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the winged bean flyer

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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 by 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 foundation members and officers of the Council are:

The late Dr. Jose D. Drilon, Jr., President, Director, SEARCA, Philippines

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

Dr. Norman Borlaug, Nobel Laureate, CIMMYT, Mexico

Professor J.P.M. Brenan, Director, Royal Botanic Gardens, Kew, England

Dr. M.S. Swaminathan, Secretary to the Government of India, Ministry of Agriculture and Irrigation

Dr. Eduardo Alvarez Luna, Director-General, Instituto Nacional de Investigaciones, Agricolas, Mexico

Mr. Louis Lazaroff, Director General/Treasurer

WINGED BEAN STEERING COMMITTEE

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. Setijati Sastrapradja, Director, LBN, Indonesia
Dr. V. Kesavan, University of Papua New Guinea
Prof. A.A. Duncan, University of Florida, U.S.A.
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the winged bean flyer

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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* is Dr. R.A. Stephenson. All communications should be sent to him at the following address:

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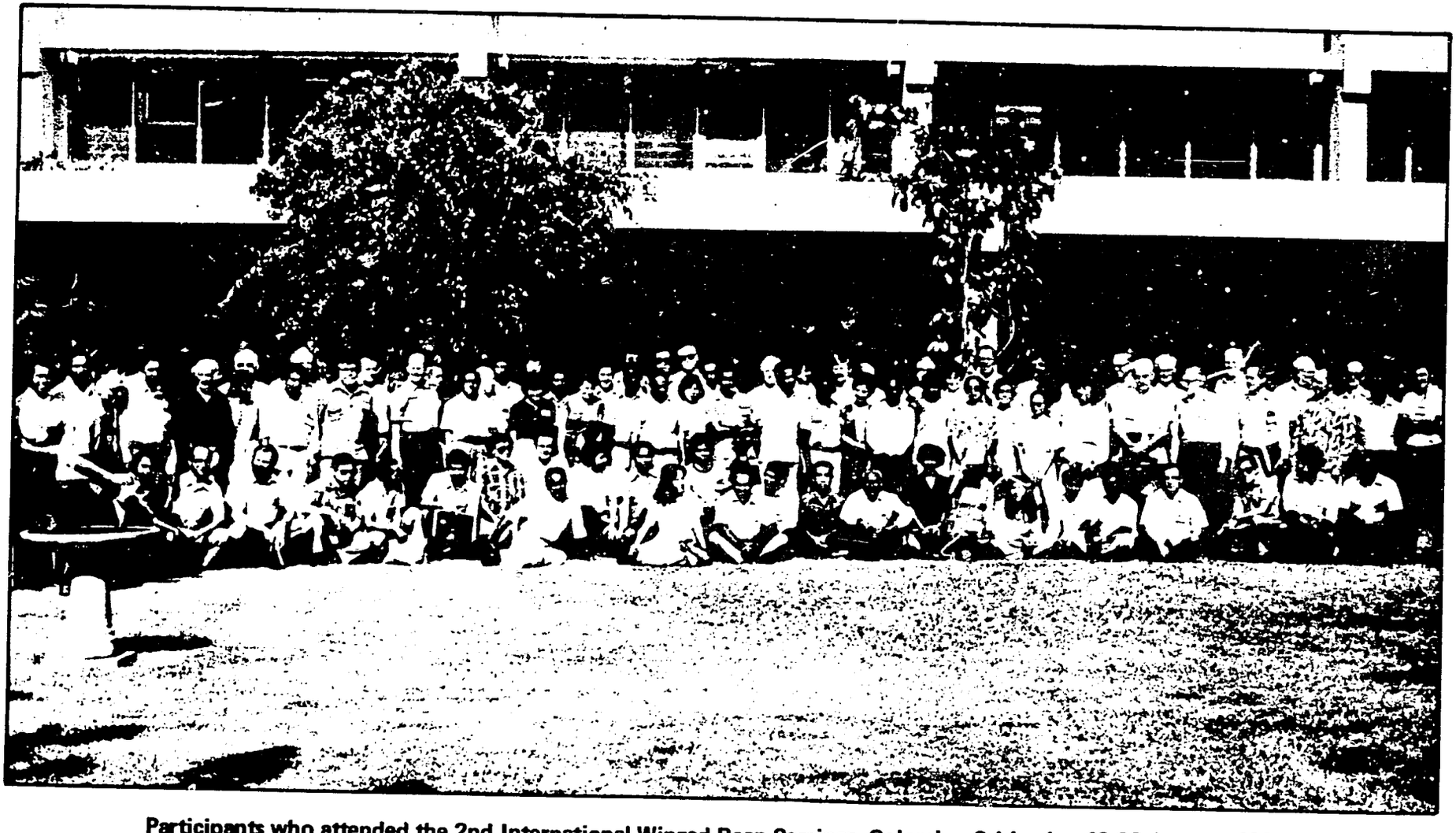
CONTENTS

		Page
I	EDITORIAL	1
II	TRIBUTE TO DR. JOSE D. DRILON, JR.	3
III	2ND INTERNATIONAL SEMINAR ON WINGED BEAN - EXTRACTS OF SUMMING UP ADDRESS	6
IV	ABSTRACTS OF TECHNICAL PAPERS:	
	A. GERMPLASM, GENETICS AND CROP IMPROVEMENT (papers 1-16)	9
	B. PHYSIOLOGY (papers 17-32)	14
	C. AGRONOMY (papers 33-55)	21
	D. ENTOMOLOGY AND PATHOLOGY (papers 56-62)	28
	E. FOOD UTILIZATION, NUTRITION AND PROCESSING (papers 63-94)	31
V	SUPPORT FOR WINGED BEAN RESEARCH	41
	GUIDELINES FOR CONSIDERATION OF WINGED BEAN RESEARCH PROPOSALS	42
	OUTLINE FOR FUND REQUESTS	46
VI	INTERNATIONAL WINGED BEAN VARIETY TRIALS - SECOND SERIES	48
VII	IBPGR WORKING GROUP MEETING	48
VIII	SURVEY OF RESEARCHERS	53
IX	WINGED BEAN FLYER SUBSCRIPTIONS AND BACK ISSUES	55



Participants who attended the 2nd International Winged Bean Seminar, Colombo, Sri Lanka, 19-23 January 1981

I. EDITORIAL

The Second International Seminar on Winged Bean, sponsored jointly by the International Council for Development of Underutilized Plants and the Sri Lanka Ministry of Agricultural Development and Research held in January in Sri Lanka, was a resounding success and indicated that efforts to bring about the development of winged bean as an important food and feed crop have been sustained throughout the world. Attendance was particularly good, with over 200 participants and observers from 36 countries. Our Sri Lankan hosts graciously set about serving the needs of the unexpectedly large group of visitors and made their stay so enjoyable and worthwhile. They did a tremendous job and deserve our sincere thanks!

The opening ceremony at the Bandaranaike Memorial International Conference Hall was most impressive. The Prime Minister, the Hon. R. Premadasa in the presence of dignitaries from Sri Lanka, from the Diplomatic Corps, participants and observers, declared the seminar open. The proceedings began with the colourful yet solemn ceremony of lighting the traditional oil lamp. As the dignitaries each participated in lighting the lamp, performers electrified the air with their exciting traditional drumming.

Participants were honoured with an invitation from H.E. the President of Sri Lanka and Mrs. J.R. Jayewardene to a tea party in the grounds of President's House in Colombo. A spectacular performance of traditional Sri Lankan dances was also provided for the enjoyment of visitors.

One of the highlights of the meeting was a decision by the Sri Lankan Government to establish an International Winged Bean Institute in that country. The Institute is expected to be formally inaugurated this autumn. We expect to be able to give you a complete report on the Institute and its anticipated program in the next issue of the Flyer.

None of the initial enthusiasm for the winged bean as a crop with enormous potential has been lost since the First International Seminar in 1978: on the contrary, the greatly enlarged group of winged bean researchers seem more enthusiastic than ever. Although much remains to be done, progress so far continues to be most encouraging.

This issue of *The Winged Bean Flyer* is devoted to reporting on the Seminar in Sri Lanka and testifies to the considerable research interest and activity which has been directed towards the development of the winged bean as a valuable crop for the developing tropics. There was a very full technical programme and the information provided in circulated papers was equally impressive. Abstracts of all these are included in this issue.

Just as this issue was about to go to press, news of the untimely death of the President of ICDUP, Dr. Jose D. Drilon, Jr. was received. His passing away is a great loss to ICDUP, to ICDUP's Winged Bean Steering Committee, to *The Winged Bean Flyer* and to all researchers working on winged bean. We are saddened by this great loss and pass on the sincere condolences of *The Winged Bean Flyer* and its readers to Mrs. Drilon and family. Dr. Drilon was one of our staunchest supporters and his substantial contributions will long be remembered.

II. TRIBUTE TO DR. JOSE D. DRILON, JR.

Dr. Jose D. Drilon, Jr.

1928 - 1981

Dr. Jose D. Drilon, Jr., a founder member of the International Council for Development of Underutilized Plants and its first president, died of a heart attack in the Philippines on June 13, 1981. Dr. Drilon was 53. At the time of his death, Dr. Drilon was also Director of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), in Los Baños, Philippines and Chairman of AMERASIA Team Services.

During his all too brief lifetime, Dr. Drilon served as a pioneer and leader in agricultural development programs in his own country, the Philippines, and internationally. Beginning with a career as an officer in the Armed Forces of the Philippines, he subsequently served for over 25 years in business, agriculture, science and education. In the Philippines he played a key role in the popularization of modern concepts of agribusiness and contributed significantly to the advancement of his country's major food production programs. He held the top post in the National Rice and Corn Corporation, was President of the Food Terminal of the Philippines, and managed a number of private corporations in construction, port services, fertilizers, farming, processing, marketing, financing, trading, training, health services, and agricultural research. He was Director General of the Philippine Council for Agriculture and Resources Research (PCARR) and rose to be Undersecretary of Agriculture and Natural Resources, acting on occasion as Secretary.

One of his most important posts in the field of international agricultural research and development was as Executive Officer of the International Rice Research Institute (IRRI), a post he held for 11 years. While helping found and serving as President of the International Council for Development of Underutilized Plants, he also served on the Board of Trustees of the International Maize and Wheat Improvement Center (CIMMYT), the International Agricultural Development Service (IADS), the Asian Vegetable Research and Development Center (AVRDC), and the International Federation of Agricultural Research and Development (IFARD).

At various times he served as consultant and visiting lecturer in the fields of economics and management with such organizations as the International Development Research Centre of Canada (IDRC), the Kingdom of Thailand, Laos, Cambodia, Indonesia and the Dominican Republic. He served as management consultant to numerous business firms in the Philippines, the United States, Hongkong and Thailand, lectured in several universities, and authored 7 books and over 200 papers in agribusiness and research management.

In an intensive, crowded and creative life, he lent his energies to the establishment and the shaping of the International Council. He participated in bringing the Council into existence at the conclusion of the first International Seminar on the Winged Bean, held in the Philippines in 1978, and left his inedible mark on its present character. He saw the Council as leading an imaginative and exciting new venture -- opening, over time, a range of presently underutilized plants for the benefit of humankind. He was unfailing with his guidance and his wisdom and the Council has grown in reputation and resources because of his insight and his farsightedness. He saw the new International Winged Bean Institute about to be established in Sri Lanka as a major accomplishment in the Council's program, envisioned a close and continuing relationship between the Institute and the Council, and looked forward enthusiastically to the role he could play in the evolution of this joint program as a member of the new Institute's Board of Trustees.

The Council and the many organizations which Dr. Drilon served and benefitted are richer because of his wisdom and humanity and poorer because of his passing. The Council itself will always be in his debt.

Dr. Drilon is survived by his wife, Mrs. Mercedes Lauchengco Drilon and his children, Jose III, Alex, Eddie, Marilou, Maricar, Tommy and Michael, his daughters-in-law Olivia Yaneza and Ma. Christine de la Cruz, and his grandson, Alex Edward.

Dr. Drilon is shown receiving the letter announcing the establishment of the International Winged Bean Institute from H.E. J.R. Jayewardene, President of the Democratic Socialist Republic of Sri Lanka. To Dr. Drilon's right is the Hon. E.L. Senanayake, Minister of Agricultural Development and Research. This ceremony took place in the historic President's House in Colombo. (Note photo of former U.S. President John F. Kennedy in the background.)

5

President of Sri Lanka

21 January, 1981.

Dear Dr. Drilon,

I acknowledge the receipt of your letter dated 21 January, 1981 requesting me, on the occasion of the 2nd. International Seminar on Winged Bean, now being held in Colombo, to formally establish an International Institute for Dambala in Sri Lanka, and to announce this event to the World. Accordingly, I have decided to announce the immediate establishment and support of the International Institute for Dambala in Sri Lanka.

We welcome the support and encouragement of the International Council for Development of Under-utilized Plants and look forward to the continued collaboration between the Council, the Government of Sri Lanka, and the new International Institute about to emerge.

Sincerely yours,

(J.R. Jayewardene)
President

Dr. J.D. Drilon, Jr.,
President,
International Council for Development
of Underutilized Plants,
C/o 2nd. International Seminar on Winged Bean,
Colombo,
Sri Lanka.

III. 2ND INTERNATIONAL SEMINAR ON WINGED BEAN - EXTRACTS OF THE SUMMING UP ADDRESS

This seminar has been successful from several points of view, not least of which has been the spirit of sharing knowledge among a truly international group of scientists whose combined expertise over a comprehensive range of disciplines provides a broad base of understanding from which ideas for the development of this underutilized crop will emerge.

In the area of germplasm, genetics and crop improvement, progress has been gratifying. From humble beginnings the vast germplasm resources of the world are being tapped. Perhaps the greatest weakness in our efforts has been the absence of information and material from Burma where winged bean production is apparently more developed than in most other countries. I was glad to hear of the collections from bordering countries and of plans to collect germplasm in Burma itself. It will inject a wealth of new resources from which improved winged beans may be developed. The need for a wider genetic base is evident and the swelling germplasm resources should provide this.

The establishment of an international winged bean germplasm centre has not yet occurred. It is important that this objective be achieved soon. In the meantime, the onus is on all who are responsible for national and regional collections to maintain and evaluate them. For the available germplasm to be exploited fully, it is essential that purity of material and complete documentation is maintained. A list of descriptors has been prepared and refined and should be used to ensure that documentation is complete.

