the winged bean flyer

Vol. 3, No. 1
December 1980

Sponsored by
The International Council for Development of Underutilized Plants

THE INTERNATIONAL COUNCIL FOR DEVELOPMENT OF UNDERUTILIZED PLANTS (ICDUP)

Established in January 1978 by specialists who participated in the First Workshop/Seminar on the Potential of the Winged Bean, the International Council for Development of Underutilized Plants was organized to encourage greater knowledge and use of promising underutilized plants needed for man. It was directed to concentrate its efforts initially on the winged bean, a hitherto neglected tropical legume which has outstanding potential for meeting the increasing needs for plentiful and nutritious food. The Council is a private, non-profit organization, incorporated in the United States, with headquarters in California. The present members and officers of the Council are:

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Dr. Edward S. Ayensu, Vice-President; Director, Office of Biological Conservation, The Smithsonian Institution

Dr. Norman Borlaug, Nobel Laureate, CIMMYT, Mexico

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The Winged Bean Steering Committee, composed chiefly of winged bean specialists, is responsible, under the direction of the Council, for the details of work on the winged bean. The Committee is composed of the following:

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Dr. V. Kesavan, University of Papua New Guinea
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Dr. Tanveer Khan, Dept. of Agriculture, Western Australia (Research Coordinator)
Mr. Wong Kai Choo, Universiti Pertanian Malaysia
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Dr. Noel D. Vietmeyer, National Academy of Sciences, U.S.A.

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RUSS A. STEPHENSON

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The Winged Bean Flyer was established in 1977, with the support of The Asia Foundation, as part of the Foundation's effort to encourage development of a cooperative international program on the winged bean, *Psophocarpus tetragonolobus* (L.) DC. The International Winged Bean Workshop/Seminar and Public Forum, held in January 1978 in Los Baños, Philippines, which the Foundation had the foresight to propose, resulted in the establishment by the participants of a new organization, the International Council for Development of Underutilized Plants. With the establishment of the International Council, the responsibility for the international winged bean program, including the publication of *The Winged Bean Flyer,* was assumed by the Council.

The *Flyer* is being produced with the welcome and able cooperation of the Agricultural Information Bank for Asia (AIBA) which is headquartered in the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in the Philippines. The Editor of the *Flyer,* appointed at the Workshop/Seminar, is Dr. R.A. Stephenson, until recently with the Faculty of Agriculture of the University of Papua New Guinea. All communications should be sent to him at his present address:

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Maroochy Horticultural Research Station
Nambour
Queensland 4560
Australia

CONTENTS

		Page
I	EDITORIAL	1
II	LETTERS TO THE EDITOR	3
III	WINGED BEAN IN THE NEWS	5
IV	SUPPLY OF WINGED BEAN SEED	6
V	NAMES GIVEN TO THE WINGED BEAN	7
VI	INTERNATIONAL COLLOQUIUM ON ECOLOGY OF BRUCHIDS	13
VII	SUPPLEMENTARY DIRECTORY OF RESEARCHERS OF WINGED BEAN	14
VIII	RESEARCH ABSTRACTS	15
	A. Chemical Composition and Nutrition	15
	B. Nitrogen Fixation	22
	C. Genetics and Plant Breeding	24
	D. Diseases	26
	E. Miscellaneous	28
IX	THESES ABSTRACTS	32
X	COUNTRY REPORTS	35
XI	WINGED BEAN FLYER ORDER FORM FOR BACK ISSUES	40

I. EDITORIAL

As the Second International Seminar on the Potential of the Winged Bean draws near, researchers in many diverse disciplines from around the World will be examining their findings and preparing papers for the Sri Lanka meeting. It is an exciting time, a time for reviewing progress and setting new priorities as we progress toward the noble goal of developing the potential of a remarkable plant, the winged bean. There are many challenges to be faced, but the potential rewards are substantial: the possibility of developing a little-known legume plant into a major, versatile and nutritious food crop for the tropics.

Unfortunately, not all scientists working on winged bean will be able to attend the Seminar. *The Winged Bean Flyer*, will, however, prepare a comprehensive report on the Seminar for Vol. 3, No. 2, including abstracts of scientific papers, report of discussions, recommendations and other points of interest. Because of restrictions on the number of people who can be accommodated at the Seminar and financial limitations, some important and interesting research findings may not be presented. The Council hopes, however, to be able to include all papers offered including those not presented orally, in the published proceedings. Every effort will thus be made to see that all findings are reproduced. But if, by chance, your research report is not presented or distributed at the Seminar, please submit a copy, together with a concise abstract, to the Editor of *The Winged Bean Flyer* for abstracting in a future issue. In this way, your work will receive recognition and we will all be better informed.

Although *The Winged Bean Flyer* has had a brief reprieve through funds made available by the U.S. Agency for International Development (AID) to produce Volume 3, we must levy modest subscriptions to cover costs for all future issues. Details will be given in the next issue. We hope you will be prepared to help us continue to produce this newsletter.

Dr. Tanveer Khan, our Research Coordinator, reports that, of the 60 trial kits destributed for the International Winged Bean Variety trials, data from only 12 of these have been received by him. This is a very disappointing response to such a vital aspect of the winged bean research and development effort. PLEASE, IF YOU HAVE ANY DATA AT ALL FROM THE INTERNATIONAL WINGED BEAN VARIETY TRIALS, SEND THEM PROMPTLY TO DR. KHAN. It is just as important to know if the crop has failed under a given set of conditions as it is to report record yields. Please help complete the picture on winged bean yield performance by sending your results and observations...TODAY.

We have received many requests for back issues of *The Winged Bean Flyer*. Unfortunately, Vol. 1, No. 1 is out of print. We have a few copies of Vol. 1, No. 2 available to distribute; a considerable number of copies of Vol. 2, No. 1; and a few of Vol. 2, No. 2. We are prepared to run off copies of Vol. 1, No. 1 and others in short supply. But this latter exercise is likely to be rather expensive and the cost would have to be borne by the individuals or institutions requesting the issues involved. An order form for back issues has been included on the last page.

Best wishes for the Festive Season ahead and for the coming Seminar. We look forward to receiving reports on winged bean research and development during 1981.

II. LETTERS TO THE EDITOR

1.

19 January 1979

Dear Sir,

I was informed of your interest in establishing links with researchers on winged beans. In the Department of Food Science and Technology, Universiti Pertanian Malaysia, Serdang, I have been looking at two aspects of winged bean utilization - production of Tempeh and milk. The publication of the comparison of 4 legumes for tempeh production shall be presented at the Symposium on the Legumes in the Tropics on 13th - 17th November 1979 at our University.

Dr. Mohamad Salleh Ismail
Department of Food Science and Technology
Universiti Pertanian Malaysia
Serdang, Selangor, Malaysia

(A summary of Dr. Ismail's paper is presented in Section VIII, A - Ed.)

2.

17 November 1978

Dear Sir: (via Dr. Noel Vietmeyer),

I wish to make inquiries regarding the winged bean.

Although my postal address is Nairobi I am actually working in northeast Zaire (Latitude 2°26', longitude 27°36'). I read the April 17, 1978 TIME magazine write-up on the winged bean so I wrote to a friend (a Doctor of Agriculture) who works in Malang, Indonesia who was kind enough to send me 8 seeds in an envelope (2 black PNG seeds, and 6

white Bali seeds). I planted them on 5th August and they have done fairly well although the pods from the Bali seeds seem bigger and more plentiful. The first of the pods appear to be starting to dry out now. However, I have noticed that there are insects here which find the green base of the flower very delectable. I have noticed on numerous occasions that they eat holes in the green base of the flower, then in a few days the flower dies and falls without producing a pod. I have noticed ants climbing up and down the stalks at times and have actually noticed them in the vicinity of the holes. Perhaps that part of the flower is very sweet and tender? If it is the ants that are hindering production of pods, then I would say my experimental plot is not representative - in the vicinity of the plot there is hard red earth which the ants particularly like for nesting. I'm trusting that my loss of pods will be made up by larger tubers.

Now that I have made a preliminary test I would like to obtain a larger quantity and variety of seeds in order to make a more extensive test. Could you please send me details of where I could obtain such seeds?

Since our arrival in the region in January, 1977 we have been rather astounded to see how little people appreciate the value of enriching their soil. Great quantities of coffee and rice are produced in the area but the husk is left in great mountains behind the processing factories. When it becomes too much it is dumped in the forest (we are on the northern edge of the Ituri Forest). I have been arranging to have some local factories dump it on an experimental plot I have prepared. Later on I want to hoe it into the earth and, when it is ready, see how winged beans grow in it. Hundreds of people pass the field every day so people will soon know if I have any degree of success.

Ronald J. Sims
Post Office Box 21285
Nairobi, Kenya, East Africa

3.

22-5-80

Dear Sir,

This laboratory has recently become interested in the tissue

culture of the Winged Bean. We have in fact already obtained callus cultures, and some organogenesis in these cultures, which promises well for eventual propagation by *in vitro* methods. We are now attempting anther cultures to obtain haploid (i.e. homozygous) progeny suitable for breeding studies. We are also isolating protoplasts to obtain cloned material which can be useful for multiplying elite individuals, if any do indeed exist. And that is precisely why I am addressing you: we have practically no knowledge at all (from this distance) of this plant's agricultural features.

Would it be possible for you to supply us, when the time comes, any particularly interesting germplasm of this species?

Thanking you,

Yours sincerely,

A. Kovoor
Director of Research
Physiologie de la Différenciation Cellulaire
Université de Paris VII
2, Place Jussieu - Tour 54 (E5)
75221 Paris Cedex 05

III. WINGED BEAN IN THE NEWS

1. Saturday Review, 25 November 1978

Mr. Norman Cousins, the Chairman of the Editorial Board, in his Editorial, entitled "Winning the War against Famine", claimed that there was good news for the world in the report of a committee of agricultural scientists who have been searching for "new" crops for the tropics. He reports that, in 1978 the annual report of the National Research Council of the National Academy of Science (NAS) was an historic document which, if translated into active programs by tropical nations of Asia and Africa, may yet spare the world from some of the horrifying hunger disasters that have been so widely predicted (and which exist today!)

