers' problems. This requires a range of survey, trial, and discussion activities over a period of many years in order to develop appropriate resource management technologies.

Differential phosphorus responses of leguminous cover crops on soils with variable history *in Journal of Plant Nutrition* 21: 1641-1653 (1998)

G. Tian, R. J. Carsky and B. T. Kang, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria c/o L.W. Lambourn & Co., 26 Dingwall Road, Croydon CR9 3EE, England. Email: <G.Tian@cgiar.org>

Abstract

The response of 8 leguminous cover crops to P application (7.5 mg P₂O₅ kg⁻¹ soil or 15 kg P₂O₅ ha⁻¹ to the depth of 15 cm) on soils with variable history was evaluated in a pot trial supplemented with a field experiment in 1993. The soil from a livestock farmer's field showed higher total organic carbon content and extractable cations compared to that from a non-livestock farmer's field. In the pot trial, P application, on average, increased shoot, root, nodule dry matter and N accumulation of the legumes by 82%, 45%, 87%, and 90% respectively, compared to the control. *Cajanus cajan*, *Crotalaria ochroleuca*, *Centrosema pascuorum*, and white-seeded *Mucuna pruriens* showed a higher P response than *Centrosema brasilianum* and *Chamaecrista rotundifolia*. The legumes grown on the manured soil showed not only higher biomass and N accumulation, but also higher increase (110% and 117%) in total dry matter and N accumulation because of P application than those grown on the un-manured soil (27% and 45%). In the field experiment, spreading legume groundcover at 16 weeks after planting was increased by 4% in the un-manured soil and by 31% in the manured soil. *Centrosema brasilianum* even showed a negative response of groundcover to P application. There was little response in erect legume height to P, except for measurements at 6 and 8 weeks after planting, when P increased plant height for *Crotalaria* on un-manured soil. Results imply high returns can be expected when P is applied to leguminous cover crops in fairly fertile soil. The relatively low response under the field conditions, compared to pot, suggests caution is needed when P is recommended for legumes grown under environmentally stressed conditions.



Diversity in phenology of *Mucuna* spp. resulting from differences in the effects of temperature and photoperiod on progress to flowering in *Journal of Agronomy and Crop Science* (1999)

Qi Aiming, R.H. Ellis, J.D.H. Keatinge, T.R. Wheeler, S.A. Tarawali and R.J. Summerfield

The University of Reading, Department of Agriculture, Earley Gate, P O Box 236, Reading, RG6 6AT, Berkshire, UK.

Summary (Contributed by J. D. H. Keatinge)

A wide selection of *Mucuna* spp. germplasm was evaluated over a range of contrasting photothermal conditions in controlled-environment glasshouses at the Plant Environment Laboratory at The University of Reading in UK. Dates of emergence and first flowering were recorded. Models were fitted to the first flowering data to quantify the relative sensitivity of each species to photoperiod and temperature. All accessions showed short-day responses but there were substantial differences in the sensitivity of rate of progress to first flowering to environment, particularly to photoperiod. This would result in differences in maturity period between accessions which, with appropriate understanding, could be functionally exploited by NGOs and NARS. Thus, transfer of germplasm between locations considerably differing in latitude, or with radical changes in the seeding calendar, would be better undertaken within the context of an improved understanding of the photothermal implications for crop phenology. Failure to be aware of these differences may have critical consequences for NGOs and NARS seeking to extend cover crop technology with *Mucuna* spp. For example, some germplasm will flower and set seed successfully in longer photoperiods but others clearly will not. The range in relative maturity period displayed between *M. preta* and *M. añã* (Zamorano Dwarf landrace) is both a potential hazard and also a potential advantage depending on the precise objective in a specific farming system. If there is only a narrow window of opportunity for growing a cover crop, such as between the cropping of subsistence cereals, then clearly Zamorano dwarf's earliness could guarantee the satisfactory completion of the crop's growth within the cropping cycle. Whereas, if the objective was weed suppression for the longest possible period, such as under plantation crops or to maximise biological productivity for green manuring, an exceptionally late flowering species even in short days such as *M. preta* might well be preferable. Flowering responses to temperature must also be considered. Even though differences between germplasm in the thermal plane were negligible it is evident that species such as *M. deeringiana*, *M. jaspadea* and *M. veracruz-stepan* may be further delayed in flowering if average air temperatures are $>32^{\circ}\text{C}$. As such environments might be found closer to the tropics rather than the equator (owing to reduced cloud cover in drier seasons) the coupling of longer photoperiods with warmer temperatures might seriously influence phenology in such accessions.

