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INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

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Report on Winged Bean Program in Asia

June 1981 - March 1983

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INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

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INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

Introduction

The following is a report of the activities of the International Council for Development of Underutilized Plants during the period June 1981 through March 1983.

It is organized to follow the major categories of the grant made to the Council by the Agency for International Development, namely:

A. The work of the germ plasm centers

B. The goals of projects calling for study, experimentation and extension under priority areas of work

C. The evaluation of the International Winged Bean Variety Trials

D. The evaluation of the winged bean information and documentation center.

It includes also information on a number of additional developments that have taken place with the Council's support or that reflect its continuing effort to encourage work on this plant.

Documents referred to in the text as well as other materials that may be of interest, are included in the Appendix.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

REPORT ON WINGED BEAN PROGRAM IN ASIA
JUNE 1981 - MARCH 1983

A. Establishment and Continuation of Germ Plasm Centers in Asia

As indicated in the first report of the Council (or ICDUP, as it is also referred to below), the decision by the Government of Sri Lanka to establish an international research center on winged bean, now officially known as The International Dambala* (Winged Bean) Institute, made it likely that the principal and world-wide germ plasm center for winged bean would be established as an integral part of the new institute. At the first meeting of the Institute's Board of Directors, held in Sri Lanka in March 1982, it was decided that one of the principal and initial activities of the Institute would be the establishment of the world-wide germ plasm collection. The Institut as described below in the section devoted to it, is now in operation.

While the Institute was in the process of being established, and in order to help establish the base for such an Institute collection the Council provided funds (as described below in the section, "Study, Experimentation and Extension") to the Sri Lanka Winged Bean Committee to complete the collection of indigenous Sri Lankan winged bean variotypes, and to secure accessions from outside the country. All accessions were to be evaluated, tested and replicated, with all data, seeds, and other materials to be turned over to the Institute once the latter was in a position to assume full responsibility for germ plasm collection and management. The work of the Sri Lankan Winged Bean Committee would be carried out by

*The Sinhalese name by which winged bean has been known in Sri Lanka for centuries.

University of Peradeniya staff on the University of Peradeniya Farm, which is adjacent to the grounds of the international Institute.

Although the Council conducted considerable correspondence with the University of Papua New Guinea regarding the establishment of a sub-center in that country which is a principal center of winged bean cultivation, no agreement had been reached with the authorities of that University. It will now be the responsibility of the new International Winged Bean Institute to determine whether it wishes to encourage and help support the establishment of such a germ plasm subcenter in Papua New Guinea, linked to the principal collection at the Institute.

B. Study, Experimentation and Extension

Guidelines for Consideration of Winged Bean Research Proposals by the Council have been completed. These were reproduced, together with an outline to be used by research workers in making requests for funds, in The Winged Bean Flyer, Vol. 3, No. 2 (August 1981). The announcement of available support, the guidelines and the form to be used in making requests for funds, are reproduced in the Appendix as item I.

Bearing these guidelines in mind, the Council made the grants listed below for study, experimentation and extension during the period June 1, 1981-April 30, 1983.

Each request for research or experimentation made by the Council must be approved by its Winged Bean Steering Committee, composed of thirteen outstanding researchers experienced with winged bean. The names of the members of the Winged Bean Steering Committee are listed in the Appendix.

Grants made by the Council vary in size from under $500 to approximately $15,000 and are usually for a period of one year, though at times renewable on evidence of satisfactory performance. Grants have supported research and

experimentation on varietal testing, plant breeding, agronomy, testing and processing of plant parts, etc. The Council is encouraging experimentation with contract farming among small holders of low income in order to secure adequate-sized harvests from the viny plant in order to meet local demand. Because of the shortage of ripe seed for use by researchers, experimenters and leaders of village level programs, the Council is also supporting seed multiplication of selected varieties for distribution. The Council is the principal source of winged bean seed, though some seed is also obtainable from such institutions as the Mayaguez Institute of Tropical Agriculture in Puerto Rico and from national agencies or individuals such as the National Bureau of Plant Genetic Resources in New Delhi for work in India principally and from Sri Kuntjiyati Haryono, Gadjah Mada University, Yogyakarta for work in Indonesia.