The NAS assignment was to enlarge the list of edible crops. At present, 30 crops provide 95 per cent of the calories and protein consumed by man throughout the world. The NAS report identified 400 plants not now

in general use that would be appropriate for large scale cultivation in tropical countries. Of these, 36 were selected as being especially promising in terms of edibility and nutritional value. Perhaps the most promising of them, he claims, is the winged bean which is potentially more capable of relieving protein hunger in the world than any other known vegetable. For example, Mr. Cousins pointed out that a mixture of winged beans and maize has protein value as high as milk.

Problem areas, such as breeding for dwarf types which do not require support on stakes, exist. Furthermore, the need for research into food processing was stressed.

Mr. Cousins concludes that "the central significance of this (NAS) report is that the human race is not locked into a ghastly famine inevitability. The land exists, so do the plants. The knowledge is waiting to be tapped. All these elements can come together if the values can be mobilized that will put human life and meaning first on the world's agenda.

2. Crops and Soils, vol. 31(4):18-19(1979)

Under the "Farm Crops.....Crop Management" section, an article suggests that "Winged Bean" may be a promising protein source, particularly in areas that depend on low protein corps like yams and cassava. Although commercial production is not yet feasible, the bean has several advantages as a kitchen garden vegetable. It is cultivated as a source of young green pods and can supply protein to a family for several months because of its high yielding, protein-rich nature. It can be used much like the soybean. Although mass production is impossible at present, the report relates the belief of Ted Hymowitz and Christine Newell of the University of Illinois that large scale commercial production could be achieved by developing a free-standing, determinate variety that could be mechanically harvested like the soybean. Meanwhile, it's a great backyard vegetable where it serves as a locally-produced source of protein.

IV. SUPPLY OF WINGED BEAN SEED

Dr. A.A. Duncan, the Director of the Agricultural Research and Education Center, University of Florida, has notified The Winged Bean Flyer that his Research Center no longer has any winged bean seed for distribution. Small samples of three selected varieties and planting instructions may be obtained by sending US$2.00 to cover handling and mailing charges to the International Council as follows:

International Council for Development
of Underutilized Plants
18 Meadow Park Court
Orinda, California 94563
U. S. A.

For the time being, the Council will also be able to fill a limited number of larger requests for Tpt-1 and Chimbu. It is prepared, on request, and with sufficient advance notice, to attempt to fill special requests for small amounts of selected varieties from various geographic sites, for researchers and others.

Certain seed can also be obtained, we understand, from the following:

Wingseed Company
4151 Street Road
Langhorne, Pennsylvania 19407
U. S. A.

Mr. Philip Saetveit
P. O. Box 511
Honaunau, Hawaii 96726
U. S. A.

We are attempting to determine the seeds available from these two sources.

V. NAMES GIVEN TO THE WINGED BEAN[a/]

Name	Geographical Region	Language
Aglmong (Almong)	Papua New Guinea	Metlba (Medlpa)
Alyongo	Papua New Guinea	Wapenamanda
Amale	Philippines	Ibanag

a/ Prepared by Louis Lazaroff from tables in A. Claydon, "Winged bean--a food with many uses," Plant Foods for Man, 2:203-24, 1978; T. Hymowitz and J. Boyd, "Origin, Ethnobotany and Agricultural Potential of the Winged Bean--*Psophocarpus tetragonolobus*," Economic Botany, 31(2):180-8, April-June 1977; unpublished papers by N. Haq, The University, Southampton, England, and other materials.

Name	Geographical Region	Language
As bin	Papua New Guinea	Pidgin
Asparagus bean		English
Asparagus pea	Australia	English
Baboto	Indonesia	
Batang-baimbing (Batung-baimbing)	Philippines	Sulu, Bikol
Be-magu	Papua New Guinea	Abelam
Beyed	Philippines	Sulu
Biraro	Indonesia	
Blait	Papua New Guinea	Terebu
Borbai Krui	Kampuchea	Brous
Botor[b/]	Indonesia	
Brung	Indonesia (N. Sumatra)	
Buligan	Philippines	Ifugao, Bontok
Burmese bean		English
Busemburu	Papua New Guinea	Dami
Calamismis	Philippines	Tagalog
Calongcan	Bali	
Ceylon bean		English
Chandaree	India	
Chara-koni-sem (Charkoni-sem)	India (Bengal)	Bengali
Charputee	India	
Chaud haari-phali (pholi)	India	Hindi

b/ According to Claydon, 1978, "botor" is believed to be derived from the Arabic "batr," meaning "lobe."

Name	Geographical Region	Language
Chavdhari ghevda	India (Maharashtra)	Marathi
Chiajin	Papua New Guinea	
Chiao *tou* chih		Overseas Chinese
Churakee	India (Tamilnad)	Tamil
Cigarillas[c/]	Philippines	Tagalog, Pangasinan
Colombo	India (Tamil Nadu)	English
Culebet	Banda	
Dara-dhambala	Sri Lanka	Sinhalese
daû câu[d/]	N. Vietnam	
daû rông[d/]	S. Vietnam	
Dhambala (Dambala)	Sri Lanka	Sinhalese
Foakona bin	Papua New Guinea	Pidgin
Four-angled bean		English
Fua	Papua New Guinea	Itu
Goa bean		English
Haricot de la forêt		French
Haricot dragon		French
Hto-pong[d/]	Burma (Shan states)	
Ite	Papua New Guinea	Bargham
Jaat (Jaat botor)[b/]		
Kachang belimbing	Malaysia, Indonesia (Irian Jaya)	

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c/ Cigarette

d/ Syllables in italic mean "bean."

Name	Geographical Region	Language
Kachang belingbing	Indonesia (Sumatra)	
Kachang botol (Kachang botor)	West Malaysia	
Kachang embing	Indonesia (S. Sumatra)	
Kachang kelisah	Malaysia	
Kadjang-outan	Papua New Guinea	
Kalamismis	Philippines	Tagalog
Kaloka	Papua New Guinea	Patpare
Kamaluson	Philippines	Bisaya
Kamranga choi	Bangladesh (Comilla District)	Bengali
Kamranga uri	Bangladesh (Sylhet District)	Bengali
Kanglo	Papua New Guinea	Pangia
Kara choi	Bangladesh (Chittagong Hill Tracts)	
Katjang botor	Indonesia	Sundanese
Kecipir	Indonesia	
Kelongkang	Indonesia (Bali)	
Ketjeper	Indonesia	
Ksang borong	Indonesia (Sumatra)	
Ku-bemya	Burma (Karen hills)	
Kulubet	Indonesia (S. Moluccas)	
Maeota	Papua New Guinea	Kwikila
Manila bean		English
Mariu/Me-en	Papua New Guinea	Eran

Name	Geographical Region	Language
Maswas	Papua New Guinea	Foran
Mauritius bean		English
Memasin	Papua New Guinea	Amele
Meumali	Papua New Guinea	Le
Mogar	Papua New Guinea	Bongu
Morisuavarai[e/]	India	Tamil
Mpir (Mbar)	Papua New Guinea	Buang
Murukavarai	India	Tamil
Ne/bisug	Papua New Guinea	Fuyuge
Ome/Omele	Papua New Guinea	Gumini
Omoi	Papua New Guinea	Mawani
Opis	Papua New Guinea	
Pai-myeet	Burma	
Palag (Palam, Pallang, Pal-lang)	Philippines	Iloko or Ilokano
Papare	Indonesia (Irian Jaya)	
Papulong	Philippines	Ilokano
Parapagulung (paru-pagulung)[f/]	Philippines	Bikol
Pata karla	Bangladesh (Mymensingh District)	Bengali
Pat-almong	Papua New Guinea	Metlba (Medlpa)
Pempem[g/]	Papua New Guinea	Kiriwina

[e/] The first part of the word "morisu-avarai" might be a corruption of the Tamil word "mulisu" meaning whole, or complete. See Claydon, 1978.

[f/] Pagulung means "round bean" in Bikol as opposed to flat bean.

[g/] Probably a corruption of the word "bean."

Name	Geographical Region	Language
Pe-myit	Burma	
Pe-saung-se	Burma	
Peychang raha	Bangladesh (Chittagong Hill Tracts)	
Pois carré	Mauritius, Mascarene Islands	French
Popeai chrung	Kampuchea	
Prabaiy	Kampuchea	Khmer
Princess bean		English
Princess pea		English
Puchandee averika	India	Tamil
Sarisre	Indonesia (Irian Jaya)	
Segadilla /seguidillas, sigadi(l)yas, sigadiya/[h], sigarillas	Philippines	Tagalog, Panay bisaya, Pangasinan
See kok tao	Malaysia	Chinese (Cantonese)
Sererella[c]	Philippines	
Szu chiao *tou*	South China	Chinese
Szu soit *tou* yen	China	Chinese
*Thua*pluu (Tua-pu)[d]	Thailand	Thai
*Thua*puu[d]	Laos	
Tupaita	Papua New Guinea	Wapenamanda
Winged bean		English

[h] Segadilla /seguidilla, sigadi(l)yas, sigadiya/ was the word used in Spain to the 16th or 17th centuries for the bean found in the Rioja region (*Lotus tetragonolobus?*). It was used to describe many other kinds of bean looking thin and large. Derived from Arabic. See Claydon, 1978.

Name	Geographical Region	Language
Winged pea		English
Yên-thê	Vietnam	
Yi doh[i/]	China	Chinese (Mandarin)

i/ Yi = wings or winged; doh = bean

VI. INTERNATIONAL COLLOQUIUM ON ECOLOGY OF BRUCHIDS

Initially, winged beans were thought to be resistant to bruchid attack. However, they have been identified as a serious storage pest of winged beans in recent years. Consequently, the following report may be of interest.

"An International Colloquium on Ecology of Bruchids attacking pulses has been organized by the Institute of Experimental Biocenotics of Agrosystems (IBEAS) of the National Center of Scientific Research (CNRS) and the Rabelais University, in collaboration with the International Organization for Biological Control (IOBC) and FAO in Tours, from 16 to 19 April 1980.