A note of caution should be heeded in the exchange of seed between countries. The report that virus can be transmitted in the seed highlights the need for vigilance. Careful roguing of suspect plants must be carried out if we are to avoid disseminating disaster which could negate our efforts to bring about the development of this worthy, underutilized crop.

Although considerable progress has been made in understanding the genetics of winged bean, more breeding activity is needed. The regional growth centres and the proposed International Winged Bean Institute in Sri Lanka are perhaps the most obvious places in which the major initial thrusts should be made.

In this regard, I would like to ask "do we have a well-defined blueprint for development of winged bean?" Given the great diversity of this versatile crop, what breeding strategy/strategies should be followed? Should we pursue the ideotype of a dwarf plant or is this, as some suggest, a fanciful objective? It would be a tremendous boost to the impetus of having winged bean widely accepted as an important food crop if clear and specific guidelines could be agreed upon.

It was most interesting to hear of the success in propagation of winged bean by tissue culture. This may be a valuable tool for breeders in the future.

In physiology of the crop and adaptation to the environment excellent progress has been made, yet much needs to be done. One of the greatest attributes of winged bean is its ability to fix nitrogen. We have seen that, with superior strains of *Rhizobium*, a four-fold increase in nitrogen fixation is possible. This is a valuable advance! It is necessary to improve the competitive ability of these superior strains and to begin characterizing specific nitrogen-fixing performance and *Rhizobium* requirements of individual accessions. It has been suggested that trials be carried out using split plots: one being inoculated, the other uninoculated.

We have also learnt, from comprehensive field trials in tropical soils, of some important nutritional requirements for increased nitrogen fixing activity, especially calcium, phosphorus and potassium. Further research into micronutrients such as Cobalt and Molybdenum is likely to be fruitful also. The possibility of finding mycorrhizal associations which can increase the availability of nitrogen and phosphorus on deficient soils is challenging and potentially rewarding. In the meantime, the use of starter solutions in such areas may be beneficial.

Genotype x environment responses have been described and, together with specific controlled environment studies, have widened our understanding of the crop and its environmental requirements. There are many areas of agreement, some of apparent conflict or confusion, and many in which further research is needed.

The responses of flowering, pod set and development and tuber initiation and development have received attention and the controlling effects of photoperiod and temperature have been confirmed. Whether day or night temperatures (or both) are critical has yet to be established. It seems that, in tropical environments, shade does not adversely affect flowering so it should be possible to grow winged bean successfully under or in association with other crops. Identification of "possible" day neutral plants is encouraging to the widening of the ecological range of winged bean.

In general, winged bean seems well adapted to the humid tropics. It needs adequate water and the effects of stress have been shown to persist for a relatively long time. On the other hand, it has been suggested that, once adequate water is applied, enhanced growth can occur, enabling the plant to recover and realize its yield potential. Possible tolerance of some winged bean lines to water logging may be of importance in adaption to poorly drained soils. Further work in these areas is likely to be rewarding.

Problems in maintaining seed viability over long periods have been highlighted and some solutions proposed. The conservation of our wealth of germplasm depends on such work.

During the seminar we have seen record yield barriers broken many times. Some levels reported are 22-60 t/ha of fresh green pods, 3-6 t/ha of mature seed and 15-17 t/ha of tubers. These are important

milestones in our quest to develop winged bean as an important crop. Much needs to be done, however, to raise *average* field performance. In fact, I believe that "production" research has slipped behind that of other areas, notably the food utilization, processing and nutrition area.

A co-ordinated research effort on agronomic aspects is needed: nutrient and soil requirements of the plant, plant support and farming systems as well as water management (which has already been mentioned) all need further attention. The report on yields and economic returns from winged bean as a component in a mixed cropping system was encouraging and should stimulate interest in similar approaches which will mesh in with existing farming systems to optimize benefits to farmers in the developing tropics. The advantages in this approach are considerable, and include the avoidance of substantial weed, pest and disease problems and the more rapid establishment of winged bean as a popular and widely used crop. Farming systems research is perhaps more difficult and complex than that associated with monoculture but I would like to stress the likely benefits and relevance to subsistence agriculture in developing tropical countries.

Although we have learnt a lot about the biology and identification of pests and diseases, there is a need to know more about their relative importance and yield losses caused by them. The absence of such information is hopefully an indication that, so far, problems have been relatively minor and manageable. Even so, continuing vigilance is needed. It is gratifying to see that work is now in progress on genetic resistance to false rust in Indonesia. Similar work in relation to other important pests and diseases should be encouraged.

Major progress in the field of winged bean utilization (food, nutrition and processing) has been made. There is an impressive list of nutritious winged bean products. The nutritive value, however, depends on proper preparation and there is an urgent need for standard processing procedures to optimize quality.

A lot is known about winged bean protein and levels of protein, fat and other constituents of winged bean foods, although different analytical techniques have been used. There is a relative dearth of knowledge on tuber constituents, however. We need to know more about haemaglutenin and tannins. Finally, there is a need for standardisation of techniques, statistics and reporting biochemical work. A good start would be to report data on a dry weight basis or to include moisture content data.

The contribution on clinical evaluation of winged bean foods has been substantial. The value of whole-seed winged bean flour for infants and toddlers has been confirmed (as has the need for proper, careful processing). The introduction of winged bean into an African community has been achieved and evaluation is underway. This work is an important step forward.

If sufficient winged bean processed products, especially for

animal feed, could be produced, there is little doubt that markets would be available, particularly in the S.E. Asian region. Preparation for large scale production is well advanced, particularly in Thailand.

To the future, we must make a breakthrough soon to justify the resources that have been provided for winged bean work. The International Winged Bean Institute and the Regional Growth Centres will provide impetus to the attainment of this goal.

- RAS

IV. ABSTRACTS OF TECHNICAL PAPERS

A. GERMPLASM, GENETICS AND CROP IMPROVEMENT

(i) Presented Papers

1. Chomchalow, N. and Pongpa-ngan, L. Winged bean germplasm collection and evaluation in Thailand.

Five collection teams worked through most of the provinces in Thailand and the 293 accessions collected were evaluated, together with another 235 accessions from other sources, including the original germplasm collection. Data were based on "collection descriptors" in "Descriptors for Winged Bean" prepared by an IBPGR *ad hoc* working group. Considerable variation was found in morphological characters. Some unique characteristics were long, lanceolate leaves, white corolla and cream seed colour. Most were non-shattering types. The presence of great genetic diversity may be the result of mutation and genetics recombination. Although winged bean is largely self pollinating, frequent visits of bumble bees to the flowers were observed, together with the resulting cross pollination as indicated by changes in several characters. At least ten accessions having high seed and tuber yield have been selected for further evaluation.

2. Eagleton, G.E.; Khan, T.N. and Chai, N.F. Winged bean origins.

The origins of winged bean is a matter of some controversy. While the other members of the genus are found in Africa, the winged bean is essentially Asian. This review of literature and current research into genetic variation in the winged bean, leaves the ultimate question of origins unresolved, but reveals diverse circumstantial

evidence for the antiquity of winged bean cultivation in Asia. There are two main foci for domestication - upper Burma and the Papua New Guinea Highlands - with a reservoir of more primitive germplasm between. This coincides with Harlan's (1971) 'non-centre' for South East Asian plant domestication, and raises general issues of agricultural origins in the region.

3. Eagleton, G.E.; Thurling, N. and Khan, T.N. Genotypic variation in the response of winged bean to differences in environment. 42 p.

Winged bean accessions representing the main centres of cultivation have been grown under comparable management conditions at field sites in Malaysia and Western Australia, covering a latitudinal range from 3°to 32°. A seed yield of 203.4 g/m^2 and a tuber yield of 1468.0 g/m^2 from UPS 122 (Papua New Guinea) and MHS 19 (Northern Thailand) respectively, were obtained from staked plots grown in Malaysia and harvested within 170 days. Yields from other accessions, particularly in Western Australia, were much less.

The effect of genotype on plant yield and its pod and root components was shown to be highly significant, as were the effects of planting site and of staking. Genotypes differed in their response to planting site but not to staking. The stability of individual genotypes across environments was examined using the joint-regression approach. Number of days to first flower was closely correlated with both pod and tuber yield in the Western Australian environments but not in Malaysia. This field evidence of sensitivity to temperature and daylength is determining winged bean response to differences in latitude.

4. Erskine, W. Inheritance of some economic characters in winged bean. 22 p.

The inheritance of a wide range of economic characters was studied in the F_1 and F_2 generations of a diallel cross between seven diverse genotypes grown in lowland Papua New Guinea. Variation due to additive effects was of substantial importance in relation to overall variation for the characters: seed weight, number of seeds per pod, pod length, leaf size, leaf area index, time to first flower, shelling percent, and grain yield. A considerable genetic advance can be expected from selection between crosses for these characters.

5. Haq, N.; Chowdhury, S.U. and Rachid, M. Germplasm resources of winged bean in Bangladesh. 13 p.

The genetic variation in both qualitative and quantitative characters of the Bangladesh land race is reported. It is suggested that the winged bean was introduced to Bangladesh recently, probably from Burma. It is found that seed yield was correlated strongly with pod number per plant and to a lesser extent with seed number per pod.

The highest yield recorded in this study was 0.66 kg. per plant (extrapolated to 6672 kg/ha at a density of 10,000 plants/ha). Eight genotypes were selected on the basis of the correlation matrix for a preliminary yield trial.

6. Herath, H.N.M. and Iruthyayathas, E.E. Winged bean germplasm collection in Sri Lanka. 12 p.

In order to add new accessions to the original Sri Lanka collection, a detailed survey and collection programme was undertaken. Several interesting plant types that were not included in our primary collection undertaken a few years ago were encountered. There were plant types in certain areas of Sri Lanka that appeared to be *drought tolerant* and a few weedy/wild types collected from road-sides and forested areas. Interviews with farmers indicated that most of the types present in Sri Lanka may be primary land varieties. It was observed that in four districts, namely Matara, Galle, Matale and Jaffna, this crop has been intensively cultivated by small scale farmers as a seasonal cash crop.

7. Karikari, S.K. The effect of seed irradiation on plant characteristics and yield of winged beans. 19 p.

Seeds of four varieties of winged beans, namely UPS 99, UPS 122, Chimbu and Kade 6/16 were irradiated with 0, 5, 10, 15 and 20 cobalt 60 at the dose intensity of 2.0 kr/mn. After irradiation, the seeds were sown in the field and plant characteristics and yield of seeds and tubers were observed. There were significant reductions in vegetative parts and yield of seeds of all four varieties at concentrations of 15 and 20 kr/mn. At these concentrations there was a significant increase in tuber yield of UPS 99 and UPS 122. It appears that with irradiation, a bushy type of winged bean requiring shorter staking could be developed. Irradiation also caused profuse flower drop thus creating a self pruned plant desirable for good tuber formation at the expense of seed production.

8. Khan, T.N. and Edwards, C.S. International winged bean trials - a preliminary report. 12 p.

Yield and yield-related characteristics of fifteen varieties in as many environments as possible were studied and production problems noted to guide the selection of most appropriate varieties in new areas. Coefficients of variation for days to flower ranged from 2 to 34%, seed yield 11 to 43% and tuber yield 39 to 122%. The large C.V. for tuber yield is of concern.

Photoperiodic conditions, as dictated by date of sowing and latitude, may affect flowering date although other factors appear to operate. In general, Papua New Guinean varieties were early flowering

and maturing and the two Indonesian varieties were later than that from Thailand. The earliest flowering genotype was UPS 99 with a range of 39 to 83 days.

The Thai variety produced the highest pod yield, followed by UPS 122, UPS 121 and LBNC 1. The highest mean seed yield across varieties was obtained in Taiwan although the highest seed yield for an individual variety was 4.3 t/ha for UPS 62 in Guatemala. Five varieties produced over 2 t/ha. Both genotype and environment appeared to affect the seed size. Reasonable tuber yield were obtained at four locations only, the best being Taiwan where the LBNC 3 from Indonesia produced 12.5 t/ha. A detailed report will be submitted as more data is received and analysed.

9. Muthukrishnan, K.G.; Shanmugavelu, R.S. and Irulappan, I. Genetic variability and correlation studies in winged bean. 8 p.

The pod yield in respect of number and weight of pods per plant and its characters exhibited a wide range. The single pod weight expressed the highest phenotypic variability followed by pod yield per plant, pod length and pod number per plant. Heritability and genetic advance on the percentage of the mean were high for pod weight, followed by pod length and pod number per plant. Phenotypically, the pod yield showed a positive correlation with number of pods and single pod weight. The single pod weight was positively correlated with length of pod. The negative relationship on the number of days to first flowering and harvest with yield was found to be non-significant.

10. Singh, R.B. Current status of winged bean collections and strategies for bridging gaps. 9 p.

There were no planned collections of winged bean material before 1973 although more recently the International Board for Plant Genetic Resources (IBPGR) augmented national efforts and has supported extensive collections of winged bean germplasm in Thailand, Papua New Guinea, Indonesia, the Philippines and Bangladesh. Further, proposals from Malaysia and other South-east and South Asian countries are under active and favourable consideration for capturing and utilising the genetic variability of this wonder bean. The IBPGR activities, namely the survey, exploration and collection, classification and description, preservation and conservation, maintenance, multiplication and rejuvenation, distribution, exchange and quarantine, evaluation, documentation, information retrieval and exchange and utilisation are vital and interlinked. The genetic resources must ultimately find their use in the improvement of economic plants, otherwise the collection will only be of ephemeral value at best. A country-wide summary of winged bean germplasm information is presented.

(ii) Distributed Papers

11. Anandarajah, K. Desirable varieties of winged bean for small farm conditions in Sri Lanka. 5 p.

The evidence suggests that winged bean production by small farmers is required to meet home food demand before cash demand. The present analysis indicates that the growth in demand will be primarily for green beans as a vegetable and to a lesser extent for green leaves rather than for grains. The ideal way of promoting cultivation of winged bean would be by means of developing varieties to fit into small farm and home garden conditions. Farmers look for varieties of vegetable type possessing high yield of green beans of good quality with regard to tenderness, neutral to daylength with long rhythm of harvest and intensive vegetative growth for green leaves.

12. Benong, M.B. and Jalani, B.S. A study of heterosis in crosses among local and exotic lines of winged bean. 13 p.

Six F_1 hybrids from crosses involving one line each from Malaysia (FES) and Thailand (NS 2807) and four lines from Papua New Guinea (UPS 66, UPS 89, UPS 99 and UPS 122) exhibited significant positive heterosis for germination, flowering date, leaf area and dry weight, pod length and weight, number and weight of seeds/pod, and 100-seed weight. However, not all hybrids showed significant heterosis for each character stated above. Shelling percentage did not show any significant positive heterosis.

