

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)**

Fifth issue, February 2002

Progress of the Project

By R.J. Carsky and M. Eilittä

Only a few months remain before the Project concludes. Most of the data collection has already been finalized. Many things remain to be done, however, from statistical analysis to the writing of reports and finalizing of accounts, to preparing for the upcoming workshop. Please note the deadlines and other advice regarding the end-of-the project activities in this newsletter.

One of the project’s most important tasks remaining is to submit the technical report to the Rockefeller Foundation. The first part of this report will consist of an overview of the project, including summaries highlighting each investigator’s results, while the second part will describe the experiences that the researchers and coordinators have had in working within the framework of the Project. The investigators’ contracts specify a deadline of March 31 for submitting their research reports and financial accounting. Please note, however, that this deadline has been extended to April 30, 2002. Please see page 2 for specific directions.

This final stretch of the current *Mucuna* Project also brings some disappointing news: CIEPCA, which has been working with networking and information exchange on green manure/cover crops from its base at IITA since 1997, is currently without funding prospects. CIEPCA and IITA are at the moment trying to find alternative mechanisms for the seed and information activities.

In *Mucuna News* no. 4 we reported on the plans for a workshop to conclude the current project. Due to the termination of CIEPCA, these plans have been in flux. We still intend to hold the workshop, most likely in Africa, but are now

aiming at September 2002. We will let all those who receive *Mucuna News* know by email as soon as we have more exact plans.

While *Mucuna News* no. 4 focused on the mid-term reports of the project investigators, this edition of *Mucuna News* reports on a wide variety of research activities and experiences with *Mucuna* by researchers who are outside of the formal project but who have become a part of our wider community of practice. Interesting work on *Mucuna* as ruminant feed has recently been concluded in Yucatan, Mexico, and is at its early phases in Nairobi, Kenya. We also report on promising results with *Mucuna* as a poultry feed in Guinea. Moreover, in this and the next edition of *Mucuna News*, we will explore information on *Mucuna*’s medicinal/therapeutic properties. Finally, this issue includes an inquiry from a Zambian project regarding the feasibility of a processing method for *Mucuna*.

We are grateful for the articles and contributions submitted by L-O. Jansson, C. Sandoval, J. Castillo-Caamal, E. Mbuthia, T. Berhe, K. Janardhanan, and P. Oudhia, and, as always, to the MOIST-CIIFAD of Cornell University for posting our newsletter on the Internet.

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This bulletin is available through the CIEPCA website hosted by MOIST-CIIFAD (http://ppathw3.cals.cornell.edu/mba_project/CIEPCA/home.html).

If you are interested in posting news or inquiries in this bulletin, please contact Marjatta Eilittä.

Project Update

Final Reporting of Investigators

In addition to the financial accounting, we will be submitting a technical report, which will have two parts. Part One will be an overview of the main results of the project, to which are appended summaries highlighting each researcher's major findings. Part Two will describe the experiences of this project from a methodological viewpoint.

For Part One, each investigator's final report is needed. As mentioned above, the deadline for the reports is April 30, 2002. Please note that – unless you indicate otherwise (i.e., you are not planning on participating in the workshop) – we would like to consider this report as the first draft of your workshop paper. If accepted for this purpose by the editors, the paper would undergo technical editing and comments would be sent to the author prior to the workshop. If not, it would be sent back to the authors for further revisions prior to editing. The report is to follow standard scientific presentation with the following sections: Abstract, Introduction/Justification, Materials and Methods, Results/Discussion, and Recommendations for Future Research. Maximum length is 15 pp double spaced, including tables, figures, and references. More detailed instructions will be given after the workshop plans have been finalized.

We also solicit your input for the second, methodological section. In it, we would like to describe experiences that the project participants and coordinators have had with this type of project. As you know, the project originated from a workshop which identified important research issues. While each investigator mainly worked alone during the project, a certain degree of coordination, facilitation, and information exchange have been provided by the project coordinators. In addition, the workshop resulted in personal contacts that have perhaps enabled researchers more easily to seek advice and feedback from each other. In many ways, the *Mucuna* Project has functioned like a network of investigators working on a common research theme. We would therefore like to solicit your input regarding the effectiveness of this type of research project in fostering information exchange, advice seeking, and other activities that may result in better and more appropriate research. To that end, we will be utilizing a brief survey form that will be sent to the project participants and others who have collaborated with the project. In this section, we would also like to account different types of exchanges of information that may have taken place among the researchers. If you have had such information exchange with a researcher in the project or a

collaborating researcher, we would be very interested in receiving copies of such exchanges with, of course, the permission of all those that participated in them.