In most cases, the Council provides only partial support for the research proposal submitted. Letters of agreement with project principals detailing the nature of the work to be performed, must be entered into before any grant is made. These letters of agreement indicate also the contributions in cash and/or kind that will be provided by the participating institution. In most cases this counterpart contribution exceeds the contribution made by the Council. Substantive and financial reports are required at the conclusion of the project and, depending on the project and its size, during the course of the project. These are maintained in the records of the Council and made available to the Information and Documentation Center for the Winged Bean.

The grants made by the Council during the period June 1, 1981-April 30, 1983, are as follows:

Winged Bean Growth Center, Universiti Pertanian Malaysia (Agricultural University of Malaysia), Mr. Wong Kai Choo. "Support for Work of Center, March 1, 1981-February 28, 1982." (1 year project: $15,000)

Partial support for Center's work in increasing knowledge and use of elite varieties of winged bean among small farmers in Malaysia and the neighboring region, so as to improve their nutrition and income. Work to be performed includes completion of screening processes begun in preceding year of Malaysian and foreign winged bean accessions, conduct of advanced yield trials, and genetic improvement. The Center will also coordinate the Council's Second International Winged Bean Varietal Trials.

Center will be expected to work with scientists in other institutions and to cooperate closely with The International Dambala (Winged Bean) Institute.

Grant covers cost of agricultural supplies and small equipment, services of an assistant and labor, internal travel, postage, publications, etc.

Counterpart contribution of the University includes the services of 2 research personnel, a laboratory assistant, field assistants, greenhouse, provision of an equipped winged bean research laboratory, cold rooms for short and long term storage, land, land preparation, and additional laborers, estimated as amounting to a total of $41,300.

Department of Primary Industries, Maroochy Horticultural Research Station, Australia, Dr. R. A. Stephenson: "Editorial Costs for The Winged Bean Flyer." (1 year project: $1,000)

Editorial expenses in preparing the Council's semi-annual newsletter, The Winged Bean Flyer, for the period January 1, 1981 through December 31, 1981. The grant covers costs of secretarial assistance, materials (paper, envelopes, etc.), postage, telephone and cable, and a small amount ($30)

for contingencies. Issues to be prepared and distributed world-wide will be Vol. III, No. 2; Vol. IV, No. 1; and preliminary work on Vol. IV. No. 2. The publication covers activities, reports on research, field experiments, meetings, etc. on winged bean.

Dr. Stephenson donates his time. The Research Station provides space and equipment without charge.

Community-Based Appropriate Technology and Development Services (CBATDS), Bangkok, Thailand, Mr. Mechai Viravaidya, Director and Thailand Institute of Scientific and Technological Research (TISTR), Thailand, "Cultivation and Use of Winged Bean Among Kampuchean Refugees and Thai Farmers." Two-year project: first year, $8,300.

The purposes of the project are twofold: to promote cultivation and use of winged bean as a source of nutritious food for Kampuchean refugees and for Thai farmers who would market it, and to achieve a large, regular supply of ripe seed required for processing by using an existing farmer network to promote cultivation of winged beans on small holdings, thus helping introduce winged bean into the Thai farming system. Distribution of seeds, extension information and collection and marketing of farmer harvests to be carried out by CBATDS through its farm network. Seeds and technical information to be provided by TISTR. Project designed to affect nutrition and income while laying basis for introducing larger and more regular cultivation and sale of winged bean by Thai small holders.

The CBATDS will provide the services of its organization and staff, technical and managerial, office and warehouse space and facilities, etc., and vehicles. TISTR provides services of its professional and clerical staff, laboratory facilities, and ripe winged bean seed. The value of the CBATDS and TISTR contributions, not including the services of the two

senior persons associated with the project (Mr. Viravaidya and Dr. Chomchalow) is estimated at $8,000 and $15,000 respectively.

