

Mucuna News

Developing Multiple Uses for a Proven Green Manure/Cover Crop

Update on the Progress of the Project “Increasing Mucuna’s Potential as a Food and Feed Crop”

CENTER FOR COVER CROPS INFORMATION AND SEED EXCHANGE IN AFRICA (CIEPCA)

First issue, January 2001

Background to this Bulletin

This is the first in a series of an informal bulletin for those interested in developing the utilization of *Mucuna* species for food and feed. It will be published occasionally during 2001, whenever there is noteworthy news to share.

Interest in developing *Mucuna*'s food and feed uses originates in the efforts of many national and international organizations during the 1980s and 1990s to research and promote green manure/cover crops. *Mucuna* has repeatedly impressed farmers and researchers due to its high biomass production, weed suppression, and consequent beneficial impacts on main crop yields. It has proved far less impressive in providing more direct benefits to farmers, despite its track record as a food and feed. Those associated with the research and development efforts soon realized that farmers would not adopt *Mucuna* unless other uses besides soil fertility and weed suppression were found for it.

This limitation of *Mucuna* was clearly identified during the Rockefeller Foundation's Green Manure/Cover Crop Exploration project (1998-1999), which recommended further work on the issue. Subsequently, CIDICCO (the International Center for Information on Cover Crops, based in Honduras) and CIEPCA (the Center for Cover Crops Information and Seed Exchange in Africa, based at the Benin station of the International Institute of Tropical Agriculture) together with Judson College in Illinois, USA, organized a workshop "Food and Feed From *Mucuna*: Current Uses and the Way Forward" in April, 2000. This small, interdisciplinary workshop brought together development practitioners with animal and food scientists, plant breeders, and researchers in toxicology and ecology. The workshop resulted in recommendations for future research on the topic that were subsequently developed into a

project by CIEPCA. This project, "Increasing *Mucuna*'s Potential as a Food and Feed Crop," has now received funding from the Rockefeller Foundation.

This bulletin is published by CIEPCA. It is intended to serve as an informal forum for information exchange on issues related to *Mucuna*'s food and feed uses. Though the bulletin originates from the efforts described above, it is by no means meant to be restricted to them. Please therefore feel free to distribute this bulletin to all interested parties and encourage them to contact us with information to share with our readers.

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Project Update

Proposal Accepted

In November 2000, the Rockefeller Foundation accepted CIEPCA-IITA's proposal "Increasing *Mucuna*'s Potential as a Food and Feed Crop" for funding. The objectives of the project are to:

- I. Evaluate potential processing methods for food and feed uses to reduce *Mucuna*'s anti-nutritional compounds while maintaining the protein quality of the products.
- II. Contribute towards furthering the understanding and evaluation of *Mucuna* germ-plasm.
- III. Assess the impacts of *Mucuna* feeds on the health and performance of non-ruminants (poultry).
- IV. Appraise impact of *Mucuna* feeds on the health and performance of small ruminants (goats and sheep).
- V. Assess potential health hazards from secondary compounds other than L-dopa in *Mucuna*.

These objectives will be pursued by a number of investigators working in different regions (see below). CIEPCA-IITA serves as funds administrator, disbursing funds to collaborating institutions through agreements with the investigators involved in the projects.

All activities will be executed by September 30, 2002. One activity is already on-going (genotype by environment trial, see below) and another has been completed (germplasm meeting in Alabama, see below). Independently from this proposal, funds will be sought for a publication of the results obtained during the project and possibly for a concluding workshop.

The Content of the Proposal

The proposal consists of six outputs, each of which includes several activities. The activities are research projects carried out by individuals or groups of individuals located in several countries of Africa and Latin America, as well as in India and the USA. The six outputs and institutions involved in executing these activities are:

1. Processing Methods for Food and Feed from *Mucuna* Beans: Universidad del Valle de Guatemala (Guatemala), University of Florida (USA).
2. Characterization and Improvement of *Mucuna* Germplasm: CIDICCO (Honduras), CIEPCA (Benin), Bharathiar University (India), Auburn University (USA), University of California-Davis (USA), University of Florida (USA), University of Zimbabwe (Zimbabwe).
3. The Use of *Mucuna* in Diets for Non-Ruminants (Chickens): University of Vermont (USA), Michael Okpara University of Agriculture

(Nigeria), Escuela Agrícola Panamericana (Zamorano).

4. The Use of *Mucuna* in the Diets for Ruminants (Goats and Sheep): University of Zimbabwe, INRAB-Institut National des Recherches Agricoles du Bénin (Benin).

5. Impact of *Mucuna*'s Secondary Compounds on Human Health: Judson College (USA), University of Florida (USA).

There is additionally a small number of activities that have not been defined and currently, CIEPCA is discussing possible projects with various individuals.