If you would like to collaborate more closely in writing the final report, please contact M. Eilittä.

Investigators are also expected to submit financial accounting at the same as their final reports. For details, please refer to the agreement form that was sent to you at the initiation of the project.

Genotype by Environment Trial

Mucuna is being harvested in all Genotype-by-Environment trial locations except in Columbia and Zimbabwe, which have been planted in the past two months. The L-dopa analysis of the 2000-2001 samples is ongoing at the Judson College. The USDA permits have been sent to this year's collaborators, who will be mailing in their samples in February and March 2002; they will be analyzed immediately thereafter. Due to bad luck, two trials sites were lost in last year's trial: At Auburn, Alabama, a fire destroyed a storage building which contained samples collected by L. Capo-chichi. In California, an early winter storm and frost devastated the *Mucuna* plants. The analysis of all samples but those of Zimbabwe and Columbia should be finalized by the end April, and will be included in the final report submitted to the Rockefeller Foundation.

Other Updates

Mucuna News no. 4 did not contain an update on all projects. One of them was the project by M. Egounlety from Universite d'Abomey-Calavi, Benin, who had just initiated his project at the time of its publication. In January 2002 M. Egounlety contributed the following update:

After several trials, the following processing method was developed: *Mucuna* grains are washed, boiled for 45 min, drained, dehulled by hand, washed, soaked twice for 12 hr, drained, washed and recooked for 45 min.

The pH of soaked beans was 5.56 after the first soaking and 4.46 after the second soaking. These conditions were favourable for the growth of fungal and lactic acid bacteria that are involved in fermentation. Good *Mucuna tempe* (mold-fermented *Mucuna*) and *Mucuna ogi* (a traditional food preparation) with 50% *Mucuna* and 50% maize were obtained from the first experiments.

Note that 10 % of the beans were found uncooked and not dehulled after 45 min cooking

time. A dark water was obtained after the first 12 hr of soaking of the cooked dehulled *Mucuna*.

Other News

Mucuna Processing in Zambia: An Inquiry

We recently received the inquiry below regarding potential *Mucuna* processing methods for Zambia. The inquiry was forwarded to some collaborators of the project whose responses are summarized after it. Please contact L-O. Jansson (agrisys@zamnet.zm) to comment on this procedure or the responses of the collaborators suggesting different approaches. We at the *Mucuna News* would be interested in any such exchange, so please send a copy of your message to M. Eilittä.

Inquiry from L-O. Jansson:

Land Management and Conservation Farming (LM&CF) is a Zambian land husbandry program sponsored by Sweden at the Ministry of Agriculture which, among others, is promoting *Mucuna* as a green manure. *Mucuna* performs very well in Zambia and the project is trying to find ways to utilize it as a food.

The project is currently considering for rural areas the processing method that follows below. It is based on fermentation of maize and *Mucuna*. Fermentation of maize is an old, traditional food technique in Zambia, typically done after partly crushing the maize through pounding, soaking/fermentation (24 hours), sun drying, and milling (in a hammer mill or pounded in a mortar). The crucial question is how much of the maize-*Mucuna* product can be eaten and for how long?

The processing method in question:

1. Coarsely grind/pound the *Mucuna* beans down to a particle size of 1mm. Traditionally this is done by moistening the beans to soften the outer shell, shelling it in a mortar, and grinding.
2. Soak in water for 24 h. Drain water and rinse the mixture.
3. Mix the soaked *Mucuna* (50%?) and pounded maize (50%?) and soak the mixture in water for 24 hours or more (?) for the fermentation process to start by the maize.
4. Drain and sun dry the mixture.
5. Store and mill.

Response from R. Bressani (Universidad del Valle de Guatemala):

I believe he can have a good quality product with mixtures of 70 parts maize and 30 parts *Mucuna*, both fermented. The elimination of L-dopa from ground *Mucuna* is good, however the particle

size should be large. A prolonged soaking of whole seeds in running water is also good but it takes a longer period of time. The two ingredients with a high moisture content should be fermented at the same, rather than using the various steps as suggested. The protein quality of the resulting flour should be very good.