"Important damage, caused mainly by bruchids, is regularly observed and serious difficulties in supply of legume seed may be caused, as it happened in Rwanda, Burundi....Although control is quite often successful in modern silos, similar techniques fail under rural conditions of storage."

FAO was asked to play a direct role in the following broad areas of research:

1. To conduct a census of actual and potential damage caused by bruchid pests.

2. To coordinate studies of the ecology of bruchids on crops and on wild populations of pulses consumed by man, and subsequently to disseminate information.

3. To conduct a census of all traditional methods of prevention of infestation and conservation of harvested

grains, to evaluate these and to disseminate appropriate information.

Further information can be obtained from:

Professor V. Labeyrie
Institut de Biocenotique Experimentale
des Agrosystems
Université Francois Rabelais
TOURS, FRANCE

VII. SUPPLEMENTARY DIRECTORY OF RESEARCHERS OF WINGED BEAN

Dr. (Mrs.) N.S. Hettiarachchy Head, Dept. of Biochemistry Faculty of Medicine University of Peradeniya Peradeniya, Sri Lanka[a/]	Nutrition, Processing and Utilization
Mr. S. Sri Kantha Assistant Lecturer Dept. of Biochemistry Faculty of Medicine University of Peradeniya Peradeniya, Sri Lanka	Nutrition, Processing and Utilization
Dr. A. Kovoor Director of Research Physiologie de la Différenciation Cellulaire Université de Paris VII 2, Place Jussieu - TOUR 54(E5) 75221 PARIS CEDEX 05 France	Tissue culture

a/ Presently, Visiting Professor, the University of Illinois, Urbana, Dept. of Food Science.

VIII. RESEARCH ABSTRACTS

A. Chemical Composition and Nutrition

1. Berry, Shiv K. (1977). Characteristics of the seed of four-angled bean *Psophocarpus tetragonolobus* (L.) DC. Malaysian Applied Biology. 6(1): 33-38.

The oil from Malaysian four-angled bean was examined for its refractive index, iodine value, acid value, saponification number, unsaponifiable matter and fatty-acid composition by gas liquid chromatography. The values for fatty acids as methyl esters were myristic 0.15%, palmitic 8.40%, palmitoleic 0.54%, stearic 5.77%, oleic 33.87%, linoleic, 32.79%, lenolenic plus arichidic 2.75%, eicosaenoic 2.80%, behenic 10.85%, docosaenoic 0.47%, and lignoceric 1.61% (area). Prof. Berry's article reports, for the first time, the occurence of eicosaenoic, decosaenoic, and lignoceric acids.

(Prof. Berry is in the Department of Food Science, Universiti Pertanian Malaysia (Agricultural University of Malaysia), Serdang, Selangor.)

2. Garcia, V.V. and Palmer, J.K. (1979). Fatty acid composition of the oil of winged bean, *Psophocarpus tetragonolobus* (L.) DC. Journal of the American Oil Chemists' Society. 56(12): 931-932.

Winged beans contain c. 34% protein and 17% oil and could be a source of oil for commerce. Investigators have determined that 71% of the fatty acids are unsaturated with oleic (39%) and linoleic (27%) acids predominating. The fatty acid profile of winged bean oil is similar to that of soybeans and peanuts. K. Cerny and others reported in 1971 that winged bean oil contains 18:4 (parinaric acid), a potential antinutritional factor, while R. Kleiman in a personal communication to C.A. Newell and T. Hymowitz reported he found no parinaric acid. (In an unpublished manuscript prepared in June 1979, Dr. Cerny pointed out that "this controversial fatty acid was proved to be in fact gadoleic acid..." Ed.)

This study was undertaken to determine the fatty acid composition of winged bean oil and to confirm the presence or absence of parinaric acid in 5 promising varieties of winged beans (Chimbu; Tpt-12; WB-19 originally Tpt-12, USDA; and "selections 10 and 12"--originally UPS 76 and 105 respectively).

The fatty acid composition of the oils of the 5 varieties was determined and found to be more similar to peanut oil than to soybean oil. The total unsaturated fatty acids ranged from 53.8% to 68.5% (mean 62.0%). Oleic acid and linoleic acids were the major unsaturated fatty acids. The major saturated fatty acids were behenic, palmitic and stearic acids. Parinaric acid, a toxic fatty acid, was not present in the oil of the

winged beans analyzed.

(From V.V. Garcia's doctoral dissertation awarded by the Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA in 1979. Dr. Garcia is on the staff of the Department of Food Science and Technology, University of the Philippines, Los Baños.)

3. Harding, J., Martin, F.W. and Kleiman, R. (1978). Seed protein and oil yields of the winged bean, *Psophocarpus tetragonolobus* (L.) DC. in Puerto Rico. Trop. Agric. (Trinidad). 55(4): 307-14.

A collection of 167 winged bean stocks was evaluated at the Mayaguez Institute of Tropical Agriculture in Puerto Rico. Dry seed yield per plant averaged 156g and ranged from 43 to 328g. These data were extrapolated to a mean protein yield of 479 kg/ha with a range of from 136 to 1062 kg/ha. Oil content varied from 14.3 to 19.1 per cent with a mean of 16.79 per cent. Protein content (C) and dry seed yield (r) were inversely related (C_e = 35.4-0.0071r), so selection for dry seed yield will be more effective than selection for protein content in increasing net protein yield. Dry seed yield was not correlated with either oil content or flowering time. Dry seed yield was related to the number of days to final harvest, but that relationship was lost when three stocks with very low yields were eliminated from the analysis. Plants produced an average of 311mg of protein per day with a range of from 113 to 697mg/day. Protein production per day and total dry seed yield per plant are apparently very strongly correlated.

4. Hettiarachchy, N.S., Herath, H.M.W. and Wikramanayake, T.W. (1978). The Nutritional Value of Winged Bean (*Psophocarpus tetragonolobus* (L.) DC.) with special reference to five varieties (cultivars) grown in Sri Lanka. Nutrition and Food Science: 2: Plenum Publishing Corporation, New York. 211-220. (Presented at the XIth. International Congress of Nutrition, held in Brazil, Aug. 1978.)

Three cultivars of the winged bean grown in Sri Lanka have been compared with a variety introduced from Papua New Guinea and another from Nigeria, with respect to the protein content of the dried seeds, flowers, immature pods and tubers, and the trypsin-inhibitory activity of the seeds. The protein content of the seeds of the indigenous cultivars were higher than that of the imported varieties. The protein content of the tubers were less than values reported by the NAS. The dried seeds contain powerful trypsin inhibitors, the activity of which could be considerably reduced by soaking and prolonged boiling, and by autoclaving. The indigenous cultivar V_3 (Colombo), could be recommended for cultivation on the large scale in Sri Lanka.

5. Hettiarachchy, N.S., Kantha, S. Sri, and Herath, H.M.W. (1979). Further studies on the nutritive value of edible portions of 16 cultivars of winged bean (*Psophocarpus tetragonolobus* (L.) DC.) Proc. of 35th. Annual Session Sri Lanka Assoc. Adv. Sci. 35(1): 8-9.

Sixteen cultivars of the winged bean grown in Sri Lanka have been chemically analysed with respect to the protein content of its edible portions. Moisture content of the edible parts as well as the oil content of the seeds were also determined.

The protein content of seeds, ranged from 29.8 to 42.5g/100g fresh weight, with a mean of 36.0g/100g. The protein content of fresh tubers, ranged from 2.27 to 8.05/100g, with a mean of 5.56g/100g. Dried tuber flour of 12 cultivars, when analysed for protein content, showed values ranging from 4.37 to 26.3g/100g, with a mean of 11.52g/100g. The range of protein values exhibited by fresh leaves falls between 4.55 and 11.81g/100g, with a mean of 7.35g/100g. The protein contents of fresh pods and flowers range from 1.31-2.73% (mean 2.02%) and 1.25-2.65% (mean 2.13%) respectively.

The oil content in the seeds, range from 11.0-23g/100g, with a mean of 17.81g/100g. The fatty acid profile of the oils show that, oleic (18:1) and linoleic (18:2) formed the major fatty acid components with mean values of 40.21% and 31.57% respectively.

As it is known that the levels of cholesterol in the blood are lowered when the fats consumed are those containing a high proportion of poly-unsaturated fatty acids, especially linoleic acid (Vergroesen, 1972), winged bean seed could be a good source for reducing the blood cholesterol level.

Amino acid composition of the winged bean tuber flour had also been determined. It is rich in lysine; the other essential amino acid values are lower, with reference to the amino acid pattern of whole hen's egg. Sulphur containing amino acids seem to be the limiting ones.

From these findings, it is recommended that cultivars SLS_7, Chimbu and 25-01 be considered for large scale propagation in Sri Lanka.

6. Ismail, Mohamad Salleh. Production of tempeh from various legumes. Presented at the Symposium on the Legumes in the Tropics, 13-17 Nov. 1979 at Universiti Pertanian Malaysia, Serdang, Selangor, Malaysia.

Tempeh production mainly from soybeans has widely been studied by many scientists. Currently, tempeh production using winged beans, mung beans and lentils is being studied. A preliminary taste-panel study indicated that tempeh from split mung beans and lentils is considered as

good as that from soybeans. Winged beans raised several problems; soaking time was much longer, removing the hull was more difficult and the tempeh was much "rougher" in texture. Currently, the amino acid profiles of these tempeh are being studied.

7. Kantha, S. Sri, Hettiarachchy, N.S., Herath, H.M.W. and Wickramanayake, T.W. (1978). Studies on the nutritional characteristics of winged bean, *Psophocarpus tetragonolobus*, tubers and leaves. Proc. of 34th Annual Session Sri Lanka Assoc. Adv. Sci. (1978). 34(1), 70.