Work Ahead for the Participating Investigators

The project coordinators have already contacted the participating investigators regarding the agreement to be signed as well as other practical details related to the initiation of the activities. It is recommended that researchers involved in each output review one another's proposals before starting their activities.

Resource Persons for L-dopa Analysis

Many researchers planning the details of their research projects are faced with the issue of L-dopa analysis. There are several different methods of analysis, some of which require equipment (such as HPLC) that is not readily available in all laboratories. Two scientists who attended the April 2000 workshop are experienced in L-dopa analysis and have agreed to act as resource persons for anyone needing advice on L-dopa analysis methods. If you have any needs in this regard, please contact Rolf Myhrman (rmyhrman@judson-il.edu) or Nancy Szabo (szabon@mail.vetmed.ufl.edu).

Germplasm Meeting in Alabama.

One of the activities of the project has already been completed. In September 21-22, 2000, two of the April 2000 workshop participants, Steve Temple and Luc St-Laurent, visited Ludovic Capo-chichi in Auburn, Alabama. S. Temple is a bean breeder-agronomist at the University of California-Davis, while L. St-Laurent and L. Capo-chichi are both knowledgeable in *Mucuna* taxonomy (see below).

The purpose of the visit was to give an opportunity for the three scientists to together assess the morphological variability in the accessions grown by them (particularly the Auburn trials of L. Capo-chichi), to discuss the research of L. Capo-chichi, and to recommend further work on issues related to *Mucuna* germplasm. The three participants have produced a final report, which is available on request from Ludovic Capo-chichi (cludovic@acesag.auburn.edu).

Based on the visit, the group made the following recommendations:

- Further crosses of *Mucuna* should be made and their agronomic characteristics evaluated. Such crosses should include crosses between high and low, and between low and low L-dopa lines.
- L-dopa data should be obtained on a number of individual plants from a supposedly uniform cultivar or landrace to better estimate the range of plant-to-plant and seed-to-seed variability in L-dopa levels that one can expect.
- The taxonomy of *Mucuna* genus and *Mucuna pruriens* species needs to be clarified to allow for a correct identification of species and cultivars within species.
- Current use of cultivar names should be discontinued in formal research, and researchers should make clear in their communication that names are used only to denote the origin of the seeds and are not taxonomic descriptors.
- A centralized seed bank should be organized for *Mucuna*, to store germplasm and passport data.
- Investigation of wild germplasm of *Mucuna* should be encouraged.

The group also recommended that while the genotype by environment trial (see below) be continued in 2001, certain modifications be made, such as including a greater number of accessions, including accessions which are diverse in maturity and morphological characteristics, and involving trial sites at a wider range of latitudes.

Genotype by Environment Trial

As part of the project, a genotype by environment trial on the production of L-dopa is being conducted. There is little information on whether the production of L-dopa in *Mucuna* is mainly controlled by genetic or environmental factors although some researchers have suggested that environmental factors, particularly latitude where *Mucuna* is grown, may play a major role. Determining the comparative role of environment and genotype is important for further work on reducing L-dopa content of *Mucuna*, perhaps through germplasm improvement.

Four *Mucuna* accessions from same seedlots were provided by CIEPCA. While in most sites, planting took place in July 2000, in Zimbabwe it was done in November, 2000.

The trial sites include: Cotonou, Benin (responsible researchers: A. Eteka and R. Carsky), Mt. Pleasant, Zimbabwe (B. Maasdorp), Olancho, Honduras (T. Zúñiga), Davis, California, USA (S. Temple) Bell Glade, Florida,

USA (R. Gilbert), Gainesville, Florida, USA (M. Eilittä). The trial design is Randomized Complete Block, with 4 replications. Plot size is variable and in two cases, the trial is planted in pots. The *Mucuna* accessions planted did not survive a storm and early frosts in Davis, California. In Gainesville, FL, only two accessions matured. Rolf Myhrman from Judson College, Illinois, will analyze the *Mucuna* seed produced in this trial.

The plans for the genotype by environment trial for 2001 are currently being discussed.

Other News:

Workshop Proceedings:

Proceedings of the workshop "*Mucuna* as a Food and Feed: Current Uses and the Way Forward" are expected to be published in April 2001. In addition to all the papers presented at the workshop, the proceedings will include an overview of issues related to *Mucuna*'s food and feed uses, a chapter on future research and development issues (which includes the recommendations of the working groups) and conclusions which will summarize the major findings of the workshop. The editors of the proceedings are Milton Flores, Marjatta Eilittä, Robert Carsky, Lyndon Carew, Rolf Myhrman, and Jaime Rojas. The proceedings will be published by CIDICCO (International Center for Information on Cover Crops).