Response from M. Egonlety (Universite d'Abomey-Calavi, Benin):

One of the techniques that may be interesting is the co-fermentation technique (simultaneous fermentation of maize and *Mucuna*). As in Zambia, fermentation of maize is an old household traditional technique in Benin and Nigeria. Here, maize is soaked for 2-3 days, milled, wet-sieved and fermented for 1-2 days. The slurry (or deposit) known as *ogi* is cooked into a porridge for weaning and breakfast foods or into a stiff gel for lunch and dinner. *Ogi* can be kept for up to 14 days by replacing the water once or twice a week, depending on the temperature.

In the maize-*Mucuna* fermentation process developed by us, *Mucuna* is boiled for 45 min., drained, hand-dehulled, soaked twice for 12 hr, recooked for 45 min. and milled. The milled *Mucuna* and the soaked milled maize are mixed, wet-sieved and allowed to ferment up to 48hr. Samples were taken at 12 hr intervals for L-dopa analysis and biochemical changes. The color of the slurry is improved (becoming whiter) during fermentation of the mixture.

The effectiveness of this technique on L-dopa content has not yet been evaluated.

Response from M. Eilittä:

Regarding soaking: Soaking ground *Mucuna* is going to reduce the L-dopa content greatly. The rate of extraction depends on the *Mucuna*:water ratio and the fineness of the particles. You propose grinding to a particle size 1mm - based on the results of several investigators (including those that A. Teixeira has obtained during this current project), it is clear that with your method you can reduce a very large part of the L-dopa, especially if your water:*Mucuna* ratio is high. Stirring of the mixture further increases L-dopa extraction. What we do not know is the impact of the soaking of such small particles (for a relatively long period you propose) on the amino acid balance of the beans but several of the research projects are looking into this now.

Regarding fermentation: As you know, the fermentation is likely to increase the bioavailability of the nutrients also in *Mucuna*. The big question is whether those nutrients were reduced greatly in the first stage.

Regarding safety of *Mucuna*: These are the "million-dollar questions." I personally tend to assume the cautious line and think that given the various contraindications of L-dopa on diseases/ conditions that are common (cf. paper by N. Szabo and I. Tebbett in the upcoming proceedings), we need to strive for extremely low L-dopa. I think our best guideline right now is the content of L-dopa in processed fava bean, as we know that large populations have been eating it for hundreds and thousands of years. That content is very likely less than 0.1%. Note that within the Project, a mutagenic characterization of *Mucuna* and a quantification of some of the alkaloids present in it will be conducted, shedding further light on *Mucuna*'s impacts on human health.

Research in Yucatan on *Mucuna* Beans as Sheep Feed

As in many other locations, quite a bit of work on *Mucuna* as a green manure/cover crop took place in the Yucatan during the 1990s. And, as elsewhere, these experiences led to explorations of *Mucuna*'s food and feed uses. *Mucuna News* No. 2 reported on a number of research projects on *Mucuna* beans as a feed for monogastrics (poultry and pigs) in the Yucatan. Additional, recently concluded work has focused on *Mucuna* beans as a feed for ruminants, particularly for sheep, a common livestock in Yucatan. There have been two phases in the past work: In the first phase, the explorations focused on *in vitro* processing to attempt to detect any toxic impacts that may occur and to determine whether this effect may be exacerbated in a closed rumen simulation system (*in vitro* gas production). The second phase took place *in vivo* and consisted of feeding sheep remarkably high *Mucuna* levels to induce toxicity (if any) and to monitor physiological parameters. In the future, plans for *in vitro* work include using pure L-dopa instead of whole *Mucuna*, in order to ascertain that other constituents of *Mucuna* are not confounding the effect of L-dopa.

The summary immediately below outlines the results of the first phase of work, where no negative impacts were detected and which indicated that *Mucuna* has good potential as a ruminant feed. Subsequently, the *in vivo* projects that were concluded in January 2002 are listed; their results will be presented in later issues of *Mucuna News*.