The findings of this research give clear indications to IARCS, NARS and NGOs that although *Mucuna* spp. are short-day plants, it would be unwise

to adopt a cavalier attitude to their popular dissemination across key photothermal boundaries. Such actions might well provoke a negative farmer backlash. It is not necessary for such problems to occur as there is clearly a wide range in germplasm maturity which can be exploited sensibly. Nevertheless, it requires a clear understanding by NARS and NGOs that the photothermal boundaries of the recommendation domain of any one accession are defined and thus limited. This recognition must underpin the informed decisions of NGOs as they continue their dissemination of this family of species for use in cover crop and green manure technologies in the design of sustainable cropping systems in the tropics and subtropics.

Integrated soil management for the savanna zone of W. Africa: Legume rotation and fertilizer N in *Nutrient Cycling in Agroecosystems* (1999)

R.J. Carsky, B. Oyewole, and G. Tian, International Institute of Tropical Agriculture, IITA-Benin, 08 B.P. 0932, Cotonou, Benin Republic

Abstract

Integrated soil management with leguminous cover crops was studied at two sites in the northern Guinea savanna zone of northern Nigeria, Kaduna (190 day growing season) and Bauchi (150 days). One-year planted fallows of mucuna, lablab, and crotalaria were compared with natural grass fallow and cowpea controls. All treatments were followed by a maize test crop in the second year with 0, 30, or 60 kg N ha⁻¹ as urea. Aboveground legume residues were not incorporated into the soil and most residues were burned early in the dry season at the Kaduna site. Legume rotation increased soil total N, maize growth in greenhouse pots, and dry matter and N accumulation of maize. Response of maize grain yield to 30 kg N ha⁻¹ as urea was highly significant at both sites and much greater than the response to legume rotation. The mean N fertilizer replacement value from legume rotation was 14 kg N ha⁻¹ at Kaduna and 6 kg N ha⁻¹ at Bauchi. With no N applied to the maize test crop, maize grain yield following legume fallow was 365 kg ha⁻¹ higher than natural fallow at Bauchi and 235 kg ha⁻¹ higher at Kaduna. Benefit of specific legume fallows to subsequent maize was most related to aboveground N of the previous legume at Bauchi, where residues were protected from fire and grazing. At Kaduna, where fallow vegetation was burned, maize yield was related to estimated belowground N. The results show that legume rotation alone results in small maize yield increases in the dry savanna zone.

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UNPUBLISHED REPORTS ON COVER CROPS

Farmer solution for the introduction of mucuna into farming systems

By Guy Nouatin, GREPID 02 B.P. 331 Gbégamey, Cotonou, Tel. (229) 30 33 03, E-mail <uniho@bow.intnet.bj>

The mucuna fallow was introduced early 1994 by a Hohenheim University project to improve and maintain soil fertility in Hayakpa, a village located in the Atlantic Province of southern Benin. At the end of each cropping season, farmers harvest and store the mucuna grains without actually knowing what to do with them. This situation discouraged many farmers from introducing the technology into their farming system in spite of the remarkable results obtained on experimental plots. The table below shows the average yields of the first maize season obtained by the Hayakpa farmers on experimental and control plots after mucuna fallow in 1995, 1996 and 1997.

Maize grain yield (kg/ha) after mucuna fallow in Hayakpa farmers' fields from 1995 to 1997. *Source:* UNIHO-G5

	1995	1996	1997
Number of trials	8	13	20
Experimental plots	1200	1045	1355
Control plots	868	767	826

Farmers convinced of the fertilizing effect of mucuna and its role in the protection of soil from erosion and suppression of weeds have invented a way of managing the mucuna fallow that eliminates the labour involved in harvesting the grains, as it is not directly compensated for by the sale or consumption of the grains.

Farmer management of the mucuna fallow

First year:

The mucuna is relay sown among the first rainy season maize; after harvesting the maize, the mucuna grows to maturity on the plot during the second rainy season. The farmer does not harvest the seeds but lets the pods burst in the field.

Second year:

The land is prepared at the beginning of the following season without the seeds being harvested, and the maize is sown in the mucuna mulch. During field maintenance, mucuna plantlets are hoed together with the weeds in order to prevent them from competing with the maize at booting stage. At Hayakpa, farmers weed their maize field only once and all mucuna seeds that germinate after this are no longer weeded.

Management of the mucuna during the second season depends on how much the mucuna sown in the first season has improved the soil fertility. The yield of the first season maize makes it possible to take one of the following decisions:

- if the maize yield is high, then the field will be cultivated during the second season after weeding the mucuna that has completely covered the field.

By so doing, the farmer will succeed in completely ridding the field of mucuna;

- if the yield is low, then the soil has not recovered its fertility, which compels the farmer to leave the mucuna fallow for another year.

Farmers plant a few seeds of mucuna beneath a tree in the field to ensure steady supply of seed in subsequent years.

This method of managing the mucuna fallow offers the following advantages:

1. The labour involved in harvesting and shelling Mucuna grains (itchy with hard pods) is greatly reduced;
2. The labour involved in introducing mucuna in the second year is reduced;
3. Mucuna biomass is made available for the second season maize; this is not possible with the procedures proposed by scientists in their research protocols.