Mucuna Use in E. Nigeria

Mucuna has a varied, but little-investigated use as a food in E. Nigeria. *Mucuna sloanei* is widely used but in small quantities as a soup thickener and some research has been conducted on it. Some research has also been conducted on *Mucuna pruriens* as well as on *Mucuna flagillepes*.

Seemingly, in terms of quantity, *M. pruriens* is the species most consumed. In mid-October, 2000, Sunday N. Ukachukwu and Marjatta Eilittä had an opportunity to learn about such use during visits to farms and a market in the area surrounding Nsukka, a university town in the Enugu state. In this area, *M. pruriens* is visible in many homegardens; it is not normally planted in the fields. It is typically planted near trees and climbs around the trees, clearly producing high amount of seed per plant. In some homegardens, it is also planted by the fence or to climb the yam stakes together with yam. Both white- and black-seeded *Mucunas* (scientists in the region refer to these types typically as var. *cochinchinensis* and *utilis*, respectively) are used but the white-seeded is preferred.

Mucuna beans are also sold in a local rural market though only two sellers could be located in October, an off-season period (*Mucuna* was at flowering-green pod stage). Many of those interviewed in the market and in the villages mentioned that they mainly eat *Mucuna* during its harvest period, beginning in January, and did not have any available.

In this area, *Mucuna* is prepared in various ways. Its principle use is as dry beans in a stew ("soup"). It is briefly dry-roasted (5-10 minutes) in a pot on fire until the seed becomes spotty brown. It is then pounded, sieved (to separate the seed coats) and added to a soup consisting of greens, vegetables, oil and sometimes meat; in that soup, it is cooked at least 30 minutes. It was estimated that a cup containing about 200 seeds feeds approximately 10 people. It is therefore used in the same way as the seed of *egusi* melon, an extremely popular ingredient in Nigerian cooking, and sometimes the seeds of *Mucuna* and *egusi* are mixed.

A number of minor uses were mentioned by those interviewed:

- As dry beans in plain stew: Preparation is similar to above but only oil, pepper and salt are added (i.e., the stew contains no greens, vegetables or meat). The stew resembles a thick slurry and is eaten with a staple.
- As fresh beans in a stew: Green pods are boiled, pods and seed coat are removed, the seed is ground and mixed with water, and the mixture is added in a soup.
- As dry beans in flour: *Mucuna* is prepared into flour as described above, but that flour is mixed with yam or cassava flour and used as a staple.
- As a snack food: One interviewee mentioned that *Mucuna* is also roasted well (until completely brown) and eaten with oil palm kernels as a snack.

Mucuna is generally eaten by both old and young. Those interviewed had various opinions about problems that one may incur after its consumption. While some of the market ladies made dramatic impersonations of dizziness when inquired, others insisted that there are no problems with *Mucuna* consumption. Still others pointed out that *Mucuna* caused problems only under certain conditions, e.g., if the soup has an inadequate oil content, if the soup is not well cooked (i.e., over 30 minutes), or if the seed coat (especially of the black-seeded type) is not removed. Similarly contradictory views were given on *Mucuna*'s palatability. Most interviewees agreed that in general, *egusi* is a more preferred soup ingredient, but did not want to admit that they themselves did not like *Mucuna*. *Egusi*'s higher price (fetching 11-12 nairas per cup in

January, at *Mucuna* harvest time when *Mucuna* may be priced at only 2 nairas) also demonstrates this preference.

During the visits by S. Ukachukwu and M. Eilittä, three women made demonstrations on how *Mucuna* is cooked to flour stage according to its principle method of preparation. Clearly, this pre-preparation into flour is relatively quick, and comparatively high L-dopa content is likely in *Mucuna* flour that is added to stews (samples were collected for analysis). The most likely explanation for continued consumption of *Mucuna* in spite of L-dopa's negative impacts is that relatively small amounts of it are consumed. However, with an average consumption of 20 seeds (see above; approximately 16-18 g) per person; at 5% L-dopa content (typical in raw beans) the maximum amount of L-dopa ingested would be 0.8-0.9 g (800-900 mg), a medium dose for medicinal use of L-dopa. If cooking procedures reduce the L-dopa to half of this, still 400-450 mg of L-dopa would be consumed.

One of the activities of the current project includes field-level surveys that will be conducted on the utilization of *Mucuna* as a food and feed in various countries of Africa and Asia. For more information or if you have knowledge of *Mucuna*'s utilization as a food and feed in these regions, please contact Marjatta Eilittä (meilitta@gru.net).

Mucuna Work in Mexico

RED/gac (Network/Cover Agriculture Group) is a network of non-governmental organizations and academic institutions working on green manure/cover crops in Mexico. Most of the organizations involved have been collaborating since 1992, first as a network of projects that were funded by the Rockefeller Foundation, and more independently since 1997. Currently, the group is working together on germplasm collection and multiplication, development of a KIT on green manure/cover crop systems for Mexico, human resources, and animal feed issues, among other topics.