In vitro gas production and digestibility of *Mucuna* bean

By C. Sandoval, P. Herrera, A. Ayala, and C. Capetillo, Univ. Autónoma de Yucatán, Mexico

Beans and husks from *Mucuna* were evaluated using the *in vitro* gas production technique. *In*

vitro dry matter (IVDMD) and organic matter (IVOMD) digestibility of beans were high at 97.94 ± 0.35 and $96.02 \pm 1.31\%$. The IVDMD and IVOMD of husks were lower, 78.96 ± 1.69 and $78.85 \pm 1.75\%$ respectively. Energy value for ruminants (MJ kg DM^{-1}) was estimated from the digestible organic matter contained in the dry matter and was 13.90 and 11.14 for beans and husks, respectively, showing the high potential of both *Mucuna* fractions. The gas production profiles were described with the equation: $\text{ml gas} \cdot \text{gDM}^{-1} = a + b(1 - e^{-ct})$ (where a=intercept, b=potential gas production and c=rate of gas production), yielding the following parameters for pods and beans respectively; a= -32.5 ± 3.96 and -37.11 ± 4.084 ; b= 264.6 ± 4.88 and 249.6 ± 4.084 and c= $(\% \cdot \text{h}^{-1})$ 3.053 ± 0.1700 and 4.208 ± 0.1909 . These profiles are similar to those of a good starchy feed or a bean. The antinutritional factors did not show any detrimental effect on the *in vitro* fermentation.

The results indicate that *Mucuna* has potential to replace conventional energy sources (e.g., maize and sorghum) in ruminant diets. In addition to the beans, the husks can be incorporated into the diet without expecting major problems because of their high digestibility. Further studies will be carried out by A. Ayala to clarify any effects L-dopa might have during *in vitro* fermentation.

For further information, please contact C. Sandoval (ccastro@tunku.uady.mx).

Other Recently Concluded Research Projects in Yucatan

In addition to the work reported above, there are a number of other projects on *Mucuna* as a sheep feed which concluded in January 2002. If you are interested in obtaining preliminary results or contacting any of the researchers, please contact J. Castillo-Caamal (jcastillo12@hotmail.com).

Following projects have been recently concluded:

- Feeding increasing levels of ground *Mucuna* pods as a complete feed. Bachelor's thesis research of A.M. Castillo. Supervisors: A. Ayala and J. Castillo-Caamal.
- *Mucuna* feed as a substitute for soya, including a digestibility trial. Bachelor's thesis research of F. Pérez. Supervisor: A. Ayala
- Free intake of *Mucuna*, to attempt to identify possible problems with toxicity. Researchers: several Bachelor's students and one Master's level student, A. Ayala, J. Castillo-Caamal.

A Research Project on Mucuna Silage for Goats in Kenya

In Kenya, adoption of forage legumes in smallholder mixed crop-livestock systems is low. Since 1994, the Legume Research Network Project and Soil Management Project have introduced new legume species for soil fertility maintenance but it has become evident that for wider adoption, these legumes need to have uses beyond soil fertility maintenance.

Several research projects were started to investigate and improve the feed and food utilization of these legumes. Two of the projects are part of the *Mucuna* Project: the project led by E. Wanjekeche on food processing techniques and the project by R. Muinga and her collaborators on *Mucuna* as a feed for dairy cows. In addition, *Mucuna News* No. 3 reported on the Ph.D. project of E.M. Nyambati at the University of Florida with field research conducted at the Kenya Agricultural Research Institute (KARI) in Kitale; his work also originated from these projects. E. Nyambati's research focused on supplementing dairy cows with *Mucuna* hay. Another, a more recent, effort is that by E. Mbuthia of University of Nairobi on evaluating the effect of including legumes on quality of legume-grass silage for feeding goats. The work was started in 2001 as a part his Ph.D. studies. This project is summarized below. For more information, please contact E. Mbuthia (ellymbuthia@yahoo.com).

Effect of inclusion of high-protein forage legumes and molasses in Napier grass silage on silage quality and performance of dual-purpose goats

By E.W. Mbuthia, Univ. of Nairobi, Kenya

Due to its high biomass productivity and focused efforts of agricultural extension services, Napier grass (*Pennisetum purpureum*) has become the main forage feed for dairy cattle in Kenya. In the rainy season, it grows rapidly but its quality deteriorates as the dry season approaches. For dry season fodder, farmers either leave Napier grass standing as a reserve, purchase equally low-quality Napier grass from commercial producers, or make use of crop residues or roadside pastures. The quality of Napier grass fodder could be improved through the incorporation of legumes; in addition, such legumes may be conducive to higher microbial activity in the rumen.