13. Chandel, K.P.S.; Pant, K.C.; Arora, R.K. and Mehra, K.L. Genetic resources and co-ordinated research programmes on winged bean in India. 9 p.

(To appear in subsequent issue.)

14. Chundawat, B.S.; Patel, G.L. and Tikka, S.D.S. Variability correlations and path coefficient analysis of yield in winged beans. 8 p.

Genetic variability, correlations and path coefficient analysis were performed for six characters in a collection of winged bean introductions. A wide range of phenotypic variation was observed for most of the plant characters. High genetic coefficient of variation and high expected genetic advance were observed for pods/plant, weight/pod and green pod yield/plant. The pod yield was found to be significantly and positively correlated with weight/pod, pod width and pods/plant. The path coefficient analysis revealed that seed size had the highest direct effect followed by weight/pod, pod width and pods/plant. These

traits should, therefore, be considered as selection criteria for green pod yield improvement in winged bean.

15. Gopalakrishnan, P.K.; Rajemohan, K.; Prabhaharan, T. and Peter, K.V. Secondary centre of origin of winged bean - Inferences from a somatic analysis of collections from South India. 7 p.

The geographical area falling 8°- 16°N latitude and 74°- 78° longitude comprising the state of Kerala, Karnataka and part of Tamil Nadu in India is observed as a reservoir of considerable variability in winged bean. The presence of such a high variability despite the autogamous nature of the crop leads to the possibility of a secondary centre of origin of the crop in these areas. The 18 winged bean lines collected indigenously exhibited considerable variability for a number of polygenic characters like number and weight of pods per plant, length of pod, number and weight of seeds per pod and per plant, percentages of wrinkled seeds and 100 seed weight. They also possessed variation in the content of carbohydrates, protein, fibre, iron, calcium and ascorbic acid in immature pods, protein, iron and calcium in seeds and protein in flowers and leaves. Knowledge regarding centres of origin is vital to assemble maximum amount of variability to be used in production as well as resistance breeding.

16. Rao, N.R.G.; Shivashankar, K.T.; Shivashankar, G. and Sulladhanath, U.V. Preliminary evaluation of winged bean germplasm for green pod yield, seed yield and their attributing characters.

(To appear in subsequent issue.)

B. PHYSIOLOGY

(i) Presented Papers

17. Broughton, W.J. and Lenz, F. Physiology and nutrition of the winged bean. 16 p.

Two methods (whole-plant growth analysis and gas-exchange) were used to measure the response of cultivar UPS 99 to the environment. Optimum temperature for root growth was 25°C, its rate of acetylene reduction (when inoculated with RRIM 56) was maximal at 30°C and it demanded an atmospheric temperature of about 35°C for best shoot growth. Under these conditions water use efficiency was 0.016. The rate of photosynthesis reached a plateau at 900 vpm CO_2 - this condition also gave the lowest rate of transpiration. It is therefore suggested that a considerable portion of CO_2 - exchange of *P. tetra-*

gonolobus occurs through pathways other than stomata. Under normal conditions, the light compensation point was 1,700 lux, while that for CO_2 was 60 vpm. Light respiration diminished the potential photosynthetic efficiency by forty percent. Water stress (as measured by sensitivity to slightly increased CO_2 levels) caused the rapid closure of stomata, and the response was "remembered" for up to five days. Thus we suggest that the plant is drought sensitive, and that yields are unlikely to be increased by "CO_2 - fertilisation".

18. Chandrasegaram, S. and Senanayake, Y.D.A. A study of the reproductive load of winged bean. 15 p.

Effects of pruning and type of support on total reproductive load and pod set were studied in two selections of winged bean (UPS 61 and UPS 122 (Chimbu) at Peradeniya over two years. Removal of alternate branches on the mainstem significantly reduced total reproductive load and final pod number. A vertical trellis was significantly superior to single stake support for production of higher buds, and flowers. The proportion of pods to total reproductive load showed a narrow range between 7.12 - 8.75 percent in both years. Flower and bud abscission varied in both varieties which averaged 75.88% and 87.68% for UPS 61 and UPS 122 respectively. The average percentage bud abscission to total abscission for UPS 61 and UPS 122 were 22.5 and 12.5. Performance of winged bean during the two years was influenced by environmental conditions which had distinct climatic differences. Rainfall and sunshine hours seemed to be critical for flower production, pod set and abscission in winged bean.

19. Hew, C.S. and Lee, Y.H. Germination and short term storage of winged bean seeds. 5 p.

Seed of local variety of winged bean were placed either in sand or between filter paper in either light or under darkness at 25°C. Under light, the intensity was 75 ft c and the daylength was 12 hours. Germination was better in seeds between filter paper, particularly for seeds under darkness. In general germination was better under darkness although it occurred satisfactorily under light. Seeds failed to germinate at 15°C and at 35°C, the percentage germination and root growth of seedlings were adversely affected. It was further noted that germination was influenced by the stage of maturity although, once pods first turned brown, germination was good.

Freshly harvested seed contained 20 - 21% moisture. Germination was reduced in seeds with lower moisture contents of 10% and 13%.

Vigour of seeds stored for 2 weeks was only half that of the control and germination was nil after storage for 2 months. Further work on seed storage is needed.

20. Kim Ki June. Experimental adaption of winged beans in different

latitudinal locations in Korea.

(To appear in subsequent issue.)

21. Lubis, S.H.A.; Hansen, J. and Mumford, P.M. Storage of seeds of winged bean. 13 p.

The viability of seeds stored at 10 - 12 percent moisture content in an air-conditioned room for various periods was tested for different seed collections. Accessions of varying age were stored at different temperatures and moisture contents for short periods. Storage at low temperatures and moisture contents prolonged seed viability. Seeds stored at -20°C for up to 9 months showed no significant decline in viability, indicating that this is a suitable technique for the long term conservation of seeds of winged bean. Drying also had a beneficial effect on the maintenance of viability at this temperature.

Controlled deterioration was used to distinguish low vigour seed after storage. The percentage of abnormal seedlings and chromosome aberrations increased after storage, indicating loss of vigour. The importance of good storage conditions for the genetic resources conservation of winged bean collections is discussed.

22. Uemoto, S.; Fujieda, K.; Nonaka, M. and Nakamoto, Y. Effects of photoperiod and temperatures on the raceme budding of winged beans. 15 p.

The effects of photoperiod and temperature on raceme budding were studied using nine UPS selections and native strains in both Sri Lanka (SLS) and Thailand (TLS) in the first experiment and three UPS and SLS selections in the second experiment. The seedlings were grown after germination till the third trifoliate leaf stage under various combined environmental conditions, in daylengths of 8, 11 and 13 hours, and in air temperatures of 20°, 25° and 30°C, respectively. After the treatment, the status of those raceme budding was observed under natural long day and high temperature conditions in the green house. The critical daylength for raceme budding of most strains tested was 12 hours approximately. Under the short daylength conditions, the bud number at which raceme budding occurred increased with higher temperature. Pre-treatment of long day and high temperature caused a change of phase from reproductive to vegetative and this was accelerated by higher temperature after pre-treatment, excepting that the change in UPS 99 was considerably moderate. Under 13 hours day-length, raceme budding was observed only in UPS 99, 62 and 31 at low temperature (20°C). Moreover, it was recognized that raceme budding in UPS 99 was observed under 15 hours light regime at 20°C and this selection was significantly different from the others in developmental responses for photoperiod. After the young seedlings were treated with 8 hours shortday and 20°C temperature and were introduced to a reproductive phase, they were

transferred under various conditions of daylength and temperature. Three UPS selections of 99, 47 and 45 showed noticeable responses of raceme budding in 13 hours and 20°C regime and particularly it was clarified that UPS 99 had continuous raceme budding on main axis even in 16 hours daylength.

23. Venketeswaran, S. Tissue culture studies of the winged bean. 15 p.

Surface-sterilized asceptic hypocotyl explants and thin slices (1-2 mm thick) of mature cotyledons were inoculated to a modified salt-sucrose agar medium supplemented with 0.1 mg/1 kinetin and 1.0 or 5.0 mg/1 2,4-dichlorophenoxyacetic acid (2,4-D). In certain cases, 1.0 or 5.0 mg/1 α -napthalene acetic (NAA) was also used. After 3 - 4 weeks in culture, the callus tissues proliferated well. Hard, compact, friable, green pigmented, yellow or white callus were formed when tissues were maintained in media containing different growth substances. Filtered cell suspensions (approximately 70% single cells) from liquid suspension cultures when plated on agar petri-plates produced colonies from single cells and cell aggregates. Differentiation of roots occurred in large numbers on tissue growing in media containing 0.1 mg/1 kinetin and 0.1 mg/1 NAA. A high number of roots were formed on callus maintained in dark vs. light. Root differentiation also occurred in liquid cultures. Different cytokinins did not induce shoot differentiation. When tissues were transferred to only mineral salt-sucrose medium, upon the second or third transfer, bud, shoot and embryoids were formed which eventually produced young plantlets. Protoplast isolation from young leaves of plants were very successful. Experiments are in progress to culture protoplasts to produce calli, *in vitro* organogenesis and regeneration.

24. Wong Kai Choo. Environmental factors affecting the growth, flowering and tuberization in winged bean. 15 p.

Experiments were conducted under both controlled environment as well as tropical field conditions using a Malaysian winged bean selection (M 14/4). Plants grown at reasonably optimal day/night temperature 25°C/18°C were vegetatively more vigorous when the photoperiod was long (16h). However at 32°/22°C, the vegetative growth under a short photoperiod (8h) was as great as at the 16h photoperiod. Low day temperature combined with reasonably low night temperature (18°/18°C) markedly depressed vegetative growth.

The critical daylength for flowering was between 11h 15 min and 12h 15 min. However, under reduced light intensity there appeared to be a shift in the critical daylength to a lower value. Even under inductive daylength, the temperature regime had to fall within limits before flowering occurred. Day temperature at a high 32°C and a low 18°C and night temperature at a low 14°C inhibited flowering. A minimum size or 'age' must be reached before the plant can be induced to initiate flowers by at least 3 - 4 weeks of inductive short days.

Flower bud development to anthesis reouired a sufficient number of short days (8 weeks).

Tuberization was affected more by daylength than by temperature. Short day is necessary for the winged bean to initiate tuberization almost irrespective of the temperature. Once initiated, development of tubers could proceed even under non-inductive conditions.

25. Balasubramaniam, S.; Thiagarajah, M.R.; Udugampola, N. and de Silva, M. A preliminary study on the effects of water stress on growth and free amino acid composition of winged bean. 10 p.

Winged bean plants (varieties LBNC 3, TPT 2 and UPS 47) were grown in pots and subjected to two moisture regimes. The control plants were well watered throughout the 9 week period of study, while the stressed plants were subjected to five watering and drying cycles. Control plants had water potential values ranging from -0.5 to -1.5 bars. The lowest water potential recorded was -8.3 bars in stressed TPT 2 leaves. There seemed to be no marked differences in leaf water potential among stressed plants. Water stress reduced leaf area in all varieties. The changes in total dry weight suggest that there may be varietal differences in winged bean for tolerance to water deficits. An increase in the level of proline was detected in the roots as well as in the leaves of stressed plants of UPS 47 and TPT 2. Asparagine was high in roots of stressed TPT 2, but this amide was not detected in the root samples of non-stressed plants. Glutamine was absent in non-stressed leaves of UPS 47, but was present in large amounts in the stressed leaves. These results suggest that there may be a common pattern of amino acid metabolism in a wide range of species during water stress.

26. Chai, N.P.; Jalani, B.S. and Singah, R. A study on development and nutritional content of winged bean pods. 13 p.

Pod development and nutritional content of five lines of *P. tetragonolobus* of different origins (M 13/1, Malaysia;N-2, Thailand; UPS 45, 66 and 122, Papua New Guinea) and one line of *P. scandens* from Malawi were studied. Pods of *P. tetragonolobus* grew rapidly and attained their maximum size 15 days after anthesis. Growth of *P. scandens* pods was slow. During the period of rapid pod growth, crude protein content decreased. It stabilized between 15 and 25 days after anthesis and then increased. The crude fat content increased slowly until day 15 and then rapidly until day 30 - 35 when it stabilized. Crude fibre increased slowly until day 10 and then more rapidly until it stabilized at day 25. At maturity, the small pods of *P. scandens* had the lowest crude fat and the highest crude fibre content. There was little difference in the growth and development of pods of the different lines of *P. tetragonolobus*. It was concluded that green pods are best eaten between day 10 and 15.

27. Chomchalow, N. A study on the flowering behaviour of winged bean.

(To appear in subsequent issue.)

28. Chomchalow, S. Inoculum production for winged bean and other grain legumes in Thailand.

(To appear in subsequent issue.)

29. Kumarasinghe, R.M.K. and Kumarasinghe, K.S. Nitrogen fixation in *Psophocarpus tetragonolobus* (L.) DC in relation to photosynthesis and photorespiration. 11 p.

In the winged bean, nitrogenase activity increased towards flowering and declined with the formation of young pods. Clearly, the onset of flowering promotes, while the initiation of pods inhibits, nitrogenase activity. It is likely that both changes in photosynthate supply to nodules and changes in the hormonal balance affect nitrogenase activity during transformation from vegetative to reproductive growth. Since pod formation in the winged bean continues for a considerable period of time, storage amino acids might play an important role in providing the nitrogenous requirements for the pods that develop secondarily.

In addition to differing in growth and morphological features the winged bean cultivars examined differed in their rates of net photosynthesis, photorespiration and nitrogenase activity. Nitrogenase activity of the different cultivars was closely related to nodule efficiency and the net photosynthetic rate. The proportion of photosynthate allocated to nodule nitrogen fixation or shoot development varied according to the cultivar, and this is expected to be determined both by genetic and environmental factors. Photorespiration, on the other hand, is generally regarded as harmful to plants but the occurrence of it in the winged bean did not endow any apparent deleterious effect on nitrogenase activity or shoot growth. Thus from the point of view of nitrogen fixation and photosynthesis it appears that, of the 17 cultivars tested, LPPC 1, UPS 47, TPT 8, LBNC 3, TPT 6, UPS 99 and UPS 121 are more suitable for growth under conditions as prevailing in Peradeniya.

30. Padmasiri, I.S. and Pinto, M.E.R. Influence of seed treatment on the germination of winged bean. 4 p.

Germination was improved significantly by an incision in the seed coat treatment and by shaking seed for 15 minutes in coarse sand. Immersion in warm water for 15 minutes had no beneficial effect on germination.