Dynamics of the adoption of mucuna fallow in southern Benin

A.N. Honlonkou, unpublished report to CIEPCA for partial funding of PhD research (supervised by V.M. Manyong, RCMD, IITA).

CONCLUSION

The objective of the present study was to determine the dynamics of adopting mucuna fallow (MF) in southern Benin. An analysis of the adoption data shows that 7% of the farmers of the three regions of Southern Benin adopted the MF in 1997. All the same, the data of the adoption rate over 7 years (1991-1997) suggest that the dissemination of the MF has been very effective. The particularly dynamic role of non-governmental organizations such as SG 2000 between 1994 and 1996 was also noted. When compared to mineral fertilization the research results demonstrate that farmers in Southern Benin appreciate the quality of MF better than chemical fertilisers because of its control effect on noxious weeds, long-term improvement of soil fertility, low cost, and ease of availability at the village level. From an analysis of the constraints to the adoption of the technology, major factors that seem to have a positive impact on adoption are accessibility to informal credit, formal education, literacy in local languages, and land availability. It thus became obvious that MF is more likely to be adopted by men than women.

Work in Uganda on GMCCs by CIAT

The following information was obtained from on-station and on-farm work conducted in central Uganda. All work was done within one degree of the equator, between 1100 and 1200 meters above sea level, with annual precipitation of 1100-1250 mm distributed in a bi-modal pattern with two similar cropping seasons per year. The soils are typically deep, often sandy clay loams of 5.2-5.8 pH and 2.5-3.5% OM, and with a clay "B" horizon. Some of our findings follow.

Crotalaria ochroleuca as a green manure crop

Crotalaria fallow is superior to weedy fallow. Grain yields of maize and beans following one season of *crotalaria* fallow were 41 and 43%, respectively, more than following a two-season weedy fallow.

Yields of the subsequent maize crop were generally higher with surface application of mature *crotalaria* biomass as compared to incorporation of immature *crotalaria* biomass, but the effects on the second subsequent food crop were inconsistent. Biomass produced, and nutrients in the biomass, are more if *crotalaria* is allowed to mature, but the mean C:N ratio was 28 for mature and 23 for immature material.

Bulk density of the surface soil (2-7 cm) was less for two seasons following production of *crotalaria* green manure as compared to continuous cropping with maize. Water infiltration, from initial application of water to dry soil until 45 minutes later, was more following green manure with effects persisting for two cropping seasons (4.2 mm/min following green manure versus 2.8 mm/min following maize). The effect persisted for a third season if the *crotalaria* was allowed to mature. Otherwise effects on soil physical properties were similar for mature, surface-applied and immature, incorporated *crotalaria* green manure treatments.

Crotalaria can be produced in sole crop or by intercropping with other crops, e.g., maize or beans. The 'best bet', however, appears to be production by intercropping with beans: *crotalaria* should be sown into beans at the first weeding (3 weeks after sowing of beans); it continues to grow after harvest of the beans; and the biomass is incorporated when preparing for the next crop.

Comparison of Crotalaria ochroleuca, Canavalia ensiformis, Mucuna pruriens and Dolichos lablab

Canavalia was superior for intercrop production of the green manure with maize. The competitive effect on the associated maize was less and green manure (biomass and plant N) produced was more, while the effects on yield of subsequent crops were similar for the four species.

Following sole crop production of green manure, the increased maize yield was 32% for *dolichos* and 62% for *crotalaria*, but intermediate for the other two species. Only sole-cropped *canavalia* resulted in significantly increased yields of food crops in the second subsequent season.

N recovery rate was highest from *crotalaria* green manure, indicating more efficient N use and less N loss than with other species. The better N recovery

with *crotalaria* may have been due to slower decomposition of the biomass, as *crotalaria* had the highest C:N ratio and the most lignin.

Mucuna and *lablab* were best for early weed suppression except that delayed germination of *mucuna* reduced its competitiveness. Soaking *mucuna* seed over-night and planting only swollen seeds resulted in early and even seedling emergence. Farmers appreciate *mucuna* and *lablab* for their fodder value. We find less farmer interest for *crotalaria* than for *mucuna* and *canavalia* due to labor requirements.

Farmer experimentation on integration of legumes into cropping systems

Farmers did much of their own experimentation to better integrate the legumes into their diverse cropping systems. Most farmer experimentation was on intercropping of *canavalia* with banana and *mucuna* with maize.

They found that *mucuna* could be sown at 75 x 60 cm. The following maize crop was sown by simply uprooting the *mucuna*, dropping 3 maize seeds in the hole while leaving the *mucuna* biomass on the surface, and eventually thinning the maize to two plants per hill. No tillage was required, planting was eased, and little weeding was needed.

When intercropping with banana, legume plant density should be low to reduce competition with banana. Farmers often plant *mucuna* under banana and prune regularly to produce fodder for dairy cows.

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