Twelve cultivars of the winged bean grown in Sri Lanka, have been chemically analysed with respect to the protein content of tubers and leaves. Trypsin inhibitor activity present in the tubers and leaves of respective cultivars is also reported. The protein content of the tubers range from 4.8-25.6% on dry weight basis and in accordance with the values quoted by the NAS (1975). The protein content of the leaves range from 4.5-11.8%, and compares favourably with the values reported by the NAS. Tubers of all the cultivars studied except one (UPS_{39}) contain trypsin inhibitor activity, but the leaves of the 4 cultivars examined do not contain the trypsin inhibitors The inhibitory activity present in tubers can be eliminated by autoclaving for 15 minutes at 121^{0}. It is suggested that farmers be encouraged to substitute the winged bean for other, poorly nutritious vegetables presently under extensive cultivation.

8. Kantha, S. Sri, Hettiarachchy, N.S. and Herath, H.M.W. (1979). Development of trypsin inhibitors in the seeds of winged bean, *Psophocarpus tetragonolobus* (L.) DC. Proc. of 35th Annual Session Sri Lanka Assoc. Adv. Sci. 35(1), 9.

The development of the trypsin inhibitors in the seeds of the pods of 3 winged bean cultivars (SLS_1, SLS_6 and SLS_{11}) was studied. The protein content of the different developmental stages of seeds (ovary, 1-5 days old seeds, 6-8 days old seeds, 9-12 days old seeds, 13-20 days old seeds, 21-27 days old seeds and mature seeds) were determined by micro-Kjeldahl method. The protein content in the ovary ranged from 5.30-6.10%. Protein synthesis accelerated as the age of the seeds advanced. The range of protein content in 21-27 days old seeds, is 6.64-9.62%. In the mature seeds, the protein values range from 29.81-39.37%.

The amount of trypsin inhibitor/s in the mature seeds varies among the cultivars (4.89×10^4-2.35×10^5 trypsin inhibitor units/g. protein). The ovaries are devoid of trypsin inhibitor/s. In SLS_1 and SLS_6 cultivars, trypsin inhibitor/s appears only at 21-27 days old seed; whereas in SLS_{11} cultivars trypsin inhibitor activity is exhibited at an earlier stage (13-20 days) of seed development.

Whereas it had been confirmed in earlier reports, that the mature seeds contain a significant amount of trypsin inhibitor activity, it is

shown from the present study that the trypsin activity in the 21-27 days old seed is also of considerable significance.

9. de Lumen, Benito O. and Salamat, Lourdes A. (1980). Trypsin inhibitor activity in winged bean (*Psophocarpus tetragonolobus*) and the possible role of tannin. J. Agric. Food Chem. 28: 533-6.

Winged bean (variety Chimbu) had the highest trypsin inhibitor activity (TIA) among several beans examined. Most of the TIA could be heat inactivated. Residual tannin in the cooked bean could account for the heat-resistant TIA which was approximately 1% of the original. The effects of soaking in different salt solutions prior to cooking on TIA and tannin were studied. Without soaking, the loss of TIA after boiling for 60 min was only 4%. Soaking in water, 10% ash solution, 0.1 N $CaCO_3$, and 0.01 N $NaNCO_3$ resulted in at least 95% total loss (soaking and cooking), indicating the importance of soaking in reducing the TIA. NaOH (1 N) was most effective in decreasing the tannin in the cooked bean. These studies suggest that tannins may play a more important role than the heat-labile, proteinaceous trypsin inhibitor in heat-processed winged bean.

10. Rajendran, R., Bhargava, B.S. and Satyanarayana, A. Comparison of protein and mineral content of different legumes cultivated under similar agroclimate. Presented at the XXth. Int. Hort. Congress, Sydney, 15-25 Aug 1978.

Legumes as a source of protein are well recognised. The less popular ones are Cluster bean, Jack bean, Sword bean, and *Winged Bean*. Recently, there have been efforts to popularise winged bean. No information is available about the protein and mineral composition of these crops for comparison with other cultivated legumes. In the present work crude protein and some mineral components of the vegetable legumes at edible maturity were evaluated. The relative importance of different legumes is discussed. Winged bean was rich in protein and calcium.

11. Rajendran, R., Satyanarayana, A., Biswas, T.E. and Selvaraj, Y. Winged bean in India - present status and future prospects and analysis of components of yield. Presented at the XXth. Int. Hort. Congress, Sydney, 15-23 Aug. 1978.

Winged bean has recently gained importance as an unexplored crop of the humid tropics due to unusually high yield potentials with appreciable quantities of dietary protein in seed, pods, flowers, tender leaves as well as root tubers. Roots nodulate freely and leave the soil rich in nitrogen. It can be grown under irrigation as a main crop, companion crop, cover crop for gardens and plantations, green manure crop, as well as a follow-up crop. Its seeds are also a rich source of oil. Despite these qualities little is known about its genetic improvement. In the present

study, information on the nature and magnitude of variation in the available material, association of characters with yield and among themselves and the extent of environmental interaction has been studied along with the direct and indirect causative factors on yield through path-analysis. Heritability and genetic advance for different characters varied considerably. High heritability for pod length was associated with farily high genetic gain indicating the presence of additive gene effect. Ideal plant type for yield increase is suggested.

12. Rajendran, R., Selvara, V. and Satyanarayana, A.A. Winged Bean variation and correlation studies of seed protein with some agronomic characters. Presented at the XXth. Int. Hort. Congress, Sydney, 15-23 Aug. 1978.

Winged Bean, an unexploited tropical legume, has potential for improving human diet and enriching the soil. Its seeds, green pods, leaves, flowers and root tubers which are consumed as food are rich in protein. No information is available about the variation in protein content and its correlation with agronomic characters. Work presented in this paper compares the protein yield of 25 lines of indigenous and exotic collections of winged bean, grown in the same agroclimate. Results indicate that there is a wide variation in seed protein content ranging from 27 to 41%. Most of the lines had 35 to 37% crude protein. Differences in protein content in the individual plant selections within the line were also observed. Correlation of agronomic characters with seed protein showed that increase in yield components will not reduce the percentage protein content.

13. Senanayake, Y.D.A. and Ponnadurai, M. (1979). Chemical characterization of winged bean, *Psophocarpus tetragonolobus* (L.) DC. and related *P. palustris* Desv. J. Natn. Sci. Coun. Sri Lanka 7(2): 119-21.

Of the few species in the genus *Psophocarpus*, only winged bean and *P. palustris* are cultivated. The latter however compared to winged bean is a less vigorous creeper, bear smaller fruits and seeds and is native to West Africa. Due to the wide separation of native habitats of the two species, an investigation was begun to study their relationship through interspecific hybridization and distribution of phenolic constituents on paper chromatograms. The chromatogram showed that there were spots common to both species even though the two species are widely separated geographically suggesting a common origin in their evolution. Spots specific to the two species were also found, suggesting a long period of isolation of the two species which could contribute to reproductive barriers. Preliminary studies on interspecific hybridization between the two species suggest that such barriers exist.

14. Spata, J.M. (1980). Winged Bean: Promising source of protein. Cereal Foods World 25(7): 388-9.

This article provides information on the winged bean to the American Association of Cereal Chemists, stressing the similarity in composition to that of soybean. Both have trypsin inhibitor which is easily destroyed by cooking. Both have a similar amino acid profile, methionine and cystine being the limiting amino acids in mature winged bean seeds. The high efficiency ratio of the mature winged bean is almost identical to that of soybeans. The major proteins of the seed have sedimentation coefficients of 25 and 65, indicating that protein concentrates and isolates made from winged bean may function differently from those made from soybeans. The oil of winged bean seed is three times richer in tocopherol than soy oil, making it a stable oil more resistant to oxidation. The fatty acid profile of winged bean oil is more like that of peanut oil than of soy oil.

15. Yap, T.N., Van Soest, P.J. and McDowell, R.E. Composition and *in-vitro* digestibility of the winged bean (*Psophocarpus tetragonolobus*) and possible utilization of the whole plant in ruminant feed. (Unpublished paper - Department of Animal Science, Cornell University, Ithaca, N.Y. 14850, U.S.A.)

The composition and nutritive value of winged bean plant parts were evaluated. The crude protein (CP) content was highest in the seeds (42.02%) followed by young leaves (33.93%), old leaves (23.63%), green pods (22.61%) and tubers (20.57%). The dry pods (seeds removed) and old stems had the lowest CP, 9.75 and 11.51%, respectively.

The neutral detergent soluble fration, representing the soluble carbohydrates and proteins available to the ruminants, was highest in the seeds (76.89%), tubers (72.43%) and young leaves (68.65%).

Lignin was highest in the old stems (16.98%), dry pods (15.0%) and young stems (13.51%). Since cutin, ash and lignin bound proteins (ADFN) were low, lignin content was the most important factor which depressed *in-vitro* digestibility. Low *in-vitro* digestibility was observed in young stems (64.50%), dry pods (61.88%) and old stems (58.15%) while the seeds and tubers had high *in-vitro* digestibilities (91.70 and 95.28%, respectively).

True cutin was determined only in the seeds (2.96%). "Cutin" in the other parts (compounds insoluble in neutral detergent) was about 2%.

Results indicated that winged bean plant parts would make an excellent supplement for ruminants.

B. Nitrogen Fixation

16. Faizah, A.W., Broughton, W.J. and John, C.K. (1980). Rhizobia in tropical legumes. XI. Survival in the seed environment. Soil Biol. Biochem. 12: 217-27.

Factors affecting rhizobia in the seed environment of the legumes *Cajanus cajan*, *Centrosema pubescens*, *Glycine max*, and *Psophocarpus tetragonolobus* were investigated. These included the effects of fungicides, insecticides, and herbicides on the survival and growth of rhizobia on agar and in liquid cultures. The pesticides used varied on their toxicity towards rhizobia but many fungicides and insecticides could be used in the vicinity of inoculated seeds. Certain fungicides and insecticides were shown to have little or no effect on the Rhizobium-legume symbiosis of *C. cajan*, *C. pubescens*, *G. max* and *P. tetragonolobus* when added directly to inoculated seed. Various protective pelleting procedures were investigated including preparation of coating materials containing rock phosphates from different localities, talc and bonemeal. These were applied to the seed in mixtures suspended in aqueous solutions of substituted celluloses, or gum arabic. Talc and Christmas Island rock phosphate both proved satisfactory while "Cellofas" is recommended as the adhesive in this formulation. Soaking seeds before pelleting in an effort to remove anti-rhizobial substances from *G. max* seeds was beneficial in the case of soybean cultivar KS437, but harmful when applied to Palmetto seeds.