31. Santhanakrishnan, P.; Kandasamy, D. and Oblisami, G. The interrelationships between the spermosphere microflora and three

genotypes of winged bean. 12 p.

Seeds were sown in small pots and samples taken at 24 hour intervals for analysis of the bacteria population, actinomycetes and fungi using soil extract agar, Ken Knight's agar and Martin's Rose Bengal agar medium respectively. The establishment of rhizobia in the spermosphere region of seeds was also studied by inoculation in sterilized soil and counting the population at 24 hour intervals using yeast extract mannitol agar medium. Nitrogenase activity of the spermosphere soil was also measured. Varieties differed in the pattern of bacterial and actinomycete population changes with time. Such variations in the populations might be attributed to the quantitative and qualitative nature of seed diffusates. Varieties also differed in the rhizobium population harboured, the levels apparently increasing concurrently with the decline in the quantity of phenolics exuded from seeds. There were exceptions to this response, however, and it is suggested that the qualitative nature of phenolic substances in the diffusate might play a role in the colonization of Rhizobia. A positive relationship between nitrogenase activity and populations of *Rhizobium* and other bacteria was observed. Similarly for the relationship between nitrogenase activity of the spermosphere soil and allantoin content of the cotyledons of the germinating seeds.

(iii) Poster Display

32. Ruegg, J. Effects of temperature, water and photoperiod on flowering and yield of winged bean. 5 p.

A six-week period of water shortage reduced seed yields by a third and tuber yield of Tpt-8 by half. Later, however, when the water supply was again adequate, winged bean plants showed enhanced growth. It is suggested that they might still realize their full yield potential. There may be scope for the selection of types which have some tolerance to water logging. Water logging killed all plants of Kade 1 - 26 whereas half of the Tpt-8 plants survived. Stem bases under water were thickened and adventitious roots were produced at the surface.

Cool temperature delayed flowering and reduced pod and seed yields but enhanced tuber production of Tpt-8 but not Kade 1 - 26. Under a 16 hour photoperiod, a 22/18°C temperature regime was more inductive to flowering than 27/23°C. One selected type showed potential for pod and seed production under the 16 hour photoperiod at both temperature regimes. Thus it seems likely that a day - neutral type which would prove useful in environments where daylength varies due to season and latitude can be selected.

C. AGRONOMY

(i) Presented Papers

33. Karikari, S.K. Agronomy of winged bean - State of the art. 10 p.

The agronomic work on the Winged bean (*Psophocarpus tetragonolobus*) so far carried out throughout the world may be covered broadly under the areas of General Agronomy, Cultivation Practices, Planting, Spacing and Supporting, Weed Control and Cover Cropping and Fertilization and Nutritional Requirements.

Although this work has gone on over a long period of time, co-ordination of research information has been poor. Agronomic research areas that need to be more closely studied are the crop's moisture requirements, population, cultivation systems especially its use as a cover crop, staking methods and fertilizer requirements. Varieties, cultivars, lines and all germplasm materials should be standardized for uniformity to enable proper comparison of agronomic results to be made. A major breakthrough in the winged bean agronomic research would be the development of prostrate type that will eliminate staking.

34. Purcino, H.M.A.; Purcino, A.A.C. and Lynd, J.Q. Soil fertility effects governing growth and nodule parameters at anthesis of two winged bean cultivars with a Typic Eutrustox (dark red latosol) from Minas Gerais, Brazil. 18 p.

Winged bean cultivars, Tinge WB-21-8 and Siempre WB-12-11 /names assigned by U.S. Dept. of Agriculture, Mayaguez Institute of Tropical Agriculture, Puerto Rico/ were grown with complete factorial soil fertility experiments for P, K, Ca, Mg, and S combinations on a Typic Eutrustox from Central Brazil. Nitrogenase (C_2H_2 reduction), growth and associated nodule enzyme and composition were determined at anthesis. Highly significant increases in nitrogenase activity levels resulted with applied P and K for both cultivars with significant increases for Ca conditions and for interaction combinations of these elements. Growth, nodulation and cytosol enzyme activity levels of GOT, GDH, GS and GOGAT all increased significantly with applied P, and with the exception of GDH to applied K when combined with P. αKG was increased to highly significant levels with K treatment regardless of P applications. Cytosol composition was increased significantly for each plant nutrient element contained in the treatment combinations. Highly significant inverse retroversion existed for K and Na. Na was negatively correlated with every parameter determined in these studies for both cultivars. Multiple regression with highly significant parameters determining nitrogenase activity levels were Tinge: Nase = 69.51 αKG + 2. 78 nod. wt. + 0.035 K + .052 GOT, R^2 = .664, CV = 32.7%; Siempre: Nase = 30.14 α KG + 2.30 nod. wt. + .025 K + .019 GOT, R^2 = .776, CV = 26.8%. Practical application of these data include the requirement or adequate available

soil K when P is not limiting. High Na levels are inhibitory to K and the result is depressed nitrogenase. Enzyme activity levels and nutrient components within nodule cutosol are indicative of nitrogenase at anthesis, but may differ significantly between cultivars.

35. Smith, W.F. Potential of the pullulator vertical growth system for food production. 6 p.

The "pullulator", a device for use when arable soil in unavailable or highly scarce, consists of vertical cylinders filled with rooting substrate. Holes around the periphery of the cylinder accept seeds or plants and nutrient solution and water is applied regularly. Winged bean of Chimbu and Tpt-1 have been grown successfully in this device.

36. Stephenson, R.A.; Drake, D.W. and Kesavan, V. The performance of winged bean lines in several environments throughout Papua New Guinea. II. Tuber yield responses. 21 p.

Ten winged bean lines were grown in 11 environments defined by year x location combinations and tuber yields recorded. Data were fully analysed by three-way analysis of variance and the four-way unbalanced model was examined by comparing percentages of the total sum of squares as indicators of source variances. Line x environment interaction was demonstrated by joint linear regression analysis. Two way classification analysis of lines and environments identified and grouped systematic patterns of lines across environments and environments across lines. Specific patterns were examined by plotting responses at various levels in the hierarchies.

Most lines and groups of lines, except the highest yielding UPS 122 and UPS 121, had a similar response pattern of relatively low tuber yields except at Durand's Strip and Wapenamanda. UPS 122 produced high tuber yields, the highest being 221.7 g/plant at Kuk in 1979, extrapolated to a record 17.7 t/ha. In general, the highest tuber yields were produced in the better highland environments and the lowest in the lowlands. Both moderate temperature and adequate moisture appeared to promote tuber production.

There was a tendency for tuber yield to be inversely related to seed yield although this did not occur in all situations.

It is suggested that more extensive screening of available germplasm in environments favourable to tuber production should be carried out as the winged bean, under suitable environmental conditions, has considerable potential for producing large yields of high-protein tubers.

37. Thiruketheeswaran, A. and Senanayake, Y.D.A. Mixed cropping of winged bean with snap beans. 13 p.

Two field experiments were conducted during Maha 1978/79 and Yala - 1979 seasons at Peradeniya, Sri Lanka (1,500 m) to study the yielding ability of winged bean pods as a vegetable when mixed cropped with bush and pole bean (*Phaseolus vulgaris*). Six treatments, namely three mono-cropped (winged bean or bush bean or pole bean) and three mixed cropped (winged bean - bush bean, winged bean - pole bean and winged bean - bush bean - pole bean) were tested. Total yields of the mixed cropped treatments were greater than the mono cropped systems. Bush beans had almost similar yields when grown as a mono crop or when mixed cropped with winged beans during both seasons. However, during 1978/79 and 1979 seasons, winged bean - pole bean mixed cropping gave the highest total yields (18,456 kg/ha and 22,226 kg/ha), and the highest estimated protein productivity (443 kg/ha and 533 kg/ha) respectively. The highest estimated gross income per season was observed when all three crops were mixed cropped but it was not significantly different to the winged bean-pole bean mixed cropping treatment.

(ii) Distributed Papers

38. Aslam, M. Studies on the adaptability of winged bean in Pakistan.

Winged bean, being a tropical plant, has specific temperature and day length requirements and does not seem to be well adapted for introduction on a large scale in the semi-arid regions of Pakistan due to the limited period during which healthy pods can be set, deterioration of seed germination due to various factors such as high temperature, and the need to support plants for good pod set which is costly.

39. Chahira, P.W. Experiences with the winged bean. 11 p.

Twenty-nine cultivars of winged bean seed were imported into Kenya and were grown in one location for two seasons under natural conditions. Of these, twelve cultivars were grown for one season in two more locations under natural conditions. Performance in vigour, pod yield and number of seeds per pod were satisfactory. Winged beans nodulate and tuberize in Kenya but regeneration was satisfactory in one location only. Taste of green pods, seeds and leaves was agreeable. Dry seeds took over 3 hours to cook. Laboratory analysis of dry seed for ten cultivars showed an average of over 15% crude oil, 30% crude protein and under 7% crude fibre. No major pests and diseases were observed. A preliminary trial showed no response to support and diammonium Phosphate (18% N, 46% P_2O_2).

Potential of the winged bean in Kenya as a food and fodder crop is discussed. Materials have to be obtained and tested in different ecological zones and suitable cultivars identified for each zone.

40. Fattah, Q.A. Comparative study of growth, yield performance and bio-chemical content of 34 varieties of winged bean.

Considerable variation in growth, yield and biochemical contents of different varieties occurred under field conditions in Bangladesh. Local varieties had poor growth and mature late, resulting in low yields. The Nigerian variety, Tpt-6, and the Ghanian variety, Kade 6/16 performed best. They had large leaf areas, 6098 cm^2 and 6412 cm^2 respectively and high LAI (1.84 and 2.62), and matured 10 - 15 days earlier than most of the Bangladesh varieties.

41. Flechtmann, C.H.W. Observation on winged bean in São Paulo, Brazil. 6 p.

(To appear in subsequent issue.)

42. Giraldo, I.G. Preliminary evaluation of winged bean material at CIAT.

(To appear in subsequent issue.)

43. Gunasena, H.P.M. and Gunatilake, H.A.J. Varietal evaluation of winged bean for the mid country intermediate zone of Sri Lanka. 18 p.

An experiment was conducted at the University Agricultural Experimental Station, Dodangolla during May - September 1980, to evaluate the growth and yield performance of ten Papua New Guinea (UPS), two Indonesian (LBNC), two Nigerian (TPT) introductions and three local (SLS) strains of winged beans. The biological variation among strains was high. SLS 3 and 29, TPT 1 and LBNC 1 and 3 produced flowers after 100 days or more due to photoperiod sensitivity, while others flowered in 45 - 60 days after planting. All photosensitive strains produced excessive vegetable growth. The fresh pod yields of TPT 2 and SLS 47 were 60m.t/ha and 56m.t/ha respectively. The photoperiod sensitive strains and UPS 47 and 102 had lower fresh pod yields. The highest grain yields were recorded for UPS 122 (3.1m.t/ha), UPS 121 (2.88m.t/ha), TPT 2 (2.7m.t/ha), SLS 47 (2.55m.t/ha), Thailand-D (2.32m.t/ha) and UPS 99 (2.2m.t/ha). SLS 47, UPS 122 and TPT 2 performed best both in fresh pod and seed production and are suitable as dual purpose strains for cultivation in the intermediate zone of Sri Lanka.

44. Gunasena, H.P.M. and Perera, D.G.A.H. Agronomy of the winged bean. 22 p.

The agronomy of winged bean is reviewed under the headings: agro-ecology, propagation, establishment, training and supporting, pruning, nitrogen fixation and nutrition, mixed cropping, inter-cropping and

crop rotation and yields. It concludes that, from an agronomic point of view, a number of unanswered questions remain. Comprehensive studies in the field of varietal evaluation and categorization, specifying agro-ecological and nutritional requirements, times of planting for green pod, seed and tuber production, optimum plant population, water use, support systems for both large and small scale growers, pruning, time of harvest, its place in cropping systems and the role it would play as a cover crop/mulch/soil renovator are all essential.

45. Herath, H.M.W. Winged bean in Sri Lanka. 9 p.

Winged bean has been grown since time immemorial as a home garden crop in almost every part of Sri Lanka, primarily for tender green pods. Despite this, little recognition has been given the plant until recently. Emphasis for the development of this crop in Sri Lanka is important, particularly with escalating prices for fish and meat.

Two institutions, the University of Peradeniya and the Central Agricultural Research Institute, Gunnoruwa have conducted research on germplasm evaluation, selection, agronomy and physiology. The Faculty of Medicine, Department of Biochemistry is involved in nutritional aspects. Little attention has been directed to the study of pests and diseases although preliminary investigations are being carried out at the Ruhuna University, Matara. So much is the challenge that a body solely concentrating on the promotion of this crop is essential to Sri Lanka.

46. Kesavan, V. Green pod and tuber yield in winged bean in the lowlands and highlands of Papua New Guinea. 10 p.

Five genotypes from Papua New Guinea and an Indonesian accession were evaluated for fresh pod and tuber yield in three lowland sites (Waigani, Durands, Lae) and in one highland environment at Aiyura in 1980. Genotypes differed significantly for vegetable pod and tuber yield. The two promising genotypes were UPS 121 for pod yield and Indonesian - 2 for tuber yield with projected yields of 22 t ha^{-1} of pods and 16 t ha^{-1} of tubers respectively. Environments accounted for well over 70% of the variation. The highland site (with cool temperatures) gave yields between 6 and 16 t ha^{-1} of tubers whereas fresh pod yields were higher in the lowlands (where the temperature was higher), ranging from 3.6 to 22.4 t ha^{-1}. Comparison with the previous trials for seed production showed that periodic removal of fresh pods stimulated tuber production. Genotypic (g), environmental (e) and g x e interaction effects and their implications for breeding objectives are discussed.

47. Khan, T.N.; Aslam, M. and Eagleton, G.E. Culture of winged bean at latitude 31°N, Faisalabad, Pakistan and 31°S, Australia - a possible vegetable crop. 9 p.

Summer conditions of a Mediterranean climate offer some promise for growing winged bean in view of the fact that many tropical fruits and vegetables are now grown in these areas. Trials at latitude 31° north and south have indicated that one of the most important factors limiting the adaptation of the winged bean is the long photoperiod resulting in delayed flowering, which may be delayed even further in coastal areas due to low night temperatures. In addition, very hot and dry spells put considerable stress due to excessive transpiration, in spite of plentiful moisture through irrigation, and autumn temperatures are too low to allow pod setting. Crosses between vegetatively vigorous lines and early flowering lines, however, offer hope to develop this plant as a vegetable crop.