The objective of this research is to study the effect of supplementation of Napier grass with high-protein forage legumes and molasses on silage characteristics, digestibility, and growth performance of dual-purpose goats. Legumes studied will be *Mucuna pruriens*, *Crotalaria ochroleuca*, *Leucaena leucocephala*, and *Lablab purpureus*. The first part of the study will employ

laboratory silos to study the fermentation pattern of the various combinations of Napier grass, legumes, and molasses. This will involve serial samplings over a 90-day period and analyses for important silage parameters such as ammonia, lactic acid, volatile fatty acids, and soluble sugar. Rumen simulation technique will be used with N₁₅ as the marker to measure the rumen microbial protein yield from silage diets containing legumes. This, together with the gas production data, will show whether the improved protein level of the Napier grass silage results in better nutrient utilization at the microbial level. The palatability assessment of the Napier grass-legume silage will include the growth performance and nitrogen balance of the goats as well as the *in vivo* digestibility of the silage diets.

So far, legume-enriched Napier grass silage has been made and sampled. The samples collected have been processed and are awaiting laboratory analysis. The feeding trials will be conducted in March 2002 and the rumen simulation tests will be carried out as from June 2002.

Continuing Mucuna Work in the Republic of Guinea

In the past three years, efforts have been underway in the Republic of Guinea to increase multiple uses of *Mucuna* by finding appropriate processing methods to reduce its L-dopa content. These efforts partly originated from a project funded by Sasakawa-Global 2000 to promote *Mucuna* for soil fertility maintenance and restoration. The following is an update of the most recent and ongoing work. For more information, please contact T. Berhe (t.berhe@cqiar.org).

Potential Use of Mucuna as Poultry and Animal Feed in the Republic of Guinea

By A. Camara (Ecole Nat. d'Agricult. et d'Elevage de Tolo), K. Toupou, (Ecole Nat. d'Agricult. et d'Elevage de Bordo), T. Berhe (SG2000)

In early 1999, we heard about a research project of Mr. Benign Ruiz Sesma from Yucatan, Mexico, on soaking *Mucuna* in 4% solution of Ca(OH)₂ for 24 hours as a way to drastically reduce L-dopa (85% of the original). This method was adopted in Guinea but the soaking was lengthened to 48 hours to ensure near complete removal of the toxic factor. Cracking the seeds before soaking also proved effective. These results were reported in *Mucuna News* No. 1.

Subsequent animal studies with chickens and laying hens were conducted in March 2000 – October 2001 at two agricultural schools in Guinea. Fishmeal and palmnut residue meal were substituted at 33% level by detoxified

Mucuna. Basic feed was either normal maize or High Quality Protein Maize (QPM). Growth of chickens was monitored for six months.

Rations with *Mucuna* + QPM combinations resulted in equal or better weight gain as rations with fishmeal + normal maize. Moreover, *Mucuna*+QPM fed hens laid more eggs and they were heavier than hens fed on normal ration. *Mucuna* +QPM ration also resulted in the least malformed or broken eggs (i.e., the eggs had harder shells). Consequently, *Mucuna* + QPM resulted in more marketable eggs. Other observations noted about the chicks and hens which ate ratios containing *Mucuna*: 1) Their plumage was more colorful; 2) They picked each other less; 3) They consumed less feed and water; 4) They were more active, had shinier feathers and looked healthier; and 4) Their mortality rate was less; and 5) They were heavier.

Encouraged by the positive results of the first experiments, studies are now underway in three agricultural schools. In these experiments, fish meal is being substituted gradually by detoxified *Mucuna* up to 100%. The trials include poultry (fryers) at three sites, pigs at two sites and sheep at one site. So far, no serious problems have been observed even with 100% substitution of fishmeal by detoxified *Mucuna* except that the mortality of chicks consuming *Mucuna* feeds has been slightly higher and, at high *Mucuna* ratios, their growth seems to be delayed. A 50% substitution is showing satisfactory results. All rations will be sent to the University of Arkansas, USA, for quality analysis. Results of the ongoing experiments will be available in about three months.

Positive results from these studies would be predicted to have two significant impacts. Firstly, poultry and animal feed could become much cheaper. One kilogram of fishmeal costs about 1,200 Guinean Francs while a kilo of *Mucuna* seed sells for 300 Guinean Francs. Secondly, once *Mucuna* seed gains market value more farmers would be encouraged to grow the crop, thereby contributing to the improvement of fertility of their soils.

Mucuna's Medicinal Uses

Interestingly, *Mucuna* has thousands of years of medicinal use in India, particularly for Parkinson's disease but also for other ailments. In this and the following edition of *Mucuna News*, we will explore various aspects of the current and potential medical uses. While not directly related to *Mucuna's* food and feed uses, *Mucuna's* various medicinal purposes can point to some of the active compounds it contains. Needless to

say, such information just satisfies general curiosity about the crop and its uses!