17. Harding, J., Lugo-Lopez, M.A. and Perez-Escolar, R. (1978). Promiscuous root nodulation of winged beans on an oxisol in Puerto Rico. Trop. Agric. (Trinidad) 55(4): 315-24.

Roots of winged beans were found to possess greater numbers of nodules and heavier dry weights of nodules than other legumes when not inoculated and grown in an Oxisol with no previous history of legume cultivation. Promiscuous nodulation of winged bean appears to follow an exponential growth pattern for nodule dry weight and a linear growth pattern for nodule number. Promiscuous nodulation was much greater on some genotypes than on others when genotypic means are compared. On an individual plant basis, heritabilities for promiscuous nodulation are very low.

18. Ikram, A. and Broughton, W.J. (1980). Rhizobia in tropical legumes. VII. Effectiveness of different isolates on *Psophocarpus tetragonolobus* (L.) DC. Soil Biol. Biochem. 12: 77-82.

Rhizobia isolated from fourteen different genera of legumes were tested for their N-fixing effectiveness with *Psophocarpus tetragonolobus* in standard Leonard jar trials. Isolates from all plants except *Pithecellobium jiringa* were able to form nodules with *P. tetragonolobus* although a wide range of effectiveness amongst the different rhizobia was demonstrated. Thus *P. tetragonolobus* may be considered promiscuous with respect to its

rhizobial requirements. Based on this experiment, a group or rhizobia comprising three elite strains (RRIM 56 from *P. tetragonolobus*, UMKL 36 from *Lablab purpureus* and CB 756 from *Macrotyloma africanum*, a moderately effective strain (NGR 258 from *P. tetragonolobus*), and two strains of low effectivity (RRIM 968 from *Centrosema pubescens* and UMKL 12 from *Phaseolus angularis*) were selected for further study. When these were used to inoculate *P. tetragonolobus* growing in soil taken from virgin jungle (less than 1.54 rhizobia g^{-1} soil); RRIM 56 and UMKL 36 again performed well, but NGR 258 outperformed CB 756.

19. Ikram, A. and Broughton, W.J. (1980). Rhizobia in tropical legumes. VIII. Serological characteristics of *Psophocarpus tetragonolobus* (L.) DC. isolates. Soil Biol. Biochem. 12: 83-7.

Antisera were prepared against six inoculant strains of rhizobia for *Psophocarpus tetragonolobus*, and used to react with 62 different strains in both agglutination and immunodiffusion systems. A wide array of reactions occurred, indicating the extent of heterogeneity amongst strains capable of nodulating the same host. In agglutination reactions, the heat-stable somatic antigens could be arranged in 25 serogroups. In gel diffusion, antigens which produced strong precipitin bands usually showed agglutination relationships, but the corollary was not true. The immunodiffusion technique easily distinguished homologous and cross-reacting reactions and could be reliably used in field experiments with *P. tetragonolobus*.

20. Ikram, A. and Broughton, W.J. (1980). Rhizobia in tropical legumes. IX. Pot and field trials with inoculants for *Psophocarpus tetragonolobus* (L.) DC. Soil Biol. Biochem. 12: 203-9.

Antigenically identifiable inoculants for *Psophocarpus tetragonolobus* were evaluated in three non-sterile soils contained in pots (sandy-clay, Renggam series; a loamy-sand, Sungei Buloh series; silty-clay, Munchong series). Most-probable-numbers of indigenous rhizobia ranged from 4 (Renggam series) to 13 (Munchong series)g^{-1}. Only two (RRIM 56 and 968 of the eight rhizobia tested formed >50% of the nodules in all soils. Recovery of two strains (RRIM 968 and UMKL 12) was significantly poorer from the Munchong series soil which had the most indigenous rhizobia and the highest silt plus clay content. In a field trial using a Sungei Buloh series soil containing 700 rhizobia g^{-1} capable of nodulating *P. tetragonolobus*, none of the applied strains formed >18% of the nodules; two formed no nodules. There were no significant increases in plant yield in response to inoculation in the field trial and in two soils in the pot trials. In Sungei Buloh series soil, RRIM 56 formed 90% of the nodules when the indigenous rhizobia were 5 cells g^{-1}, and 14% when the population was 700 g^{-1}. This raises the question of the need to inoculate seed sown into soils with high indigenous rhizobial populations, but there was some indication of increasing representation of inoculant strains in nodules

with time.

C. Genetics and Plant Breeding

21. Bottino, P.J., Maire, C.E. and Goff, L.M. (1979). Tissue culture of organogenesis in the winged bean. Can. J. Bot. 56: 1773-6.

Seedlings of *Psophocarpus tetragonolobus* var. Tpt2 were grown under sterile conditions on nutrient agar. Hypocotyl sections (0.5cm) from 2-week-old seedlings were used to initiate callus on solid B5 medium with 0.5mg/L2.4-D. Callus was transferred into liquid B5 and MS media also containing 0.5mg/L2.4-D. Suspension cultures developed within 6 weeks, but could not be maintained longer than 3 months. However, when suspensions were transferred into medium containing MS Salts, iron-EDTA, and the following organic compounds: inositol, thiamine, pyridoxine, nicotinic acid (0.5mg/L), kinetin (0.3mg/L), IAA (5.0mg/L), 2.4-D(1.5mg/L) and sucrose (40mg/L), optimal growth resumed and has continued for 2 years with a doubling time of 57.6h. Chromosome counts of the suspension culture cells show predominantly the diploid chromosome number of 2n=18. Greening of callus occurred in the absence of exogenous hormones, but efforts to hormonally induce organogenesis from callus have suceeded only in promoting root formation.

Note: The chromosome number 2n=18 is again confirmed here. -Ed.

22. Chandel, K.P.S., Joshi, B.S.,Arora, R.K. and Pant, K.C. Winged bean (*Psophocarpus tetragonolobus* (L.) DC.), its exploration, evaluation and genetic diversity. Presented at the National Symposium on Plant and Animal Genetic Resources, I.A.R.I., New Delhi, Dec. 1978.

(see abstract 23)

23. Chandel, K.P.S., Joshi, B.S., Arora, R.K. and Pant, K.C. Winged bean - a legume for better nutrition. Indian Horticulture (In press, 1979).

The winged bean was introduced into India at Calcutta in 1799. Its cultivation has remained confined to north eastern India and, to some extent in Maharashtra (including Goa), Karnatha, Tamil Nadu and Kerala. Apparently it has never been cultivated in north India. During the mid 1960's, new varieties were introduced from abroad and systematic evaluation was initiated at Amravati, Maharashtra and New Delhi. Research has been intensified and new germplasm has been assembled from within the country through explorations in north eastern India and Kerala and introduced from Indonesia, Papua New Guinea, Ghana and Nigeria. It prefers humid tropical and sub-tropical climates where conditions are extremely

wet although recent efforts to acclimatise it in the north Indian plains, away from humid conditions, have given encouraging results. The best time to plant is from the last week of June to the end of July, depending on the arrival of the monsoon rains. Up to 75 pods have been produced on a single plant, and green pod yield of 2.5kg, grain yield of 380g and tuber yield of 1.07kg. per plant have been recorded at Amravati Station (NBPGR). In India, disease problems have been few. Preliminary studies identified Bihar and tobacco caterpillars (*Diacresia obliqua* and *Spodoptera litura* repectively) as the most common insect pests.

(The article also described cultural conditions, nutritive attributes and culinary uses in India. -Ed.)

24. Haq, N. and Smart, J. (1977). Chromosome complements in *Psophocarpus* spp. Tropical Grain Legume Bulletin No. 10: 16-9.

Chromosome counts were made on 14 accessions of *P. tetragonolobus* and found to vary within some varieties from the same geographic area. Polymorphism was found in a single accession of an Indonesian variety 1000(4) and also in the accession UPS-45 (from Papua New Guinea); chromosome numbers of 2n=18 and 2n=20 were found. Counts on one accession (Tpt7) of *P. palustris* were 2n=18. Chromosomal polymorphism could have very significant repercussion in breeding depending on the nature of the structural differences between chromosome races. Some disturbance of fertility and some restriction on recombination could also result. The chromosome differences may also have some cytotaxonomic significance. Further detailed study is required and is continuing at the Department of Biology, University of Southampton.

25. Jalani, B.S. (1976). A preliminary study of the effects of gamma-irradiation on early growth of winged bean, *Psophocarpus tetragonolobus* (L.) DC. Malaysian Agricultural Research 5(2): 139-44.

Seeds of one accession of winged bean were given 0 (control) 10, 20 and 30 krads using ^{60}Co as a source of radiation and were then planted in plastic bags. Seed germination, plant height and nodulation were reduced with an increase of irradiation dose. Irradiation apparently stimulated the number of branches and internode length but the response of total dry weight was inconsistent. It is hoped that some of these stimulatory effects can be directed towards the use of irradiation in plant improvement.

26. Khan, T.N. Breeding for improved nutritional quality in the winged bean (*Psophocarpus tetragonolobus*). In: Breeding for Nutritive Value in Crop Plants, Ed. - A.K. Kaul, CRC Press Inc., USA. (In press).

This comprehensive chapter reviews the plant, its origin and distribution, variation and genetics, cultural practices and management; nutritional quality, nutritive factors, anti-nutritive factors, and food value; and breeding for improved nutritional quality. Forty references are cited.

27. Sastrapradja, S., Lubis, S.H.A., Lubis, I. and Sastrapradja, D. (1978). A survey of variation in *Psophocarpus tetragonolobus* (L.) DC. with reference to the Javanese samples. Annales Bogorienses 6: 221-230.

Morphological characters of twelve samples of *Psophocarpus tetragonolobus* collected from Java were studied. Those characters include cotyledon leaves, first trifoliate leaves, days to flowering, flower color, pod length, pod characters, seed size, and seed-coat color. The seedling characters were less varied than the adult characters.