48. Khan, T.N. International winged bean survey. 23 p.

Results of a survey conducted to gather experience of those who introduced winged bean to their areas since 1975 are summarised. Over 100 responses were received. Availability of the original documents is indicated.

49. Kovitvadhi, K. Status report on winged bean research in Thailand. 6 p.

The winged bean has been known in Thailand for decades where it is grown for the young edible pods and, in Ratchaburi Province, for tubers which are used as a medical remedy as well as a source of food.

The Thailand Institute of Scientific and Technological Research (TISTR), formerly the Applied Scientific Research Corporation of Thailand was the first body to develop a programme of scientific investigation into the winged bean in Thailand. Financial support has been provided by the EEC with the ultimate objective of developing winged bean as an economically viable field crop for human and livestock consumption. Although the crop is not immediately viable, results have been encouraging and the research and development programme is continuing.

50. Paulus, J.J.; Onyembe, P.M.L.; Mbemba, F.D.L. and Alimasi, O. Winged bean in Zaire. 11 p.

The history of the introduction of *P. tetragonolobus* into Zaire, and its subsequent development as a crop is outlined. A report on *P. palustris*, a species native to the region, is also given. Although there were reports of *P. palustris* leaves, shoots and tubers being consumed in some regions of Zaire, young pods have not been a human food source. This species is commonly used as a cover crop and as animal feed. An interdisciplinary research team of agronomists, biologists and chemists is studying the two species of *Psophocarpus*. Particular interest in tuber producing types is being expressed.

51. Pospisil, F.; Buresova, M.; Hlava, B.; Hrachova, B.; Michi, J.; Trans The-Tuc, Tran Quang Diu, Ngo Xuan Manh, Nguyen Thanh Quynh and Nguyen Van Hoan. The winged bean in Vietnam. 32 p.

Winged bean is grown throughout Vietnam, but only on a small, backyard, scale. A joint Czechoslavak-Vietnamese research team commenced trials in 1979 on the optimum sowing date to allow other crops to be grown during the vegetative period, lines suitable for the production of mature seeds, green pods and tubers, the ability of winged bean to "winter" or regenerate after a cold winter, plant support systems and on the possible use as a cover crop.

52. Shanmugavelu, R.G.; Muthukrishnan, C.R.; Subbiah, R. and Rajendran, P. Studies on the performance of certain varieties of winged bean.

Sixteen varieties of winged bean introduced from diversified sources were tested for their performance at the Tamil Nadu Agricultural University, Coimbatore, South India, during 1978-1980. There existed significant differences in respect of number of days taken for flowering, harvest, yield, number of pods per plant, single pod weight and length of pod. The yield potentiality of these types ranged from 0.601 to 1.188 kg per plant. Among the sixteen types, PT-16 and PT-2 were found to perform well, yielding more than one kg vegetable pods per plant. These two types took 56 and 62 days for flowering from the date of sowing. The protein content was found to be highest in PT-11 followed by PT-15 and PT-14, while the pods of the types PT-16 and PT-2 contained 37.50 and 32.50 per cent protein content on dry weight basis.

53. Shrestha, H.M. International yield trial of winged bean in Nepal. 7 p.

Field experiments were conducted using 15 varieties of winged bean at Khumaltar Agricultural Farm, Lalitpur, Nepal during 1978/79 to study the yielding ability and other agronomic characters suitable to the agro-climate condition of Kathmandu Valley. The varieties UPS 47, UPS 53, UPS 62 produced more than 3 t grain/ha and the other varieties E.C. 38957, UPS 31, UPS 45, UPS 32, UPS 99 and UPS 102 produced more than 2 t/ha. UPS 122 produced nearly 2 t/ha compared to the local check *Vigna sesquipedalis* (Yard long bean) which produced 1.5 t/ha. Thailand and UPS 121 were found to be lowest yielders (1.1 t/ha and 0.5 t/ha respectively). Variety *Vigna sesquipedalis* was early maturing (104 days) and Thailand was the latest (205 days). UPS 122 had the longest pods (23.7 cms) and also the largest number of seeds per pod (16). UPS 102 produced the shortest pods (11 cms) and also the smallest number of seeds per pod (9). Variety UPS 99 gave the highest 100 seed weight (27.2 gms) and UPS 102 the lowest (18.2 gms).

54. Sjukri, H.Z. Some notes on the winged bean variety trial in Indonesia.

(To appear in subsequent issue.)

55. Venkataraman, A. Winged bean - a crop with a future for India. 8 p.

Records of winged bean cultivation in India over 200 years ago have been documented although the crop was not exploited widely. Research and development work on winged bean has commenced at the Tamil Nadu Agricultural University and the State Government Department of Horticulture.

D. ENTOMOLOGY AND PATHOLOGY

(i) Presented Papers

56. Lubis, S.H.A. and Sastrapradja, D.S. Susceptibility of the winged bean varieties to *Synchytrium psophocarpi* (Rac.) Gaumann.

A survey has been conducted on winged bean collection of the National Biological Institute, Bogor, to assess the susceptibility to false rust (*Synchytrium psophocarpi*). A varied degree of susceptibility was observed amongst the samples studied. Subsequent hybridization studies between the resistant and the susceptible samples revealed that susceptibility was governed by duplicate additive genes and that susceptibility was dominant over resistancy. From analysis of the progenies of the crosses, the possible genotypes for the characters of the respective plant samples used in the study are proposed and discussed.

57. Price, T.V. The current status of diseases and pests of the winged bean. 32 p.

The current status of diseases and pests of the winged bean are reviewed. Three viruses, *Psophocarpus* Ring Spot Mosaic Virus, *Psophocarpus* Necrotic Mosaic Virus and Cowpea Mosaic Virus have been positively identified. *Psophocarpus* Ring Spot Mosaic Virus is seed-borne. Of the fungal diseases, 'false rust' (*Synchytrium psophocarpi*) is still the most important and resistance to this disease has been found amongst Indonesian lines. *Cercospora canescens* has been associated with leaf spots in Bangladesh. Anthracnose (*Colletotrichum gloeosporides*) has been reported from Bangladesh and the Ivory Coast. Rootknot nematodes (*Meloidogyne spp.*) have been found to cause up to 70% loss of tubers and also significantly reduce vegetative dry matter; all lines screened to date have been found susceptible.

Aphids have been associated with transmission of viruses. Winged bean has been found to be a host to pests from cowpea and cotton but is

resistant to the cowpea seed moth, the bean fly, Mexican Bean Beetle and storage *Bruchidae**. The toxicity component is in the cotyledons. Insecticide spraying controlled pest damage but in Nigeria did not significantly increase yields.

(ii) Distributed Papers

58. Harjono, S.M. Screening winged bean for resistance to false rust (*Synchytrium psophocarpi*). 7 p.

False rust reduces pod and grain yield and causes death of plants in winged bean. Thirty plants each of 69 accessions were screened at the University of Gadjah Mada, Indonesia. After natural infection the plants were rated 210 days after planting. A plant with a single sorus was rated susceptible. Nine lines did not show any infection while four others had less than 10% infection. A large number of the accessions showed a hundred percent susceptibility. Seedlings of four out of 13 lines inoculated in a moist chamber using spore medium from infected leaves showed high resistance. Further inoculation and field studies on seedlings of these four lines showed complete resistance of UGM 80 and UGM 85 to false rust and 2.2% infection in UGM 75 and UGM 110. (Collection of germplasm of winged bean was commenced at the University of Gadjah Mada from various parts of the world and more than 250 lines have been collected and maintained in the germplasm.)

59. Onesirosan, P.T. Diseases of the winged bean in Southern Nigeria. 8 p.

Observations carried out in home garden plantings of the winged bean at Ile-Ife in the humid tropical zone of Southern Nigeria have shown very little incidence of diseasesin the past four years. However, an attempt at large-scale field production has encountered false rust (*Synchytrium psophocarpi*) and web blight (*Rhizoctonia solani*) in epiphytotic proportions. Other field diseases include several viral symptoms, leaf spot (*Pseudocercospora psophocarpi*) seed mouldiness caused by invasion by several fungi and root-knot nematodes (*Meloidogyne spp.*). Mouldiness is a serious problem which leads to loss in aesthetic quality as well as loss in viability and root-knot is likely to become serious as cropping is intensified and production increased.

60. Rajapakse, R.H.S. and Kulasekera, V.L. Investigations on insect pests of winged bean.

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*Recently there has been a report (Brough, pers comm) of bruchid infestations in winged bean seeds in Papua New Guinea.

Investigations on insect pests of winged bean in Sri Lanka revealed that *Maruca testulalis* Geyer and *Mylabris pustulata* Thumb are important pests of flowers with the former causing serious damage to pods as well. The bean fly, *Ophimyia phaseoli* Tryon, was observed to be a serious pest of the seedlings. Of the other insect pests found attacking the buds, stems and leaves, the important ones were *Nezara viridula* L., *Aphis craccivora* Koch, *Aphis goddypii* Glover, and *Henosepilachna signatipennis* Bois. Their life biology and the damage done to the crop were studied.

61. Taborsky, V. Diseases and pests of winged bean in Vietnam. 11 p.

Winged bean grown in the Socialist Republic of Vietnam suffered from a deficiency disease caused by the lack of potassium. The virus disease affecting winged bean was ringspot mosaic with an occurrence rate of up to 10% in the northern part of the country, whereas in the southern part the occurrence was much higher. The most frequent fungal disease was leaf spot - *Pseudocercospora psophocarpi* (Yen) Deington.

A high level of the biological regulation of two-spotted mite, *Tetranychus telarius* Koch (now *T. urticae*) was observed in the Hanoi region, the mite being controlled by an unidentified thrips and by the predatory mite *Phytoseiulus persimilis* A.H. and the imagoes being affected by a parasitic fungus (*Entomophthora fresseni*). The aphid *Aphis craccivora* Koch was controlled by a predator (Coleoptera) and the same applies to *Iceria purchasi* Maskell. Young plants were commonly damaged by small grass-hoppers and ants. *Empoasca* spp. multiplied rapidly on mature plants. Great losses were caused by rodents (*Rattus* spp.) and by birds (pecking the flower).

Root knot nematodes of the genus Meloidogyne, particularly *M. incognita*, represent great hazard to winged bean; *M. javanica* and *M. arenaria* are less frequent. A strategy of integrated protection appears to be necessary if winged bean is to be grown on increasing areas.

62. Wijayagunasekera, H.N.P.; Perera, A.L.T. and Weerasinghe, V.L.W. Response of winged bean to simulated foliage losses. 6 p.

Plant response to simulated foliage losses in winged bean was studied, in which foliage was removed artificially to simulate natural losses. Four levels of foliage losses (17%, 33%, 50%, and 67%) and a control (no foliage removed) were used as treatments. The effects of these treatments on dry weights were examined. Plants were able to tolerate up to 33% defoliation without any physiological setback. At 17% defoliation, a significant increase in yield was obtained. Defoliation up to 50% and 60% resulted in a reduction in the dry weight of all the plant parts, except nodules. Thirty three percent defoliation was thus considered as the economic threshold level for this plant.

E. FOOD UTILIZATION, NUTRITION AND PROCESSING

(i) Presented Papers

63. Al-Jibouri, H.A. Notes on the FAO programme related to winged bean. 6 p.

FAO continues to give top priority to the production and improvement of food crops and has placed an associate expert at IITA to work on the breeding and agronomy of winged bean. The former FAO Food Legume Improvement Specialist who worked in Burma for three years included winged bean in his programme. FAO is sponsoring a Ph.D. fellowship to the University of the West Indies, Trinidad and Tobago for a candidate from Liberia to work on winged bean and is sending a consultant to Guinea to formulate a large-scale project on research and production of winged bean.

Winged bean was one of the topics during the FAO Expert Consultation on the Production and Improvement of Food Legumes in the Caribbean, Central America and Panama which was held in the Dominican Republic in 1979. The FAO seed exchange laboratory is sending winged bean seed samples to FAO field projects for introduction and testing. The IBPGR Secretariat published a report on "Descriptors for winged bean" in 1979, copies of which are available on request. FAO wishes to cooperate and assist, as much as its limited resources permit, in evolving a viable national programme for the introduction, development and expanded production of the winged bean.

64. Caygill, J.C. and Jones, N.R. Anti-nutritional factors in winged bean parts and their removal.

(To appear in subsequent issue.)

65. Chomchalow, N. The winged bean as a source of food for refugees in South East Asia.

(To appear in subsequent issue.)

66. Cerny, K.; Hoa, D.Q.; Dinh, N.L. and Zelena, H. The winged bean seeds as a major source of protein in the diet of small children. 30 p.

The present study has been conducted in order to assess the nutritive qualities of mature winged bean seeds as a possible major source of protein in the diets of infants and toddlers. Two diets were designed with equal amounts of major nutrients and energy values. In

the experimental diet, most of the protein was of vegetable origin (winged bean seeds and rice); skimmed milk provided most of the protein in the control diet. Long-term feeding trials were carried out in well nourished Czech infants and in Vietnamese infants and toddlers with protein energy malnutrition. Eight three-day metabolic balance studies of nitrogen, calcium and lipids were performed in six healthy Vietnamese infants aged 7 to 12 months using the method of alternating the two extracted faecal fat using gas chromatography. The efficacy of the winged bean based formula was found to be above 90 per cent of that of the skimmed milk diet, based on the mean gains in weight. The difference between the two diets was not significant in this respect. Biochemical analyses carried out at the beginning and at the end of the studies revealed no differences between the two groups of Czech infants. In the malnourished Vietnamese children an improvement of the biochemical findings related to the nutritional status of the children and considered as dependant on the amount and quality of the dietary protein could be recorded at the end of the study, showing no differences between the groups.

67. Chubb, L.G. Outlook for the winged bean in Europe in the 1980's. 8 p.

During 1969-79, world oilseed production increased from 106 million tons to 178 million tons per annum to satisfy increasing demand for oil and protein for human and livestock nutrition. Projected demand for livestock products in the E.E.C. to 1990 indicates only slow growth, except for poultry meat. The future market price of oil seeds will be determined by the price of cereals compared to oilseeds, economic and climatic factors influencing the type of oilseed cultivated, and the market value of oil compared to protein meal. Close correlations exist between prices of different oils and between protein meals because of the accepted substitution of either one oil for another and one protein for another. It is anticipated that protein prices will rise steadily, accompanied be some fall in edible oil prices. Provided the anti-nutritional factors present in the winged bean are destroyed, the extracted decorticated meal could play a significant role in pig and poultry diets.