In the following two articles, various aspects of medicinal uses are explored. First, P. Oudhia describes the cultivation of *Mucuna* for medicinal uses in India. The second article describes some of the medicinal uses found for *Mucuna* in an Internet search. The next number of *Mucuna News* will include a more in-depth look at the medicinal uses of *Mucuna* in India.

Cultivation of Mucuna for Medicinal Uses in India
By P. Oudhia, Indira Gandhi Agricultural University, Raipur, India

Mucuna has long been known and valued in Indian medicine. Although in many parts of the world, *Mucuna* is grown as green manure crop, Indian farmers are not aware of this. They are growing it because of its demand in national markets as a medicinal herb. *Mucuna* is an integral part of over 30 of the popular drugs in India, including *Mustang*, useful in male sexual impotence and *Gertiforte*, useful in "senile pruritus" and fatigue.

Most of the farmers raise the *Mucuna* crop in *kharif* season. They cultivate this twining legume in the field boundaries with the support of barbed wire fence. The cultivation on the fence not only utilizes the land but also reduces the cost of providing support to the growing crop. Many farmers who have planted trees like teak and eucalyptus use them to support growing *Mucuna*. Only a few farmers are cultivating it in open fields, where they use bamboo sticks to provide support.

The use of chemical inputs are prohibited in herbal farming in ancient systems of medicine but unfortunately most of the Indian farmers are using fertilizers and insecticides in order to increase the production of this crop. Heavy infestation of *Aphis craccivora* on *Mucuna* crops has been noted in many areas.

I have conducted many field experiments at farmers' field in different agro-climatic zones of India. These experiments were conducted in Rajkot, Raipur, Kanker, Siliguri, Harpalpur, Baster and Sarguja districts. Some observations and results include:

1. Use of a spray containing fresh cowdung, cow urine solution and neem leaves not only helped with crop growth but also repelled insects from the crop.
2. Seed rate 50 kg ha⁻¹ was found best as compared to seed rates of 10, 15, 20, 25, 30, 35, 40, 45, 55, 60 kg ha⁻¹.
3. Crop grown with support was found to be more vigorous and free of pest as compared to crop grown without support.

The area under *Mucuna* is continuously increasing in some parts of India. Both white and black varieties of *Mucuna* are under cultivation in Madhya Pradesh, Chhattisgarh and Andhra Pradesh states. In the Indian system of medicine, the black variety is considered more valuable as compared to the white variety but as the black variety possesses allergenic hairs on its pod, farmers hesitate to cultivate it. The average market prices of black and white varieties, respectively, are 50 and 40 Rs./kg (1 US\$ = 47 Rs.). The purchasers buy the seed at very low prices from farmers (at 10-15 Rs./ kg). Due to the lack of adequate processing method and information regarding national and international markets, *Mucuna* growers are facing a great number of problems. In the national market, most of the *Mucuna* seeds collected from different parts of India are sold to Indian pharmacies where there is very little quality control. Cheating is also done, and is even common, as some sellers burn the white variety to sell it as the black variety.

For more information, please contact P. Oudhia (pankaj.oudhia@usa.net).

Mucuna's Medicinal Uses: Browsing the Internet

If you have browsed through the Internet in search for information on *Mucuna's* uses as a green manure/cover crop or as a food and feed, you have been sure to run into countless websites where *Mucuna's* medicinal uses are discussed and where various preparations including *Mucuna* are sold. For your information, the following is a partial listing of the purposes to which *Mucuna* is sold in the Internet sites - this does not, of course, signify that we endorse such uses!:

- For symptomatic relief of Parkinson's Disease: *Mucuna's* high content of L-dopa is the main reason for its use for the symptomatic relief of Parkinson's Disease and such use goes back thousands of years within the Ayurvedic medical system of India. A number of websites that give information on Parkinson's Disease mention *Mucuna's* potential, particularly those that support alternative treatments for Parkinson's. Some trials with humans have been conducted and reported in literature, indicating improved performance of *Mucuna* over synthetic L-dopa; such trials were, however, limited in size. A product tested in one of the trials, HP200 was reportedly approved by the Indian Food and Drug Administration and is available in India under the brand name Zandopa. Apparently, the United States Food and Drug Administration has approved the drug for clinical studies.