From the data gathered it was shown that some samples produced offspring which were similar in characters to their parents. Such a condition indicated the possible retainment of the parental characters. On the other hand there was evidence that some samples were heterozygous in nature. The role of *Xylocopa confusa* was discussed in relation to the mode of the pollination. The need for further studies was stressed to clarify the breeding system existing in this species.

28. Senanayake, Y.D.A. and Thiruketheeswaran, A. (1978). Stigma receptivity in winged bean, *Psophocarpus tetragonolobus* (L.) DC. SABRAO Journal 10(2): 116-9.

The time of pollen-shedding reported here is later than for mung beans or for pigeon pea in which emasculation must be carried out about 21 hours before flower opening. It is, however, earlier than observed for winged bean by Lubis (1978) in Indonesia. In her material, pollen-shedding was observed at 1 am - 2 am which was 7 to 8 hours before the flowers opened. Like most other grain legumes and vegetable legumes, winged bean is seen here to be a highly self-fertilized species. But out-crossing up to 7.6% has been reported recently (Erskine, 1978). The present study shows that outcrossing is possible because the stigma is receptive up to 34 hours after the flowers have opened and even a higher degree of outcrossing than reported in the literature could be expected as a result of high insect activity under favourable conditions.

D. Diseases

29. Drinkall, M.J. and Price, T.V. (1979). Studies of *Synchytrium psophocarpi* on winged bean in Papua New Guinea. Trans. Br. Mycol. Soc. 72(1): 91-8.

Sporangia of *Synchytrium psophocarpi* (Rac.) Gaumann from Papua New Guinea were globose or ovate, had hexagonal walls and ranged from 12.5 to 27.0(21.4)µm diam, and 20.0 x 15.0 to 35.0 x 22.5(25.2 - 19.4) µm. Unopened sori contained between 4272 and 4890 sporangia. Germination occurred at temperature of 5-30°C and 84-100% r.h., in the presence of free water. Each sporangium contained between 102 and 156 zoospores; these emerged after 40 min incubation and maximum germination occurred after 70 min. The viability of sporangia from unopened and recently opened sori was greater than sporangia from old sori. Sporangia exposed to the air lost their viability after 4 days; this increased to 24 days when stored in a sealed plastic box at 5°. Live zoospores were pyriform and measure 5.0 x 2.5 to 10.0 x 5.0 (6.9 x 4.6)µm whilst fixed zoospores were spherical and measured 2.5 x 2.5 to 5.0 x 3.0 (3.34 x 2.5)µm. Flagellar length of recently emerged zoospores varied from 7.5 to 16.25 (12.98)µm. Zoospores lost their motility 30 min after emergence from the sporangium and encysted after a further 2-3h; encysted zoospores were spherical and measured 3.0-6.0 (4.39) cm diam. The flagella were withdrawn by vesicular retraction.

30. Fortuner, R., Fauquet, C. and Lourd, M. (1979). Diseases of the winged bean in Ivory Coast. Plant. Dis. Reptr. 63: 194-9.

Incidence of diseases and pathogens on winged bean, *Psophocarpus tetragonolobus*, recently introduced into Ivory Coast was observed. Root-knot nematodes (*Meloidogyne* spp.) severely damaged roots and tubers of the bean. Three viral diseases were observed, which sometimes produced very heavy damage. A leaf anthracnose caused by *Colletotrichum gloeosporiodes* did not reduce yield.

31. Khan, A.Z.M., Nowsher and Nahar, K. (1978). *Cercospora canescens*, associated with a leaf spot disease of the winged bean plants (*Psophocarpus tetragonolobus*) in Bangladesh. (short communication).

Winged bean plants at the University of Dacca were found to suffer from a leaf spot disease in winter 1977. The spots were circular to sub-circular, up to 0.5mm in diameter, whitish-grey, surrounded by a reddish brown border. The fungus associated with the disease leaf spots was *Cercospora canescens* Ellis and Martin in which, although encountered on a wide range of the Leguminosae, has not been reported earlier on winged bean. The specimen cited in the text is deposited at C.M.I., Kew.

32. Vera-Chaston, H.P. (1977). *Synchytrium psophocarpi* (Rac.) its development and anatomy of infection on *Psophocarpus tetragonolobus* (L.) DC. Kalikasan, Philipp. J. Biol. 6(3): 183-98.

The chytridiomycete *Synchytrium psophocarpi* (Rac.) Gaumann, an obligate endoparasite of *Psophocarpus tetragonolobus* (L.) DC., was studied in situ. Emphasis was on the development of the fungus, the histo-anatomical response of the host, and the nature, structure and formation of galls on different parts of the host plant.

Ingress is direct through the epidermal cells in all above-ground parts of the host plant. The parasite undergoes intercellular migration from the epidermal cells down into the cortical zone, wherein are passed all subsequent stages of development as follows: increase in volume and rounding up of the thallus; progressive enlargement of the primary nucleus; an apparent "akaryotic" phase following the disappearance of the nucleus and membrane of the primary nucleus; reappearance of nuclear material in the form of secondary nuclei in the cytoplasm; and finally, conversion of the whole thallus into a zoosporangial sorus. Resting spores are not produced.

E. Miscellaneous

33. Mertens, C., Paulus, J. and Schmitz, A. (1979). Le Pois Carré: *Psophocarpus* - une plante riche en proteines pour les tropiques - Fondation Universitaire Luxembourgeois Serie "Documents", Arlon Belgigue. 33pp booklet.

34. Nangju, D. and Baudoin, J.P. (1979). Performance of winged bean (*Psophocarpus tetragonolobus* (L.) DC.) in Nigeria. Journal of Horticultural Science 54(2): 129-36.

Winged beans were grown at Ibadan (sub-humid) and Onne (humid) under different management practices. The plants took about 11 days to emerge from the soil but this period could be shortened by soaking the seed in water at pregermination prior to sowing provided the soil was moist at planting. Staking (minimum 1m) was essential for high yields and a woody legume, *Leucocephala*, could replace the trellis, and also improved seedling emergence and soil fertility. All cultivars tested at Ibadan showed a delay of about 30 days in flowering when planted in April compared with September. At Ibadan yields up to 2400 kg ha^{-1} or 11 kg $ha^{-1}d^{-1}$ were obtained, but soybean outyielded winged bean. At Onne winged bean was the most promising among six species of grain legumes with respect to nodulation, pest and disease resistance, resistance to field weathering and yield.

35. Newell, C.A. and Hymowitz, T. (1979). The winged bean as an agricultural crop. New Agriculture Crops. American Association for the Advancement of Science, Western Press, Boulder, Colorado, U.S.A.

A comprehensive treatment summarizing information on species of the genus *Psophocarpus* and their distribution, taxonomy, cytology, morphological variation, chemical composition and nutritive value (with tables presenting proximate composition of different parts of the winged bean, content of minerals and vitamins, amino-acid and fatty acid composition), and giving information on germplasm resources, nodulation, utilization for food, medicinal and other purposes in Asia and Africa, diseases and production. An extensive list of references is cited.

The paper was presented at the AAAS symposium in 1978.

36. Ravelli, G.P. (1977). The winged bean as a new source of protein for rural populations in the Ivory Coast, West Africa. Extract from the Annual Report 1977 of the Nestlé Foundation. (This report is liberally illustrated with attractive colour photographs - Ed.)

This report outlines a field project presently being undertaken by the Nestle Foundation in the forest region of the Ivory Coast with the aim of increasing the protein content of the local diet through the consumption of the winged bean by encouraging its culture in family gardens.

Part I gives results obtained in field trials with seeds obtained from Papua New Guinea (PNG), variety UPS 32, and from Ghana (GH). Material and methods of culture are described. The behaviour of the two varieties (PNG and GH) under varying environment conditions and their morphological characteristics are compared. Pest problems (mainly nematodes, *Meloidogyne* sp. and viral diseases) are discussed. The Ghana variety was found to be more vigorous, more resistant to pest attacks and better adapted to local environmental conditions. Although the region under study can be defined as "hot humid tropics" (latitude 5° to 7° North, pluviometry 2,300 to 1500 mm annual average) both varieties behave like annual plants in that they did not survive the dry season, November through March. Composition tables are given for both varieties.

Part II outlines the project's nutritional aspect. Two villages, comparable in size and population composition, situated at the northern limit of the Ivotian rainy forest were chosen: an experimental village and a control village. In both villages the preschool-age population receives medical attention and the children's nutritional status is periodically assessed by clinical, anthropometrical and biochemical standards. In the experimental village the winged bean culture (Ghana variety) in family gardens is being promoted by agronomic assistants and the consumption of green pods, leaves, seeds and possibly tubers is encouraged by household assistants. Both villages show a sizable prevalence of marginal to frank PCM, with yam and cassava as staple food

and with a low protein content of the diet. It is hoped that the additional protein source from the winged bean will result in improved nutritional status and better growth pattern in the children of the experimental village.

Acceptability problems and the population's reaction to the culture of this new crop are discussed.

37. Ruegg, J. (1979). The development of winged bean (*Psophocarpus tetragonolobus* (L.) DC as influenced by photoperiod, temperature and growth media--a preliminary report. (Unpublished). Department of Crop Science, Federal Institute of Technology (ETH), Zurich, Switzerland.

Selections of winged bean from Papua New Guinea, Nigeria, Ghana and Costa Rica were grown for preliminary studies in growth cabinets set to an 11-hour-photoperiod with day/night temperatures at 27/23°C and 22/18°C. A second batch of plants was grown in a temperature controlled glasshouse with a 16-hour-photoperiod and temperatures as similar to the ones in the growth cabinets as technically possible. In the 11-hour-photoperiod and at 27/23°C flowering began after 54 days, averaged over all selections, and at 22/18°C 15 days later. UPS 31 and UPS 99 were earliest flowering and the beginning of flowering at 22/18°C was least delayed in these selections. In the 16-hour-photoperiod vegetative growth was profuse but flowering occurred only in three per cent of all plants. Flowering could be induced to a certain degree by exposing the plants to an 11-hour-photoperiod. The cool temperature was more conducive to flowering than the warm for plants without and with the inductive exposure to the 11-hour-photoperiod. Different growth media and use of inoculum are described. The 11-hour-photoperiod and the cool temperature seemed to be more conducive to the initiation of tuber growth than the 16-hour-photoperiod and the warm temperature.