68. Claydon, A. Winged bean - the vegetable food. 10 p.

The characteristics and traditional uses of winged bean as a vegetable food are described. Nutrient contents of raw and cooked winged bean leaves, flowers, pods and unripe seeds are reviewed, and suggestions for their commercial marketing and processing are given. Winged bean vegetative parts should be cooked as little as possible, and the pods be harvested at either three or four weeks after flower opening if green beans or peas are to be marketed in the tropics.

69. Garcia, V.V. The water soluble proteins of winged beans. 29 p.

The solubility of winged bean protein nitrogen was found to be a function of pH and salt concentration. The nitrogen solubility was lowest at pH 4.0, the apparent isoelectric point. The maximum solubility in water at neutrality (pH 6.70) was about 60.4%. Solutions of Na_3PO (0.5%, pH 11.0) extracted the most protein (86.0%), compared to 70% in 0.75 - 1.0 M NaCl (pH 6.95), 69% in 0.25 M Na_2SO_4 (pH 7.20) and 66% in 0.20 - 0.30 M Na_2PO_4(pH 9.20).

Fractionation of the aqueous extract on Biogel A-1.5m gave two high molecular weight and two low molecular weight components. The acid-precipitated protein yielded two fractions of high molecular weight components and a fraction of lower molecular weight. The "whey" yielded two relatively low molecular weight proteins. The amino acid composition of the aqueous extract, the precipitate and the "whey" were similar to the defatted winged bean flour.

SDS-PAGE of winged bean proteins indicated the presence of well resolved proteins and or subunits. The high molecular weight fractions appeared to consist of proteins, with a molecular weight of about 74,000 while the low molecular weight fractions consisted of proteins with molecular weights of about 20,000.

70. Gillespie, J.M.; Blagrove, R.J. and Kortt, A.A. Characterization of winged bean seed proteins. 19 p.

There are marked differences in several amino acids between the winged bean and other legume seeds. Whereas for many legumes it is possible to identify legumin-like and vicilin-like proteins with sedimentation coefficients of 11S and 7S respectively, it does not seem possible to do this for the winged bean. Psophocarpin C, with a sedimentation co-efficient near 7S would appear most like a vicilin-type protein except for its comparatively high content of methionine. The winged bean is a tropical legume which shows exceptional promise as a food crop for the humid tropics (Anon., 1975). Analysis of the seed protein (Kapsiotis, 1968; Cerny et al., 1971) indicates a more desirable amino acid composition than for most legumes, particularly with reference to lysine and the sulphur-containing amino acids. However, the levels of cystine and methionine still limit the nutritional value of the seed. Detailed studies of winged bean seed proteins were undertaken in our laboratory in the hope that this information could be used to improve the quality of the seed by breeding for higher levels of sulphur-rich components. In this paper we describe our results on the isolation and characterization of the major proteins present in the winged bean seed.

71. Heyneker, Ing. W.G. The winged bean (Kecipir) for health, strength and a better standard of living for the small farmer in Asia and Africa. 9 p.

Methods of preparing a variety of food products from winged bean which can be made by the small farmer in his own kitchen, are described.

Because of the range of food products and their ease of preparation, it is suggested that winged bean has the potential to develop into the no. 1 crop in Indonesia. Experience in cultivating the crop is also described. Production in Indonesia is increasing and it is expected that the first winged bean processing plant will be constructed in Gorontalo during 1981.

72. Hildebrand, D.F.; Chaven, G.; Hymowitz, T.; Bryan, H.H. and Duncan, A.A. Variation in protein and oil content of winged bean seeds as measured by near infrared light reflectance. 7 p.

Simultaneous estimations of protein and oil concentrations in winged bean seed meals made by a near infrared light reflectance instrument coupled to an analog computer (grain analyzer) were compared to protein and oil determination by Kjeldahl and soxhlet extraction procedures. The correlation between Kjeldahl protein and the grain analyzer values was 0.988. The correlation between soxhlet extracted oil and the grain analyzer values was 0.995. The 240 winged bean accessions evaluated in this study were obtained from 16 countries. The seed protein contents ranged from 20.7 to 45.9%. The seed oil content ranged from 7.2 to 21.5%. Three accessions of *Psophocarpus scandens* (Endl.) Verdc. were analyzed for protein and oil content. IL 14, IL 53 and IL 66 had seed protein contents of 32.3, 27.1 and 33.8% and oil contents of 14.2, 10.8 and 15.6% respectively.

A centrally located grain analyzer facility should be able to monitor the protein and oil values in winged bean cultivar and breeding trials carried out anywhere in the world.

73. Hildebrand, D.F.; Chaven, C.; Hymowitz, T. and Bryan, H.H. Variation in storage root protein content in winged beans. 8 p.

The storage root forming capacity of 189 *Psophocarpus tetragonolobus* (L.) DC. and 3 *P. scandens* (Endl.) Verdc. accessions was evaluated after one year growth at Homestead, Florida. None of the *P. scandens* accessions formed storage roots whereas 38 of the *P. tetragonolobus* accessions showed storage root formation. Great differences in tuber production were observed among the accessions. The environmental component of the phenotypic variance for storage root production appears to be very large. The protein content of the storage roots ranged from 8 to 31 percent on a dry weight basis with a mean of 16 percent.

74. Hildebrand, D.F.; Chaven, C.; Hymowitz, T. and Bryan, H.H. Variation in protein and nitrate content of vegetative growth of winged beans.

(To appear in subsequent issue.)

75. de Lumen, B.O.; Reyes, P.S. and Belo, P.S. Studies on winged bean lipoxygenase. 16 p.

Lipoxygenase activity in winged bean was unexpectedly low compared to other plant sources. Recovery of extractable activity was highest when buffers within the pH range 7.0 through 9.0 were used. The enzyme was partially purified by sequential column chromatography on Sephadex G-150 and DEAE Sephadex A-50 of the ammonium sulphate fraction. Ca^{++} had a definite activating effect while KCN, cysteine and vitamin E inhibited enzyme activity. The pH optimum was around 6.0. Boiling whole beans in water inactivated all lipoxygenase in 60 min while for dehulled beans, complete inactivation was achieved in 18 min.

76. Ravelli, G.P.; N'Zi, G.K. and Sylla, B.S. Winged bean trials in the Ivory Coast (West Africa). 23 p.

This paper reports on progress of The Nestle Foundation's winged bean four year project which commenced in Jan. 1977. The project involves three main aspects: agronomic studies on adaptation, promotion of the culture of winged bean in family gardens and subsequent consumption by the family and nutritional and medical surveillance of the pre-school age population of that village to detect possible beneficial effects resulting from the improvement of the nutritional value of the family's diet due to winged bean consumption. An equivalent control village in which winged bean was not grown was also studied for comparison. Initially protein malnutrition had been prevalent in both villages, the stable food being yam and cassava. It was found that the plant adapted well to the conditions of soil and climate prevailing in the forest zone of the Ivory Coast, although disease problems were more serious than expected.

77. Sathe, S.K. and Salunkhe, D.K. Investigations on winged bean proteins and antinutritional factors. 15 p.

Two cultivars of winged bean (Chimbu and HF-10) were investigated. The molecular weight distribution profiles of two cultivars differed significantly. Major protein subunits of Chimbu had estimated molecular weights of 51,000; 18,000 and 12,300 daltons while subunits with estimated molecular weights of 145,000; 55,000; 29,000; 14,7000 and 14,000 daltons characterized HF-10 proteins. Sequential extraction with distilled water and 2% NaCl recovered 91.08 and 87.7% (respectively for Chimbu and HF-10) of total proteins. Soaking the beans in alkali resulted in elimination of haemagglutinating activity, significant reduction in tannins and trypsin inhibitory activity, and improvement in *in vitro* protein digestibility.

78. Soedjarwo, A. Mechanical dehulling of the ripe winged bean seed.

The difficulty of dehulling winged bean seed using traditional methods in Indonesia is probably a factor restricting popularization of the crop which has potential for tempeh making. Peeling is facilitated by washing one kilogram of seeds with tap water and then boiling for 3-5 minutes in five kilograms of water to which 300 - 400g of ash has been added. Ash from bamboo leaves is better than that from firewood, giving

faster and cleaner peeling. After boiling, decant the ashed water and drain the seed. Cool and then soak the half cooked beans in clean tap water overnight. Drain and wash (2 or 3 times if necessary). Boil in tap water for 20 minutes, drain and peel the bean by hand, by feet trodding or by processing through a special peeling machine (a modified rice milling machine). Using this process, the testa is removed easily. The dehulled seeds may then be dried and stored for future use.

79. Sri Kantha, S. and Hettiarachchy, N.S. Nutritional studies on winged bean grown in Sri Lanka. 34 p.

Thirty two cultivars were analyzed for protein contents of seeds, tubers, tender pods, leaves and flowers. Percentage of fat, moisture carbohydrate, crude fibre and ash were determined in seeds. Mean weights of a mature seed and a tuber were 0.28 ± 0.07 g and 34.7 ± 16.4 respectively. The mean protein content of seeds, leaves, flowers, immature pods and tubers were 36.7 ± 3.38, 7.4 ± 2.1, 2.1 ± 0.54, 2.1 ± 0.51, 5.5 ± 1.59 g/100 g fresh weight respectively. Amino acid analysis of seed flour showed that it was rich in lysine, which is deficient in rice that forms the staple diet of Sri Lankans. The mean oil content in seeds was 17.8 ± 3.86. The fatty acid profile of the oil showed that oleic (40.2 percent) and linoleic (31.6 percent) acid fractions formed the major fatty acid components. Trypsin inhibitor contents in the raw mature seeds, mature tubers and fresh leaves ranged from 10.C - 49.5; 0.2 - 33.2; 0.2 - 1.0 mg TI/g sample, respectively. Phytohaemagglutinin content in the raw mature seeds was 3,200 - 25,600 haemagglutination units/g sample.

80. Truong, V.D.; Raymundo, L.C. and Mendoza, E.M.T. Lipoxygenase activity in germinating winged bean seed and its role in beany flavour formation. 24 p.

Lipoxygenase (linoleate:oxidoreductase E.C.1.13.11.12) specific activity was determined by a spectrophotometric assay in different varieties and lines of winged bean, cowpea and soybean. Winged bean lipoxygenase activity was comparable to that of soybean (11-48 units/mg protein) while cowpea had the highest specific activity (205-316 units/mg protein). Lipoxygenase activity gradually decreased from 42 to 26.3 units/mg protein during nine days of germination. This was accompanied by a decrease in total fats (18.5 to 13%) but with an increase in polyunsaturated fatty acids (24 to 37% of fat). Both catalase and peroxidase activities increased during germination (9 to 155 and 0.074 to 1.19 units per mg protein, respectively). The total protein of winged bean seeds slightly increased (29 to 31%). Polyacrylamide gel electrophoresis under denaturing conditions showed the degradation of the high molecular weight proteins (55,000) to smaller proteins of 27,000 and 20,000 daltons. The development of an unpleasant off-flavour was observed during germination. Purified lipoxygenase was found to catalyze formation of volatile components in a model lipoxygenase-linoleate system. These components were also noted to be among the volatile substances of raw winged bean homogenate. The role of lipoxygenase in the production of the beany flavor of winged bean is

discussed.

81. Wijewardene, R. and de S. Waidyanatha, U.P. Live mulch cropping - prospective new role for winged bean.

The research programme at IITA, in collaboration with the Department of Agriculture in Sri Lanka is: (a) to re-evaluate a number of varieties of *Psophocarpus* as a cover crop which also produces food, (b) to re-evaluate the live mulch cropping system on the undulating uplands of the humid and semi-humid tropical regions utilizing suitable varieties of winged bean under low-input conditions in association with maize, rice, millet, cowpea, soybean and green and black gram, (c) to develop and evaluate techniques necessary for the satisfactory utilization of the system by the small farmer and (d) to evaluate the techniques for efficiency and ease of adoption by small farmers in comparison with other conservation farming techniques.

82. Yap, T.N.; McDowell, R.E. and van Soest, P.J. Composition and *in vitro* digestibility of the winged bean and possible utilization of the whole plant in ruminant feed. 10 p.

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 that in 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 fraction, 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 the winged bean plant parts would make an excellent supplement for ruminants.

(ii) Distributed Papers

83. Citroreksoko, P.S. The analysis of toxic substances in the seed of winged bean. 4 p.

The analyses of the toxicants in the bean have shown the absence of cyanide compounds and canavanine. The main alkaloids were insoluble

in water. The high content of fat in the bean (about 18% by dry weight) caused difficulties in imbibing water. When the bean was boiled with 1% solution of sodium bicarbonate it gave more taint odour than when boiled in water. This odour was reduced by addition of 1% solution of citric acid.

84. Escueta, E.E. and Tisalona, H.M. Solubility profile of winged bean protein. 21 p.

Protein solubility in aqueous media of two winged bean varieties were studied over a range of pH values (2-12), salt concentration (0.025-1.0 M) and winged bean meal to water ratio (1:5-1:40). Protein solubility was maximum at 1:20 meal to water ratio, with a value of 69.31% nitrogen solubility. Protein recovery was also highest at 1:20 meal to water ratio, with a value of 58.48% nitrogen recovered. The isoelectric point of winged bean protein was observed to be pH 4. Solubility curves of winged bean proteins in salt solutions (NaCl and $MgSO_4$) exhibited quadratic trends. Sodium chloride exhibited a parabolic curve with a minimum solubility at 0.075 M while $MgSO_4$ exhibited a maximum solubility at about 0.25 M concentration. At low concentration (0.1 M), NaCl did not change the pH-solubility profile of winged bean protein, but at higher concentrations (0.5 M-1.0 M) it shifted the curve to a linear behaviour with a solubility increasing with pH value. Magnesium sulphate on the other hand affected the pH-solubility profile at all three concentrations (0.1, 0.5, 1.0 M), with solubility decreasing with increasing pH value.

85. Hettiarachchy, H.S. and Sri Kantha, S. Household preparations from winged bean. 21 p.

In Sri Lanka, the winged bean is traditionally eaten as immature pods and leaves. The mature seeds are seldom consumed or processed. This study reports the feasibility of preparing winged bean for food using low-level village technology at low cost. Winged bean seeds take approximately two hours of cooking for tenderisation because of its hard texture. Soaking for 6 - 10 hours and blanching the seeds in 0.5% $NaHCO_3$ or 0.5% NaCl solutions for 30-40 mins. were found to be acceptable methods for efficient tenderisation in the preparation of "winged bean curry". Processed winged bean flour was used to prepare "rotti", "thosai", "wadai", bread and cake, the supplementation level being 10%. Recipes prepared proved acceptable as side dishes or snacks. Winged bean milk, prepared from the processed winged bean seed flour, can form a substitute for coconut milk, and is rich in protein (30%).