- For weight management or energy lifter: For these purposes, one producer mixes *Mucuna* together with Korean Ginseng and Ashwaganda, an Ayurvedic medicine.
- For male vitality: An Internet site also sells a product including various extracts that have been used in Ayurvedic medicine to support male vitality. One two-tablet supply included 280mg *Mucuna pruriens* seed pod extract, standardized to 25% L-dopa (i.e., 70mg L-dopa). Other ingredients include: Ashwagandha root extract (*Withania somnifera*), Shatavari Root Extract (*Asparagus racemosus*), and Country mallow Root 10:1 Extract (*Sida cordifolia*).
- For increased muscle size and performance: A website sells a human growth hormone, "a triple strength herbal enhancer". Each serving (2 capsules) contains 750mg of *Mucuna pruriens* extract (20% L-dopa, i.e., 150 mg L-dopa), 250 mg *Tribulus terrestris* extract (an Ayurvedic herb), and 2 mg *Piper longum*.

Selected Bibliography of Mucuna

Introduction

This is the fourth in a series of listings published in *Mucuna News* of references on topics related to *Mucuna's* food and feed uses. The series has included the following topics: nutritional characterization of *Mucuna* beans (No. 2), L-dopa and alkaloids in *Mucuna* (No. 3), and *Mucuna's* feed potential (No. 4). At the conclusion of the project, we would like to develop these articles into a bibliography of texts that are relevant to *Mucuna's* food and feed potential.

At the moment, we are planning on compiling the bibliography in Word, and either publishing it inexpensively as a hard copy and/or making it available through the Internet. If you are aware of any other documents that would be important to include in the bibliography, please contact M. Eilittä.

Part IV. Genetics/Taxonomy of Mucuna

In this issue, we focus on potential genetic improvement of *Mucuna*. We will therefore report references to two types of articles. First, we will list articles/texts on *Mucuna* taxonomy and genetics, most notably those by L. Capo-chichi who is currently conducting his Ph.D. studies on the topic at Auburn University, USA, but also several articles from Indonesia in the 1970s and also from the early 20th century USA. We will also report on articles/texts that describe genetic variability in *Mucuna*, whether from an agronomic or a nutritional point of view.