38. Secreto, A.C. (1979). Winged bean: a potential tuber crop. Radix: 16-18.

This report reviews aspects of winged bean tuber production in general and the research initiatives of Dr. Marianito R. Villanueva, Director of the Philippine Root Crop Research and Training Center in particular. The collection of locally-available cultivars numbered 171 accessions which were being tested for their adaptability, resistance to insect pests and diseases and tuber yield. Cultural practices that promote the production of tubers were also being studied.

39. Sinnadurai, S. (1977). Studies on winged bean in the coastal savannah (Accra plains) of Ghana. Trop. Grain Legume Bulletin No. 10: 14-5.

Seeds were sown at 30 day intervals from March 1975 to February 1976. The time between emergence and flowering differed significantly, the shortest being 45 days for the mid-December sowing and the highest 136 days for the mid-March sowing. The latter sowing resulted in the highest yield, although the difference was not significant.

Under short 8 hour days, root nodule number and weight decreased significantly although a 1 hr. break in the dark period reversed this. Flowering (40 days after emergence), fruit set and seed yield was significantly higher under short days and under break in the dark period treatments than under normal daylength (12hr.). Plants under a 16hr. light photoperiod failed to flower but remained vegetative as long as there was moisture in the soil.

Bagged flowers produced viable seed, indicating that insects are not essential for pollination.

Winged bean proved to be a beneficial fallow crop in rotation with dry-season, irrigated tomato crop, the higher levels of soil N increasing the yield of marketable fruits.

40. Thompson, A.E. and Haryono, S.K. (1980). Winged bean: Unexploited tropical food crop. Hort. Science 15(3). 233-8.

The recent history of winged bean is reviewed. It is suggested that 2 major groups of germplasm exist: one from Papua New Guinea (PNG), the other from Indonesia. The germplasm from other areas of S.E. Asia is similar to that from Indonesia and the Nigerian material appears to have been derived from PNG germplasm. One important feature of the Indonesian germplasm is the existence of accessions having a high level of resistance to False Rust. In general, the Indonesian material lacks the various anthocyanin pigmentation patterns on stems, leaves and pods widely found in the PNG lines. A unique flower was discovered in accession from Madura, having a normal blue base colour with patches of purple in the centres of the wing and banner (standard) petals.

Observations indicated that Indonesian accessions were later in maturity, had greater vegetative vigour and were higher yielding than most of the PNG accessions. A high percentage of the Indonesian accessions retain their vegetative vigour after fruiting and could be characterized as short-lived perennials. At 245 days after planting, yields of 11t/ha of green pods or 2.5t/ha of dry seed were obtained.

41. Wally, Y. (1977). The winged bean, *Psophocarpus tetragonolobus*. Egyptian Journal of Horticulture 4(2): 99.

The exceptional attributes of winged bean are described. Although winged bean is indigenous to the humid tropics, it responds favourably to irrigation and consequently, can be grown in drier regions. Winged beans have great potential for facilitating the problem of protein malnutrition, especially if cultivated in Upper Egypt and at the high dam borders.

IX. THESES ABSTRACTS

1. Ekpenyong, Thomas Essien. Biochemical and nutritional evaluation of the winged bean, *Psophocarpus tetragonolobus* (L.) DC. (Unpublished Ph.D Thesis, University of Nebraska, May 1978) - Current address: Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

The winged bean - *Psophocarpus tetragonolobus* (L.) DC is a tropical legume with exceptional biochemical and nutritional characteristics. Every part of the plant can be utilized for human food, livestock feeds and for pharmacological purposes.

The objective of this study was to evaluate its chemical composition, amino acid profile, *in vitro* digestibility, changes occurring during processing, factors affecting extraction and precipitation of the proteins and the fatty acid composition of the oil. Other studies involved the presence of such antinutritional factors like the trypsin inhibitor activity (TIA), irease activity and haemagglutinating activity. Finally, studies were conducted with male weanling albino rats in order to evaluate the protein quality of winged bean meal (WBM), soybean meal (SBM) and casein fed at 10% and 12% level of protein. In this last study, the parameters used were liveweight gains, feed intake, efficiency of feed utilization (F/G) and protein efficiency ratio (PER).

The seeds of the winged bean have a chemical composition similar to, or sometimes better than, that of soybean. The dry seeds contain 36% protein, 24% carbohydrates and 16% oil. The vegetative part too, is rich in protein, fats and minerals. The roots have an exceptionally high level of protein and some amino acids, superior to any known tropical tubers. There are more unsaturated than saturated fatty acids (72.4% vs 27.6%) and this is important in the contribution of such oil to the cholesterol problem. More behenic acid was found than previously, and the oil contains more oleic and arachidic acids than either soybean or peanut.

The amounts of protein extracted and precipitated are pH - dependent. Proteins of the winged bean were found to be more soluble at alkaline than acid pH. The points of minimum and maximum dispersion were pH4 and 12 respectively. The pH4 corresponded to the isoelectric pH where proteins aggregate and precipitate. Water extracted more proteins than any solvent at pH12. Sodium hydroxide was next best at 0.1M concentration and a pH of about 12.

The nutritive value of the winged bean in terms of the *in vitro* digestibility showed that mature pods had the highest digestibility (73.8%) and raw seeds the lowest (67.3%). Processing, involving autoclaving (84.3%), dry heat (71.6%) and soaking prior to cooking (83.6%) improved digestibility by as much 20% in the case of autoclaving.

The amino acid composition is similar to that of soybean. Winged bean protein is deficient in the sulphur-containing amino acids. It is richer in lysine, phenylalanine and leicine than soybean and compares well with whole egg. Methionine in the winged bean is tied up with some anti-nutritional factors.

Like most legumes, the seeds contain both trypsin inhibitors and hemagglutinins. No urease activity was detected. Raw seeds had antitrypsin activities of 38.8 - 57.5 TIU/mg, autoclaved seeds had 1.5 - 4.4 TIU/mg. The results show that these inhibitors can be inactivated by autoclaving and that the degree of improvement of the dietary effectiveness of the protein depends upon temperature, time of heating and moisture level in the sample.

Results of rat feeding trials showed that both raw seeds and seeds soaked in water without any heat treatment caused death in rats. Rats fed on 12% protein diets gained more weight and had better feed conversion than those fed on 10% protein diets. Supplementation of the winged bean diets with methionine improved its nutritive value. The protein efficiency ratio (PER) of the winged bean and soybean were about the same.

Preliminary results also show that winged bean proteins contain more albumins (89.5%) than globulins (76.5%). Also found were prolamins (12.7%) and glutelins (51.2%).

2. Abstracts of Studies on Winged Bean No. 1

- Prepared by the Palawan Agricultural Research Center, P.N.A.C., Aborlan, Palawan, Philippines. This monograph records the results of research undertaken during 1977-1978. Researchers and their projects are listed:

Apdon, J.V. and Baaco, M.B. Performance Test of Different Varieties of Winged Bean under Natural Condition in Coconut Plantation.

TPT-6-D3-DBK gave the highest yield of 171.9g dried beans per plant, equivalent to a computed 1,711 kg/ha. Fresh tubers of the native variety gave the highest yield of 211g/plant, equivalent to 2,111 kg/ha.

Bangoya, M.A. and Orlido, E.C. The Effect of Time of Planting on the Growth, Inflorescence (Development) and Yield of Winged Bean.

Time of planting had a significant effect on yield, the August planting being better than September and October.

Castro, V.A. and Anunciado, A.C. The Effect of Various Levels of Phosphorus on the Performance of Winged Bean.

Compound fertilizers containing the highest percentage of P(28-112-28 kg/ha) gave higher yields of both seed and tubers (1135 kg/ha and 247 kg/ha respectively). Plants receiving higher levels of P flowered and matured earlier.

Chinense, M.B. and Ponce de Leon, E.L. Preliminary Study on Pests and Diseases of Winged Bean.

The most prevalent insect pests that attacked the winged bean plants were the beanfly, bean pod borer, aphids, root grubs, mealy bugs, scale insects, grasshoppers and ants. False rust (orange gall) and cercospora leaf spot were the main diseases.

Flores, D.F. and Ponce de Leon, E.L. Preliminary Study on the Agronomic Characteristics of Nine Local Collections of Winged Bean from Southern Palawan.

RXS No. 5 Poblacion was the highest yielder with an extrapolated mean seed yield of 378kg/ha.

Quiamco, R.I. and Baaco, M.B. The Response of Winged Bean to the Different Levels of Fortified Organic Fertilizer.

Reblando, E.R. and Baaco, M.B. The Effect of the Different Methods of Cultivation on Tuber and Bean Yield of Winged Bean.

Reid, T.C. and Ponce de Leon, E.L. The Effect of Animal Manures and their Combination with Complete Fertilizer on the Growth and Yield of Winged Bean.

Cattle manure, in combination with complete fertilizer, significantly enhanced earlier flowering and maturity (90 and 127 days respectively, from seeding), and induced a significant increase in the number of pods and the yield of dried beans (754 kg/ha).

Sabenacio, F.G. and Ponce de Leon, E.L. The Effect of Different Time of Fertilizer Application on the Yield of Winged Bean.

Seed and tuber yields did not differ significantly.

Ubay, A.T. and Orlido, E.C. The Effect of Varying Levels of Nitrogen Fertilizer on the Growth and Yield of Winged Bean.

Vasquez, T.M. and Baaco, M.B. Study on the Effect of Various Types of Trellises on the Yield of Winged Bean.

A-Type and T-Type produced higher (extrapolated) dry bean yields of 1315 and 1151 kg/ha respectively, being almost twice the yield of the control and fence type trellis.