86. Karikari, S.K. and Asamoah-Appiah, S. Research on winged beans in Ghana - a country report. 11 p.

Despite the widespread publicity so far given to the nutritive value of the winged bean, local consumption is still very meagre. How-

ever, the crop is now being grown and eaten mainly as a green vegetable by a proportionately large number of people in urban areas particularly Accra, among the University community, and in the Kade/Akwatia area.

Research work on the crop has been concentrated at the Kade Research Station, the Departments of Crop Science, Animal Science, Nutrition and Food Science and Home Science, all of the University of Ghana, the School of Agriculture at the University of Cape Coast and the Crop Research Institute at Punso. The crop has caught the attention of the Ghana Government and in the Government's Action Programme for Agricultural Production for the year 1980/81, an estimated area of 5,000 hectares of land in the Northern Savanna Zone has been earmarked for the cultivation of winged bean as an alternate crop to rice. Currently the utilisation of the crop is being intensified through nutrition, extension and home science education so that its importance as food and feed will be more appreciated among the rural communities.

87. Nardiyono, S. and Sudarmadji, S. Winged bean sauce processing by acid hydrolysis. 7 p.

Although rich in high quality nutrients, winged bean seeds are difficult to process due especially to the hardness of seed coat and the strong beany flavour. One of many potentials of winged bean as food is as bean sauce, a condiment widely known in Asia. Traditionally, bean sauce (especially soy sauce) is produced by mould fermentation techniques. Another method is through acid or alkali hydrolysis which is faster and more easily controlled than the mould fermentation. Hydrolysis of defatted winged bean flour in 6N HCl solution by heating at 100-105°C has provided the following data: total nitrogen, amino nitrogen, soluble solids, reducing sugars and salt showed maximum contents in the hydrolyzates after about 15 hours of heating.

88. Onyembe, P.M.L.; Paulus, J.J.; Mukienga, K.; Kembola, K.; Mbemba, F.D.L. and Alimasi, O. Study of the food value of *Psophocarpus palustris* Desvaux. 9 p.

Analysis of crude protein, amino acids, fat, fatty acids, carbohydrate and ash showed that *P. palustris* may have similar food value to *P. tetragonolobus* and thus have potential for development as a source of high protein human food. Further work on the qualitative and quantitative analysis of vitamins in young leaves and pods and antitrypsin factors in the seeds needs to be carried out.

89. Pitakarnnop, N. Production of pellets from winged bean tubers and seed cake for animal feed. 7 p.

It is technically feasible to produce high quality pellets from winged bean mixed with tapioca. The pellets have a hardness between 13.9 - 18.7 kg, Pfost number of 13.5 - 18.1% meal, the meal/pellet ratio

of 1.5 - 3.4% meal and 11.8 - 13.2% moisture. Winged bean tuber, haulm, leaf and seed cake (11% moisture, 41.3% starch, 0.4% sand, 5% fibre and 2.5% ash) can be used as raw materials for animal feed and compare with the composition of tapioca chips. The production capacity of pellets from the mixed ingredients was estimated to increase from 2202 kg/hr to 3,000 kg/hr.

90. Ramanvongse, S. and Munsakul, S. Chemical and processing characteristics of winged bean seeds. 12 p.

The chemistry and processing characteristics of 10 varieties of winged bean seeds were investigated. The results showed that these varieties do not differ much. Seeds of winged bean contain an oil content of 16 - 18%. The oil can be easily refined to a light colour by using the commercial edible oil refining process. The chemical and physical characteristics of both crude and refined oil are similar to those of other edible oils. Oleic and linoleic acids, which represent up to 39 and 27% respectively, are the major fatty acid components of oil. The minor fatty acids are myristic, palmitic, palmitoleic, stearic, arachidic, linolenic, and behenic acids. The defatted seed meal contains high percentages of protein and carbohydrate ranging from 36 - 43 and 35 - 40% respectively. Amino acid analysis of the seed meal indicated the presence of 18 amino acids and the high quantity of lysine and aspartic acids.

91. Spricigo, L.E. and Miguel, O.G. Phytochemical analyses of winged bean. 17 p.

The phytochemical analysis of the various parts of *Psophocarpus tetragonolobus* (L.), showed the presence of osis, osides, steroids, amino group, tannin, organic acids in general, alkaloids, treterpene, gums and mucilage, cardioactive and flavonic glucosides.

92. Verangoon, F.; Paklamjeak, M.; Srisawat, S. and Pathomyothin, W. Winged bean products as human food.

Preliminary studies have shown that the water from the extraction of dehulled seeds yields a milk-like product, attractive in appearance, but with a beany flavour. However, the flavour can be improved by adding chocolate flavour. The product contains approximately 2% protein and 3% fat. Weaning food has been made from the mixture of dehulled seeds and rice with or without the addition of banana as flavour. The product is in the form of dried-roller flake. After reconstituting the flake in hot water, milk or soup stock, the product is ready to be given to children. The derived product contains about 20% protein, 4% fat, vitamins and minerals. The possibility of fortification of composite wheat-cassava with defatted winged bean seed flour in pre-cooked noodles has been studied and research is continuing at TISTR to improve the product quality as well as to study the nutritive value and toxicity of

winged bean products.

(iii) Film Presentations

93. Chomchalow, N. State of the art with a movie on processing and utilization of winged bean in Thailand.

94. Chomchalow, N. Cultivation of the winged bean in Thailand.

Both movies were in colour and of excellent quality. They demonstrated the considerable progress being made in large scale production and processing in Thailand.

V. SUPPORT FOR WINGED BEAN RESEARCH

The International Council is eager to encourage research on various aspects of winged bean. It has at present funds to support research in the developing countries of Asia and is prepared to attempt to secure outside support for other areas when its own resources are insufficient. Below is a list of projections for desired research prepared by the Council's Winged Bean Steering Committee, with the help of other interested persons, which will guide us in considering winged bean research proposals submitted for support.

The guidelines are not listed in order of priority. Items 1 and 2 ("Germplasm Collection" and "Crop Improvement"), as discussed in the 2nd International Seminar on Winged Bean, are of particular interest, but we welcome research submissions in each area.

Project proposals should be in the US$3,000 to $8,000 range per year and for periods not in excess of three years. Depending on the submission however, we are prepared to consider proposals in excess of these amounts and for slightly longer periods.

All projects must be accompanied by detailed budgets and by an indication of the U.S. dollar value of counterpart support that would be provided, in cash and/or kind, by the grantee. Instructions to be followed in submitting requests for project support are given at the end

of the guidelines.

GUIDELINES FOR CONSIDERATION OF WINGED BEAN RESEARCH PROPOSALS

RESEARCH THRUSTS

1. Germplasm Collection

   A. Objectives

      (i) Determine the range of variability within three species of *Psophocarpus* i.e. *tetragonolobus*, *scandens*, *palustris*.

      (ii) Make materials available to plant breeders.

   B. Strategy

      (i) Appoint Germplasm Collection and Screening Committee to provide leadership and continuity in this effort, which must extend to Asia, SE Asia, Africa and Oceana.

      (ii) Establish a centre for collecting, cataloguing, testing, evaluating, storing and maintaining germplasm.

      (iii) Make materials available to plant breeders.

2. Crop Improvement

   A. Objectives

      (i) Homozymous lines for greatly reduced segregation (variability) within lines.

      (ii) Specialised lines and combinations for green pods, dry seeds, storage roots, leaves, for food, feedstuff, oil, forage, soil improvement and ground cover.

      (iii) Dwarf lines - short internodes - determinate - self supporting for single destructive harvest, and lines with minimum or no photosensitivity.

      (iv) Lines with highest nutritional content and lowest proportion of anti-nutritional factors of various plant parts.

      (v) Low pod wall fibre so that pods of large size remain edible and shattering of dry pods is reduced.

(vi) Seed coats more permeable to water and easier to remove (dehull).

B. Strategy

(i) *Indeterminate habit* (climbing or trailing) through -

(a) Selection and inbreeding

(b) Hybridisation and variety synthesis

(ii) *Determinate habit* (dwarf type) through -

(a) Worldwide search for naturally-occurring dwarf types to be encouraged by cash reward.

(b) Mutation breeding coupled with tissue culture technology and genetic engineering.

3. Reducing Environmental Stress

A. Objectives

(i) Efficient production (input:output)

(ii) Local adaptation

B. Strategies

(i) Rhizobium studies

(ii) Cultural practices, studies, such as: crop establishment, supports and vine training, irrigation, fertilisation, plant density and arrangement, use of growth substances.

(iii) Studies of effects of moisture, drought, environmental stress.

4. Reducing Biological Stress

A. Objectives

(i) Control of insects, nematodes, diseases, weeds, rodents.

B. Strategies

(i) Resistant, vigorous, well-adapted varieties

(ii) Chemical protectants

(iii) Introductions of predators and parasites that feed on

harmful insects and creation of conditions favourable to these beneficial insects.

(iv) Alteration of soil conditions to favour beneficial rhizobia and discourage nematodes.

(v) Detailed studies of insects, diseases and nematodes affecting winged beans with special attention to viruses that might infect other food plants in areas where winged beans are not now grown...special attention to *Phaseolus* beans.

5. Harvesting and Handling

A. Objectives

(i) Uniform senescense.

(ii) Non-shattering pods.

(iii) Uniform seed and seed coat maturation and moisture content.

B. Strategies

(i) Variety development.

(ii) Study of differences in permeability to water.

6. Post-Harvest Physiology

A. Objectives

(i) Prevent loss of dry seeds, pods and edible root tubers to insects and diseases.

(ii) Prevent loss of food value.

(iii) Prevent (retard) loss of seed germination.

(iv) Understand conditioning of seed for planting or for food and feed uses.

B. Strategies

(i) Chemical treatment of seeds.

(ii) Mixing of winged bean seeds with those of other legumes to reduce insect infestation.

(iii) Controlling temperature and humidity for dry seed storage.

(iv) Determination of optimum moisture content for stored seed.

(v) Determination of methods for conditioning stored seed prior to planting and using for food.

7. Product Development

A. Objectives

(i) Development of wholesome and palatable food and feed products such as: flour, milk, TVP, oil, protein isolates, etc.

(ii) Combination of winged bean products with more conventional products.

B. Strategies

(i) Biochemical and physical analyses of plant parts, plant products and extracts.

(ii) Determination of available nutrients coupled with animal feeding trials.

(iii) Screening of selections for special useful attributes.

(iv) Development of methods of removing beany smell and flavour.

(v) Development of machinery appropriate for small-scale processing of seeds for oil, flour, milk, etc. at the village level.

8. Economics and Marketing

A. Objectives

(i) Develop model *production and distribution* enterprise analyses for different locations to estimate resources required for intensive and extensive production.

(ii) Develop model processing and enterprise analyses to estimate the amount of raw product required for efficient manufacture of various products.

B. Strategies

(i) Develop cost of production estimates for various locations, production and distribution systems.

(ii) Develop cost of manufacture estimates for large and

small-scale processing units.

9. Outreach Thrusts (Extension and Education)

A. Objectives

(i) Popularise winged bean products and increase skills in production and use.

(ii) Create an understanding of the benefits from eating winged beans.

(iii) Create an awareness of the financial benefits from growing and selling winged beans.

(iv) Increase production and distribution of winged bean seeds of recommended varieties.

B. Strategies

(i) Demonstrations and tests (at no risk to growers).

(ii) Publications - production guides and recipes.

(iii) Local workshops to provide information to outreach personnel.

(iv) Film with soundtrack in different languages (such as film produced in Thailand).

OUTLINE FOR FUND REQUESTS

Ten copies of your application should be forwarded to:

Mr. Louis Lazaroff
Director General
International Council for Development
of Underutilized Plants (ICDUP)
18 Meadow Park Court
Orinda, CA 94563
U. S. A.

All requests for funds should be organized as follows:

1. Title of the project

2. Responsible institution and department/branch/section

3. Immediate research or project supervisor(s)

4. Expected duration of project

5. Description of project

   (i) Introduction and background information

   (ii) Purpose

   (iii) Theoretical considerations

   (iv) Methodology and plan of work

   (v) Experimental plan for the first year

   (vi) Anticipated impact of this project

6. Budget for annual expenditure (Please give full details under each item) - :

	U. S. DOLLARS		
	198__	198__	198__
(i) Salaries			
(ii) Operating Expenses			
(iii) Materials and supplies			
(iv) Travel/transportation			
(v) Other	_____	_____	_____
TOTALS:			

7. Other sources of support available for the project; counterpart support (nature and amount in cash and/or in kind in U.S. dollar equivalents

   _____ _____ _____

8. Winged bean research being undertaken with other resources.

9. References

10. Signature of the Head of Institution

VI. INTERNATIONAL WINGED BEAN VARIETY TRIALS - SECOND SERIES

Although the results of the first international winged bean variety trials have not been analysed fully, ICDUP, through its Winged Bean Steering Committee, is sponsoring a second series of international winged bean variety trials. The first series of trials has produced a lot of valuable information despite the apparent narrowness of the genetic base of the varieties used. In the second series of trials, this base will be broadened considerably, using a larger number of varieties from more countries. Dr. Wong Kai Choo of Malaysia has been appointed as the Council's research coordinator for the second series of trials and it is hoped that he will provide more details on these in the next issue of *The Winged Bean Flyer*.

Dr. T.N. Khan, the research coordinator for the first series of trials, produced a preliminary report at the Seminar and anticipates that a comprehensive final report will be completed towards the end of 1981 or early 1982. A full statistical analysis is to be done and it is proposed that the results be disseminated in several ways: a comprehensive booklet on the detailed results, an occasional paper and a paper in a scientific journal. In addition, results from individual countries are expected to be published as well.

VII. IBPGR WORKING GROUP MEETING

The South East Asian Programme of the International Board for Plant Genetic Resources sponsored a working group comprising eleven scientists from different countries to review IBPGR winged bean activities. The participants were Narong Chomchalow, Wong Kai Choo, Graham Eagleton, Nazmul Haq, Sri Kuntjijati Haryono, B.S. Jalani, Simon Karikari, Tanveer Khan, V. Kesavan, S. Sastrapradja and R.B. Singh. Discussions included the extent of the use of the IBPGR winged bean descriptors, their effectiveness and usefulness, and, if necessary, their revision. The working group also discussed the current status of the collection of winged bean, any gaps, future plans, sampling strategy and maintenance of the genetic collections.