- Capo-chichi, L.J.A, Weaver, D.B. and C.M. Morton. 2001. AFLP assessment of genetic variability among velvetbean (*Mucuna* sp.) accessions. *Theoretical and Applied Genetics*, 103(8):1180-1188
- Capo-chichi, L., Weaver, D., and C. Morton. 2001. AFLP Assessment of genetic variability among velvetbean (*Mucuna* sp.) accessions. *Agronomy Abstracts*.
- St-Laurent, L., Livesey, J., Arnason, J.T. and A. Bruneau. Variation in L-dopa concentration in accessions of *Mucuna pruriens* (L.) DC. and in *Mucuna brachycarpa* Rech. Forthcoming. *Food and Feed From Mucuna: Current Uses and the Way Forward*. Proceedings of a workshop held in Tegucigalpa, Honduras, April 26-29, 2000. CIDICCO, Honduras. (Please watch future issues of this bulletin for further information.)
- Qi, A. et al. 2000. Validation of a photothermal phenology model for predicting dates of flowering and maturity in legume cover crops using field observation. *Biological Agriculture and Horticulture* 17:349-365.
- Siddhuraju, P., Becker, K., and H.P.S. Makkar. 2000. Studies on the nutritional composition and antinutritional factors of three different germplasm seed materials of an under-utilized tropical legume, *Mucuna pruriens* var. *Utilis*. *Journal of Agricultural Food Chemistry* 46:6043-6060.
- Prakash, D. and S.K. Tewari. 1999. Variation of L-dopa contents in *Mucuna* species. *Journal of Medicinal and Aromatic Plant Sciences* 21:343-346.
- Carsky, R.J., S.A. Tarawali, M. Becker, D. Chikoye, G. Tian, and N. Sanginga. 1998. *Mucuna* – herbaceous cover legume with potential for multiple uses. *Resource and Crop Management Research Monograph* 25. International Institute of Tropical Agriculture, Ibadan, Nigeria.
- Lorenzetti, F., S. Maclsaac, J.T. Arnason, D.V.C. Awang, and D. Buckles. 1998. The phytochemistry, toxicology, and food potential of velvetbean. In D. Buckles, E. Eteka, O. Osiname, M. Galiba and G. Galiano (Eds.). *Cover Crops in West Africa: Contributing to Sustainable Agriculture*, p 67-84. Ottawa, Canada: IDRC, IITA, and SG2000.
- Keatinge, J.D.H., A. Qi, T.R. Wheeler, R.H. Ellis, P.Q. Craufurd, and R.J. Summerfield. 1996. Photothermal effects on the phenology of annual legume crops with potential for use as cover crops and green manures in tropical and subtropical hillside environments. *Field Crop Abstracts* 49(12):1119-1130.
- Mohan, V.R. and K. Janardhanan. 1995. Chemical analysis and nutritional assessment of lesser known pulses of the genus, *Mucuna*. *Food Chemistry* 52:275-280.
- Mary Josephine, R. and K. Janardhanan. 1992. Studies on chemical composition and anti-nutritional factors in three germplasm seed materials of the tribal pulse, *Mucuna pruriens* (L.) DC. *Food Chemistry* 43:13-18.
- Wilmot-Dear, C. M. 1991. A revision of *Mucuna* (*Leguminosae-Phaseolae*) in the Philippines. *Kew Bulletin* 46(2): 213-251.
- Wilmot-Dear, C. M. 1984. A revision of *Mucuna* (*Leguminosae-Phaseolae*) in China and Japan. *Kew Bulletin* 39(1): 23-65.
- Kay, D. E. 1979. *Crop and Product Digest No. 3—Food Legumes*. Tropical Products Institute, London, UK. xvi + 435 pp.
- Lubis, S.H.A., Sastrapradja, S., Lubis, I., and D. Sastrapradja. 1980. Genetic variation of *Mucuna pruriens* (L.) DC. IV. Inheritance and genotypes of seed coat colours. *Annales Bogorienses VII* (2):79-87.
- Lubis, S.H.A., Lubis, I., Sastrapradja, D., and S. Sastrapradja. 1979. Genetic variation of *Mucuna pruriens* (L.) DC. III. Inheritance of pod hairs. *Annales Bogorienses VII* (1):1-10.
- Lubis, S.H.A., Sastrapradja, S., Lubis, I., and D. Sastrapradja. 1978. Genetic variation of *Mucuna pruriens* (L.) DC. II. Inheritance of flower color. *Annales Bogorienses VI* (4):187-191.
- Lubis, S.H.A., Sastrapradja, S., Lubis, I., and D. Sastrapradja. 1977. Genetic variation of *Mucuna pruriens* (L.) DC. II. Floral biology and pollination mechanism. *Annales Bogorienses VI* (3):133-141.
- Lubis, I., Lubis, S.H., Sastrapradja, D., and S. Sastrapradja. 1976. Methionine contents in seeds of *Mucuna* species. *Annales Bogorienses VI* (2):79-82.
- Sastrapradja, D.S., Sastrapradja, S., Aminah, S.H. and I. Lubis. 1975. Species differentiation in Javanese *Mucuna* with particular reference to seedling morphology. *Annales bogorienses VI* (1):57-68.
- Aminah, S.H., Sastrapradja, S., Lubis, I., Sastrapradja, D. and S. Idris. 1974. Irritant hairs

of *Mucuna* species. *Annales Bogorienses*
V(4):179-186.

Sastrapradja, S., Sastrapradja, D., Aminah, S.H.,
Lubis, I. And S. Idris. 1972. Comparative
seedling morphology of *Mucuna pruriens* group.
Annales bogorienses V (3):131-141.

Scott, J.M.. 1919. Velvet bean varieties.
University of Florida Agricultural Station Bulletin
152. University of Florida, Gainesville, Florida.

Coe, H.S. 1918. Origin of the Georgia and
Alabama varieties of velvet bean. *Journal of the*
American Society of Agronomy 12:175-179.

Belling, J. 1916. The time of ripening of velvet-
bean varieties. University of Florida Agricultural
Experiment Station Press Bulletin no. 241.
University of Florida, Gainesville, Florida.

Belling, J. 1915. Inheritance of length of pod in
certain crosses. *Journal of Agricultural Research*
10:405-421.

Belling, J. 1914. A study of semi-sterility.
Journal of Heredity 5(2):65-73.

Piper, C.V. and , S.M. Tracy. 1910. The Florida
velvet bean and related plants. U.S. Department
of Agriculture, Bureau of Plant Industry, Bulletin
no. 179. Government Printing Office,
Washington, D.C.

Bort, K.S. 1909. The Florida velvet bean and its
history. Bureau of Plant Industry Bulletin no. 141.
Government Printing Office, Washington, D.C.