Winged Bean Committee of Sri Lanka, Professor H.P.M. Gunasena, University of Peradeniya: "Germ Plasm Evaluation and Agronomic Studies on Winged Bean." (1 year project: $4,256)

The objectives of the project are to collect, introduce and evaluate all local germplasm; to determine those accessions most adaptable to the different regions of the country for green pod, grain, and tuber production; to incorporate the desirable characteristics for the crop of those genotypes selected as suitable and incorporate them in a crop improvement program to be undertaken by the International Winged Bean Institute; and to develop optimum agronomic practices for the varieties selected. The work is to be carried on by Dr. Gunasena in cooperation with Dr. Y.D.A. Senanayake and Dr. Walter Herath of Sri Lanka.

The University of Peradeniya will pay salaries and allowances of the senior University personnel and clerical staff associated with the project, basic equipment, office, laboratory and greenhouse space, vehicles as required, and land.

University Kebangsaan Malaysia (The National University of Malaysia), Dr. B. S. Jalani: "Breeding and Genetic Studies of the Winged Bean." (30 months project: $15,000; 1st year: $8,000)

The purpose of the study is to develop an efficient breeding strategy based on resource availabilities through comparison of alternative selection procedures (modified bulk, visual pedigree and an average index selection). Special emphasis is to be given to problems affecting selection in grain legumes and to identification of stable high yielding lines

suitable for release to local farmers. The program will also include studies of the genetics of agronomic characters. Work will be carried on in cooperation with the Winged Bean Growth Center of the Universiti Pertainian Malaysia. Dr. B. S. Jalani, Deputy Dean of the Faculty of Science, Associate Professor in Genetics and his associates will be principally responsible.

The cost of the project over the 30-month period is estimated at $150,000. This includes part of the time of 4 senior professional staff full-time of technicians and field workers ($100,000); equipment ($14,000); expendable agricultural supplies ($16,500); in-country travel and subsistance ($3,000); cost of multilocation trials ($4,000); clerical and computer expense, cost of land preparation, etc. ($12,500). Of this, the University will pay 90 per cent, or $135,000.

The International Documentation Center for the Winged Bean, AIBA[1], SEARCA[2], Mrs. J. S. Sison, Project Manager: "Operation of The International Documentation Center for the Winged Bean." (1 Year Project: $13,000)

Partial support for the operation of the International Documentation Center for the Winged Bean, jointly sponsored by SEARCA and the Council; for the publication and distribution of 1,500 copies of two issues of the Council's semi-annual newsletter, The Winged Bean Flyer; and 300 copies of one issue of the Winged Bean Annotated Bibliography, to be distributed world-wide by subscription. Dr. R. A. Stephenson of Australia serves as Editor of The Winged Bean Flyer.

[1]Agricultural Information Bank for Asia

[2]Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines.

Sri Lanka Winged Bean Development Committee, Sri Lanka, Dr. Walter Herath: "Preparation of Charter for Proposed Winged Bean Institute". (23rd September to 15th October 1981: $2,790.20)

Grant providing round trip airfare, meals, lodging, internal transportation and incidental expenses for Dr. Walter Herath from the University of Maryland (where he was a Visiting Professor) to Sri Lanka to assist in preparing the draft of the charter for the proposed International Winged Bean Institute. Dr. Herath, who is a member of the Council's Winged Bean Steering Committee, was required to meet with members of the Sri Lanka Winged Bean Development Committee, officials of the Sri Lanka Ministry of Agricultural Development and Research, and other senior government officers.

Dr. Herath received no compensation for the time he spent on this work.

The International Winged Bean (Dambala) Institute, Sri Lanka, Dr. Cyril Ponnamperuma, Chairman, Board of Directors: "Support for Costs of First Meeting of Board of Directors". (Meeting held March 16, 1982: $21,383.18)

Grant covered round trip economy airfares to Sri Lanka and incidental costs for the following five members of the Institute ten member Board of Directors: Dr. Ponnamperuma (U.S.A.); Dr. Eduardo Alvarez-Luna (Mexico); Dr. Alexander Grobman (Peru); Dr. H.M.W. Herath (U.S.A.); and Dr. Victor Rabinowitch (U.S.A.). Support also covered institute-related visits to Japan by Dr. Ponnamperuma and to Thailand by Dr. Herath, and the cost of a dinner hosted by the Board for distinguished guests in Sri Lanka. Two Board members secured other support; three required none. All room, board and internal transportation as well as an official dinner to Board, were provided by Government of Sri Lanka.