In reviewing the descriptors list which has been widely adopted by winged bean workers, the working group made some important changes and improvements. Details of these, as well as the other factors discussed, will be printed in the proceedings of the working group which will be circulated widely.

One of the significant actions of the working group was to accept the

decision reached a few days earlier at the meeting of the ICDUP Winged Bean Steering Committee naming a number of regional centres for active conservation, multiplication and distribution of winged bean. In the absence of funds to establish a principal or world centre for winged bean, and until such a principal centre can be established, the Steering Committee had proposed that the responsibility for this work be divided among certain existing institutions where work on winged bean was now under way. The IBPGR working group endorsed this suggestion by proposing that the following regional germplasm centres be established:*

Centre	Officer-in-Charge	Region of responsibility
University of Papua New Guinea, Port Moresby	Dr. V. Kesavan	PNG, Pacific Island Countries
Universiti Kebangsaan Malaysia, Bangi, Malaysia	Dr. B.S. Jalani	Malaysia, Indonesia, Philippines
Thailand Institute of Scientific and Technological Research, Bangkok	Dr. N. Chomchalow	South China, Thailand, Indochina and Burma
University of Peradeniya, Kandy, Sri Lanka	Dr. H.M.W. Herath	Sri Lanka, South India
Bangladesh Agricultural Research Institute, Bangladesh	Director of the Inst. or his nominee	Bangladesh, Eastern India, Western Burma
Dept. of Crop Science, University of Ghana, Accra, Ghana	Dr. S.K. Karikari	Ghana and the adjoining countries

*Editor's note: Subsequent to this decision, the Government of Sri Lanka announced the establishment, with the cooperation of ICDUP, of the new International Winged Bean Institute. Although the Institute is still in the process of formation, we understand that included in the present planning is the establishment within the Institute of the world center for winged bean germplasm.

VIII. SURVEY OF RESEARCHERS

In order for the International Council for the Development of Underutilized Plants, its *Winged Bean Flyer*, and its Winged Bean Steering Committee to serve the needs of researchers and others in their efforts to bring about the development of this underutilized plant, it is desirable that further information be added to our research register. Your cooperation and assistance would be greatly appreciated.

There are three aspects of research and development of winged bean for which your assistance is sought:

A. Research Funding. The Steering Committee, at its meeting in Sri Lanka, requested that a register of research projects, big or small, which had received "external" funding be compiled. Furthermore, details of potential funding agencies in each country and the procedures for applying for funds would be sought so that ICDUP can use its support to foster worthwhile research and development projects and more effectively direct resources to bring about the development of the winged bean.

B. Country Experts. Although ICDUP, the Winged Bean Steering Committee and *The Winged Bean Flyer* attempt to provide appropriate information in response to the numerous requests received (and will continue to do so), in many cases it would be more useful to direct enquiries to experts residing in that country. If you have had experience with the winged bean, would you be willing to devote a small portion of your time to passing on the benefit of your experience to other workers in your country? This would greatly increase the effective dissemination of appropriate information.

All contact persons in the organization who receive requests for information would have copies of the country expert register and could, in addition to supplying general information, direct enquiries to the country expert(s).

C. Country/Regional/Seed Dissemination Centres. The revelation that virus can be transmitted in winged bean seeds should caution workers to the dangers of unrestricted international movement of seed material. International interchange of seed has been going on with a minimum of restriction for a number of years and now, in many countries throughout the world, extensive germplasm collections exist. Seeds sent internationally must carry phytosanitary certificates. In addition, it would be desirable for centres in each country (or region) to accept the responsibility of supplying local requests for seed. If you can contribute, even in a small way, to this programme, your efforts will be appreciated both nationally and internationally. You will be serving well the development of winged bean whereas, if the present practice of unrestricted international movement of seed continues, success could be jeopardized.

Normally only small amounts of seed would be issued (20-100g) and the person receiving the samples would be responsible for multiplying his or her own supplies.

SURVEY OF RESEARCHERS

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

FROM: Name . . . . . .

Address. . . . . .

. . . . . .

. . . . . .

(Please print legibly or type)

A. External Research Funding

1. Project Title . . . . . .
2. Funding Agency . . . . . .

. . . . . .

. . . . . .

3. Amount received . . . . . .
4. Names and addresses of Potential Funding Agencies in your Country (Other than 2)

Agency Name. . . . . .

Address . . . . . .

. . . . . .

(If possible also send details of procedures for making applications for funds and any restrictions which apply. Attach a separate list if necessary).

B. Country Experts

5. Are you willing to be listed as a winged bean expert and provide information to fellow workers in your country?

YES/NO (Cross out the incorrect answer)

List your fields of expertise

(i) . . . . . .

(ii) . . . . . .

(iii) . . . . . .

C. Country Seed Dissemination Centres

6. Are you willing and able to supply winged bean seeds within your country?

YES/NO (Cross out the incorrect answer)

. . . . . .
Signature

IX. WINGED BEAN FLYER SUBSCRIPTIONS (AND BACK ISSUES)

The International Council for Development of Underutilized Plants has arranged for a financial grant to produce Volume 3 of *The Winged Bean Flyer* on the condition that, thereafter, the publication become financially self supporting. This means, of course, that subscriptions must be levied. The high quality of *The Winged Bean Flyer* will be maintained, and where possible improved at minimal costs. Much of the work involved in the production of this newsletter is honorary, the major cost being that of postage and printing.

Beginning with Volume 4, the annual subscription rate for two issues will be:

US$6.00

PLUS US$2.50 for SURFACE MAIL costs

or

US$10.00 for AIR MAIL costs

To ensure continuity of production of *The Winged Bean Flyer*, we would appreciate receiving your completed subscription form (below), indicating that you wish to continue receiving *The Winged Bean Flyer*, together with your cheque for Volume IV as soon as possible. Cheques should be made out to: The Winged BeanFlyer/ICDUP.

Please send your completed subscription notice and your cheque to:

Mrs. J.C. Sison
Project Manager
Agricultural Information Bank
for Asia
c/o SEARCA
College, Laguna 3720
PHILIPPINES

From: (Name) . . . . . .

(Address). . . . . .

. . . . . .

(Please print legibly or type)

SUBSCRIPTION FOR THE WINGED BEAN FLYER

I wish to continue receiving the two issues of *The Winged Bean Flyer* per year and enclose my cheque for:

/___/ US$6.00 for two issues, excluding postage

/___/ US$10.00 AIR MAIL

or

/___/ US$2.50 SURFACE MAIL

This will entitle me to continue to receive *The Winged Bean Flyer* (Volume IV No. 1 and No. 2) without interruption.

BACK ISSUES - THE WINGED BEAN FLYER

To: International Documentation Center for the Winged Bean
c/o AIBA/SEARCA
College, Laguna 3720
PHILIPPINES

I wish to receive back issues of *The Winged Bean Flyer*, by air mail, as follows:

Please note quantity required in appropriate box

/___/ Vol. 1, No. 1 - May 1977 (Photocopies only)

/___/ Vol. 1, No. 2 - November 1977 (Photocopies, once present supply is exhausted)

/___/ Vol. 2, No. 1 - May 1978 (Photocopies only)

/___/ Vol. 2, No. 2 - March 1980

/___/ Vol. 3, No. 1 - December 1980

at a cost of US$6.00 per issue.

I enclose US$ _____

_____
Signature

Action Pictures Taken During the 2nd WINGED BEAN Seminar

(1) – Lighting the traditional oil lamp at opening ceremonies of 2nd International Winged Bean Seminar. L to R – Mr. Ranjan Wiveratne, Sec., Ministry of Agricultural Development and Research (Sri Lanka); Hon. E.L. Senanayake, Min. of Agricultural Development and Research; Dr. J.D. Drilon, Jr., President of ICDUP; Hon. R. Premadasa, Prime Minister of Sri Lanka; Agriculture Ministry Official; Dr. Walter Herath, Sri Lanka; Sri Lankan drummer in traditional costume.

(2) – L to R – Dr. Walter Herath (Sri Lanka); Dr. Cyril Ponnamperuma (Univ. of Maryland, USA); Dr. Ted Hymowitz (Univ. of Illinois, USA); L. Lazaroff (ICDUP) at registration on opening day.

(3) – Dr. Cyril Ponnamperuma, (Univ. of Maryland, USA) keynote speaker listening to presentation on opening day of seminar.

(4) – L to R – Lazaroff, Dr. Drilon, Sri Lankan Minister of Agricultural Development and Research Hon. E.L. Senanayake and Mrs. Senanayake (back to camera).

(5) – L to R – Sam Karikari (Ghana); Dr. Ted Hymowitz (Univ. of Illinois, USA); Dr. R.E. Schultes (Harvard, USA); Dr. T.N. Khan (Australia) in front of seminar hall.

(6) — Display of foods made from winged bean exhibited at Seminar.

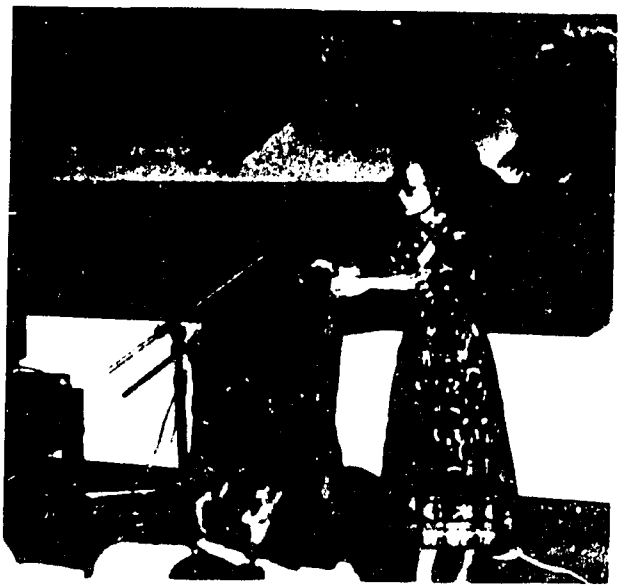
(7) — Session on Food, Nutrition and Processing (2nd Session).
L to R — Dr. Ted Hymowitz (Univ. of Illinois, USA); Dr. Carl Hittle (Sri Lanka Soybean Development Program).

(8) — L to R — Discussant at one of sessions; Dr. Walter Herath (Sri Lanka)
Moderator at one of sessions: Dr. T.N. Khan (Australia)

(9) — Sam Karikari (Ghana).

(10) — Dr. Karel Cerny (Czechoslovakia) addressing Seminar.

(11) — Prof. V. (Kesi) Kesavan (Papua New Guinea) has the floor.



(12) – Mrs. S.H.A. Lubis (Indonesia)

(13) – L to R – Dr. Drilon, (President of ICDUP); Dr. Ponnamperuma, (Univ. of Maryland, USA); Lou Lazaroff, (ICDUP); Reporter; Dr. Walter Herath (Sri Lanka).

(14) – L to R – Willie Erskine (Syria), Graham Eagleton (Australia), Dr. J. Paulus (Zaire).

(15) – Discussion between sessions: L to R – Dr. K. Kovitvadhi (Thailand); Dr. Benito de Lumen (Univ. of California, Berkeley, USA); Dr. N.R. Jones(Tropical Products Institute, London); Dr. Karel Cerny (Czechoslavakia); Dr. Narong Chomchalow (Thailand).

(16) – Dr. Jacob Ruegg (Switzerland); Dr. Ing. F. Pospisil (Czechoslavakia) examining exhibits.

(17) – Tea & Coffee Break:
L to R – Victor Delpadado (Ecuador); Jacob Ruegg (Switzerland) with board in background; Ethel Lazaroff (ICDUP); Mrs. Josie Sison (Philippines) talking with Mrs. Russ Stephenson (Australia).

(18) – L to R – Mr. Sam Karikari (Ghana); Doc. Ing. F. Pospisil (Czechoslovakia); in back, Dr. Bill Kerrey, Niftal Project (Univ. of Hawaii, USA).

(19) – Latin American Group (with Dr. Drilon and Lou Lazaroff); Dr. Drilon; Dr. Luis Spricigo (Brazil); Mr. Lehel Telek, (Puerto Rico); Prof. C.H.W. Fletchmann (Brazil); Dr. F. Olmos (Uruguay); Lou Lazaroff (ICDUP); Dr. G. Hernandez Bravo (Mexico); Dr. L.C. Lopez (Mexico); Dr. A.S.L. Tirimanna (Suriname).

(20) – Another view of the Latin American group discussing plans for Latin American cooperation with Lazaroff.

(21) – Tea and coffee break with Prof. Q.A. Fattah, Bangladesh doing the honors.

(22) – L to R – Mr. W.G. Heyneker (Indonesia) and the ladies from Indonesia; Dr. S. Sastrapradja, Mrs. S.H.A. Lubis, Dr. S.K. Haryono.

AVAILABLE PUBLICATIONS ON THE WINGED BEAN

THE WINGED BEAN

Published in 1980, this book contains the proceedings of the First International Symposium on Developing the Potential of the Winged Bean held in 1978. The book is by far the most authoritative work on the winged bean to date, containing 49 technical papers and 19 country papers prepared by over 100 scientists from 26 countries. The volume covers studies on all aspects of the plant from germplasm resources and genetics to utilization as food, forage and industrial raw material.

Prices are US$20.00 for hardbound and US$15.00 for softbound volumes, exclusive for postage. Mailing costs are US$15.00 for air mail for hardbound volumes, US$12.00 for softbound volumes and US$7.00 for surface mail for both hard and softbound copies.

Orders or inquiries may be sent to:

Dr. Ponciano A. Batugal
Director
International Programs
Philippine Council for Agriculture
and Resources Research
Los Baños, Laguna 3720
PHILIPPINES

WINGED BEAN: AN ANNOTATED BIBLIOGRAPHY. 1981 edition.

This update in the continuing bibliographic series on the winged bean is composed of 420 entries, most of them with abstracts. The bibliography is computer-generated and is complete with keyword, author and geographic indexes. The price per copy is US$10.00 plus US$9.00 for air mail or US$4.00 for surface mail.

Requests may be sent to:

Mrs. J.C. Sison
Project Manager
International Documentation Center
for the Winged Bean
AIBA/SEARCA
College, Laguna 3720
PHILIPPINES