The institutions involved in the group have conducted a number of research projects on *Mucuna* to date. In 2001, a group will initiate several new research projects. The work will be conducted in two states, Chiapas and Yucatan, in the facilities of Universidad Autónoma de Chiapas and the Universidad Autónoma de Yucatan (Autonomous University of Chiapas and Yucatan, respectively). In addition to the aforementioned institutions, a cooperative consisting of farmers and extensionists, Sociedad Cooperativa Mok Cinti (Cooperative Society Mok Cinti), is also participating in the work.

The following projects will be initiated:

- Evaluation of young bulls feeding on a corn-*Mucuna* stubble in an agropastoral system
- Use of *Mucuna* seed as a supplement for dual-purpose cows during the dry season
- Incorporation of *Mucuna* in nutritional blocks
- Evaluation of diets with *Mucuna* for the fattening of sheep in pens
- Evaluation of the chemical composition of the grain and pod of *Mucuna*
- Study on the acceptability and consumption of *Mucuna*
- Adaptation and adoption of methods to utilize *Mucuna* in the communities of Sahcabá and Hocabá, Yucatan
- Partial and total substitution of soybean with *Mucuna* as a protein source in the diet of sheep
- Evaluation of diets with *Mucuna* in the fattening of sheep in pens in the Sierra de Santa Marta region of Veracruz

For further information, contact Wel Olvein Cruz Macias in Chiapas (wel.cruz@correoweb.com), José B. Castillo Caamal in Yucatan (jcastillo12@hotmail.com) or Cristina Guerrero or Balente Herrera in Veracruz (stamarta@dns.moomsa.com.mx).

Calcium Hydroxide and L-dopa

In the April 2000 workshop, Tareke Berhe from Sasakawa-Global 2000 project in Guinea mentioned that calcium hydroxide may be a promising additive to *Mucuna*; Ricardo Bresani from Universidad del Valle de Guatemala also proposed that alkaline solutions may be useful in reducing L-dopa content of *Mucuna*. For T. Berhe, this idea was suggested by Mr. Benign Ruiz Sesma, of Merida, Yucatan.

The final workshop paper by Diallo et al. (which in the workshop was presented by T. Berhe) will include data on the impact of calcium hydroxide additive on processed *Mucuna*'s L-dopa content (Table 1). Clearly, adding calcium hydroxide to broken *Mucuna* beans results in an extremely low L-dopa content (0.01%). However, the resulting mixture is black (perhaps because of melanin) and more work is needed on the health implications of utilizing it in animal feeds. In Guinea, research with chickens indicates good growth and ready acceptance of the feed. For more information, contact Tareke Berhe (t.berhe@cgnnet.com).

Table 1. L-Dopa concentration (%) of *Mucuna* seeds after various combinations of crushing, soaking, and seed coat removal.

Seed treatment*	L-dopa concentration (%)	95% confid. Interval
1.	5.6	0.06
2.	4.03	0.05
3.	1.75	0.08
4.	0.01	0.001
5.	5.61	0.07

- *1. Whole, soaked 24 hrs., seed coat removed.
 2. Crushed, soaked 24 hrs., seed coat rem'd.
 3. Whole, soaked 24 hrs. in 4% Ca(OH)₂.
 4. Crushed, soaked 24 hrs. in 4% Ca(OH)₂.
 5. Whole seed (control)

Source: Diallo et al., forthcoming.

Work on the Taxonomy of *Mucuna*

At Auburn University in Alabama, USA, Ludovic Capo-chichi is conducting Ph.D. research on the taxonomy of the genus *Mucuna pruriens* mainly by using molecular techniques. L. Capo-chichi had two research sites in 2000: one where 18 (in 1999: 40) hill-plot, single-plant accessions of *Mucuna* species were grown on trellises with two replications and another, where 40 accessions were grown in plots with four replications. The purpose of the first was to produce seed and to collect samples for AFLP (Amplified Fragment Length Polymorphism) analyses, while in the second site, biomass and seed production were measured, morphological characteristics evaluated, and specimens collected. L. Capo-chichi has already conducted some crosses between *Mucuna* accessions as well as some AFLP analyses, which indicate relatively high variability among the species studied. Interestingly, the grouping patterns obtained through AFLP analysis coincided well with length to maturity, with large genetic difference found between early- and late-maturing accessions included in the study. These early-maturing accessions were mainly obtained from farms in Alabama. For further information, contact L. Capo-chichi (cludovic@acesag.auburn.edu).

Luc St-Laurent has also conducted work on the taxonomy of the genus *Mucuna*. His email is: stlauru@yahoo.com.