X. COUNTRY REPORTS

BANGLADESH

Khan, S.H., Head, Plant Breeding Division, Bangladesh Agricultural Research Institute, Joydebpur, Dacca and Coordinator, Pulse Research Scheme, Bangladesh Agricultural Research Council. (Unpublished Report)

The Winged Bean (*Psophocarpus tetragonolobus*) has been grown in Bangladesh as a backyard crop in many districts for a long time. No large scale cultivation is practiced and the yield and market was not considered favourable. Winged Bean research started in Bangladesh with a grant from The Asia Foundation through BARC (1977) for a period of three years. A separate collaborative project between BARI and Dr. Nazmal Haq of the Department of Biology, The University, Southampton, U.K. with funding from the Leverhulme Trust, U.K. was started in 1979-80.

BARI researchers working on the Winged Bean Project are: Dr. Sharafot Hossain Khan, Dr. Mamunur Rashid, and Dr. M.A. Quasem. In 1979-80, 215 local accessions and 20 exotic samples were planted for evaluation at Joydebpur. Results obtained were promising with some of the entries yielding 3 to 6 tons per hectare (extrapolated figure). A further evaluation trial has been set up, at Hathazari Regional Agricultural Research Station which is a natural growing area for Winged Bean with 300 entries in the summer of 1980. The trial included promising materials from last trial and some new entries.

Additional trials are also being established at Joydebpur with different promising lines to evolve pure lines and a small interspecific hybridization experiment involving *P. tetragonolobus* and *P. scandens* is also being carried out.

Fattah, Q.A. and Bano, A., Department of Botany, University of Dacca, Bangladesh. (Unpublished report).

Apparently the rhizosphere of winged bean is a rich source of carbohydrates and nitrogen. Results revealed that though the sugar content does not change during the pre- and post-flowering periods, there is a great reduction in the nitrogen content of the soil at the fruit-set stage. Thus, while considering the possible use of winged bean as an intercrop, the date of planting of other crops should be so manipulated to derive maximum benefit.

Rahman, M.A. and Ahmed, S., Department of Botany, University of Chittagong. (Unpublished note on the performance of winged bean varieties grown during summer).

In Bangladesh, there is a persistent scarcity of protein-containing vegetables during the summer months. Most legumes are grown in winter. Winged beans or "Kamranga Shim" have been grown in many parts of Bangladesh during the winter months, though cultivation is still limited to backyards. In an attempt

to study the performance of different varieties of winged bean grown during the summer, four varieties, three (Tpt-1, Tpt-2, and Tpt-6) obtained from IITA and one local variety from Chittagong were planted in a plot 34m by 20m, with 4m between lines and 2m between pits. Seeds were sown in a complete randomized design, 5 seeds in a pit. After germination, only one healthy seedling was kept for experimentation. Seeds were watered twice weekly in April and May.

Results have shown that the local Chittagong variety and Tpt-6 can be grown in summer in Bangladesh in the Chittagong area, but that varieties Tpt-1 and Tpt-2 cannot survive summer water-logged conditions. These results may be useful in stimulating the growing of this highly nutritious plant in Bangladesh during the summer months when legumes are scarce and where malnourishment is endemic.

BRASIL

Flechtmann, C.H.W. and Ademilson, E.R. University of São Paulo, Brazil. (Unpublished, preliminary observations on winged bean.)

Brown seeds of winged bean obtained from Dr. Kenneth O. Rachie at CIAT in 1977, were planted in the summer of 1977/78 in the courtyard of the Department of Zoology at Escola Superior de Agricultura "Luiz de Queiroz," University of São Paulo, in Piracicaba, São Paulo (Latitude Tropic of Capricorn, 23-24°S.). Seeds germinated in c. 8 - 10 days in December 1977 and grew vigorously on trellises 2.5 metres high. First flowers were observed at the end of March 1978. Many pods developed. Tubers were harvested in late May and were found to reach about 3cm in diameter and up to 15cm in length. A considerable number of nodules of nitrogen-fixing bacteria, measuring from 0.5 to 3cm in diameter, were observed on the roots.

Four winged bean seeds were germinated in each of four 10 litre vases, containing soil infested with two species of root nematodes. Ten days after germination, the soil was inoculated again with nematodes. Plants infested with *Meloidogyne incognita* presented a few, but rather large galls, measuring about 4 times the diameter of the root. *Meloidogyne javanica* induced a few small galls.

A number of insects were observed to feed on winged bean plants, including caterpillars of *Podalia* sp. (*Lepidoptera Megalopygidae*), destroying foliage (this pest also feeds on coffee, roses, guava, persimmon, citrus, and sugar cane); two species of thrips (*Caliothrips phaseoli* and *Echinothrips mexi-*

canus) mainly on upper leaf surfaces, resulting in small whitish spots along veins; two species of *Coleoptera*, *Chrysomelidae*, *Galerucinae* and one specie of *Hemiptera*, and *Pentatomidae* were also observed. During a humid and hot period in January 1978, a considerable attack of broad mite (*Polyphagotarsonemus latus* was observed causing intense bronzing and distortion of apical buds and leaves. The common two spotted spider mite *Tetranychus urticae* attacked mainly older and median leaves causing them to drop. Two plants kept out of reach of rain, were completely defoliated. *Tetranychus desertorum*, a carnine spider mite, also developed well on winged bean leaves but was less damaging.

PAKISTAN

Hussain, A., University of Agriculture, Faisalabad. (Unpublished project report on the effect of seed inoculation and fertilizers on growth and chemical composition of winged bean.)

Variety K11 was sown in June at the start of the monsoons. Initial, detailed soil analysis was carried out. One treatment consisted of inoculation with "nitragin". Fertilizer treatments of 0-123.55kg/ha of N as urea were applied. Data to be collected include analysis of seed for moisture protein, non-protein N, oil and total P and K. Vines and roots will be analysed for N, P and K. Roots will be examined for nodulation and tubers at flowering and harvest. After harvest, soil samples will be analysed for total N.

SRI LANKA

Anandarajah, K., Research Office in Charge, Kilinochchi, Sri Lanka. (Unpublished research findings on winged bean.)

Tpt 2, Tpt 6, Tpt 8 and a locally available variety were grown on a 165cm x 165cm spacing without stakes. Differences in time to initial flowering (90, 88, 79 and 198 days respectively), yield of immature pods (52.3, 34.1, 16.4 and 5.9 t/ha respectively and tuber yield (0.8, 0.9, and 0 t/ha respectively) were obtained. The production of pods from Tpt 2, and Tpt 6 was fairly uniform for a period of 31/2 - 4 months after which it declined. The pods of all Nigerian varieties matured very quickly compared with those of the local variety. All varieties developed large numbers of large nodules without inoculation. One plant of the local variety produced 276 nodules. The seeds of Tpt 2 and Tpt 6 were variable in viability after storage, in germination rate and in seedling vigour. Removal of the

tests did not improve germination. Seeds of Chimbu variety germinated very rapidly (3-5 days) and initial flowering of those plants occurred at 49 - 53 days. A breeding programme has begun.

URUGUAY

Mr. Fernando Olmos reports that he received some winged bean seeds from Mr. Louis Lazaroff in January 1979 and information from Dr. T.N. Khan. He planted two plots in November, 1979; one with Chimbu, the other with Tpt-1. The former produced many pods which were expected to give seeds but the latter only produced a few green pods. Mr. Olmos requests information about short season varieties.

WEST INDIES

Calvert Layne of the "Organisation for Rural Development (O.R.D.), St. Vincent, W.I. reports that O.R.D. has been propagating winged beans in the rural communities in the West Indies. The O.R.D. is a non-profit, non-partisan organisation committed to improving the quality of life in rural areas. It consists of 9 full-time staff, 13 part-time extension staff and over one hundred volunteer members living and working throughout the island. O.R.D. maintains the following programmes: Education (demonstrations on food and its use, village seminars on nutrition, health care, etc., seminars on record keeping) and Agriculture (fertilizer, seed and pesticide supplies to farmers, tool renting centers, pure-bred blackbelly sheep distribution to farmers, distribution of high lycine corn and African winged bean seeds, supply of high lycine corn meal and a farmer credit scheme.)

XI. BACK ISSUES - THE WINGED BEAN FLYER

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INTERNATIONAL DOCUMENTATION CENTER FOR THE WINGED BEAN

An important component in the research program drawn up during the First International Seminar on the Potential of the Winged Bean in 1978 is a strong documentation and information system for ready reference, state-of-the-art reviews, and storage and dissemination of research results.

For this reason, the Agricultural Information Bank for Asia (AIBA) was approached soon after the Public Seminar on the Winged Bean and invited to operate as a documentation and service center for this important tropical legume. AIBA accepted the responsibility and organized for documenting materials on the winged bean, as well as answering requests for relevant documents. Documentation activities started in earnest in 1979 when The Asia Foundation gave a grant to the Center for its initial year of operations.

The objectives of the Documentation and Service Center for the Winged Bean are:

- to keep scientists involved in winged bean research informed and up-to-date on the latest developments regarding research findings on the plant; and
- to build a computerized data base for quick dissemination of research findings to all interested researchers.

THE AGRICULTURAL INFORMATION BANK FOR ASIA

The Agricultural Information Bank for Asia (AIBA), a project of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), was established in 1973 out of a felt need for more effective information transfer in Southeast Asia, which at the time was still poorly represented in terms of its literature in world agricultural information services. Today, it is the major agricultural scientific information service for the region specializing in the collection, collation and dissemination of information for scientists and field workers.

The central headquarters of AIBA is located at SEARCA in Los Baños, Philippines. It has nine member countries in the region, namely, Thailand, Malaysia, Indonesia, Singapore, Hong Kong, Republic of Korea, Bangladesh, Sri Lanka and the Philippines. These countries have national documentation centers which regularly send their current indexed scientific literature to AIBA for inclusion in computer-based bibliographies called AGRINDEX and AGRIASIA.

The objectives of the information bank are:

- to serve the research needs of Asian countries in the field of agriculture and allied disciplines;
- to promote new and better techniques for handling and disseminating agricultural information; and
- to serve as the input/output center in Southeast Asia and other Asian countries for FAO's worldwide project, AGRIS.