Board members received no other compensation for their participation in the meetings.

Mr. Rohan Rajapakse, University of Florida, USA: "Studies in Integrated Pest Management of Vegetable Crops." (1 year renewable project: $3,500)

Partial assistance toward graduate studies for the Ph.D. on integrated pest management of vegetable crops relevant to requirements of winged bean for Mr. Rohan Rajapakse of the Department of Agronomy, Ruhunu University of Sri Lanka. Ruhunu University, in the southern part of the island, is expected by some to become the agricultural university of Sri Lanka. Upon completion of his studies, Mr. Rajapakse will return to Sri Lanka to contribute to its emerging program for winged bean.

Mr. Rajapakse's studies will be supervised by Dr. A. A. Duncan, member of the Council's Winged Bean Steering Committee. The grant will be administered by the University of Florida at no cost.

The cost of Mr. Rajapakse's program in the first year is estimated at $8,800. Of this, the University of Florida will provide a stipend to Mr. Rajapakse in the amount of $4,800. In addition, Mr. Rajapakse will contribute $500 from his own funds.

Department of Plant Protection, Visayas State College of Agriculture (VISCA), Philippines, Dr. Manuel K. Palomar and Dr. Nelson M. Esguerra: "Studies on the Insect Pests and Diseases of Winged Bean in The Philippines: (1 year project: $10,818)

The purpose of the project will be to secure benchmark information necessary for the formulation and selection of control measures for some of the pests and diseases known to attack the winged bean in the Philippines, none of which have yet been studied. Two studies were originally to be undertaken: Collection, identification and determination of seasonal abundance of insect pests of the winged bean, and the transmission and host range of winged bean Mosaic Disease. The studies were to be conducted by Dr. Nelson M. Esguerra and Dr. Manuel K. Palomar.

In December 1982, however, Dr. Palomar informed the Council that Mosaic Disease seems to be a "negligible" problem in the Philippines. The University requested permission, therefore, to concentrate its efforts on the insect problems of winged bean in the Philippines, which seem to be the main problem and to work on another disease which proves more serious. It will identify this latter. The Council accepted this modification in the nature of the grant.

The information obtained through this research will be disseminated to farmers through the University's Crop Protection series of non-formal education training courses sponsored by the University's Department of Crop Protection. Farmers will also be kept informed through the University's Plant Pest Clinic. (Farmers consult the Crop Protection subject matter specialists regarding their pest problems, are aided through identification of the pests in question and are given recommendations for control and other necessary information.

The University will meet the cost of the clerk-typist, provide the services of professional staff, and provide laboratory space and equipment, a screenhouse, the use of a vehicle and other equipment. The total contribution of the University is estimated at $5,632.

Mr. S. Sri Kantha, University of Illinois: "Doctoral Studies in Utilization and Nutritive Value of the Winged Bean.: (1 year renewable grant: $7,000)

Partial support of the doctoral studies of Mr. S. Sri Kantha of the University of Peradeniya, Sri Lanka on problems of the utilization and nutritive value of winged bean. Mr. Sri Kantha will participate in these studies of winged bean being carried out in the Department of Food Science,

College of Agriculture, at the University of Illinois. He will work principally on the evaluation in vitro of the effects of common food processing changes on the formation of phytate-mineral complexes in winged bean and on the production of an acceptable bean cake or tofu-like product from winged bean. The Council made the grant because of the importance of investigations on the nutrient and organoleptic properties of winged bean seeds, since the mature seeds of the plant are not as widely accepted as those of other plants and because of the Council's interest in furthering advanced work on winged bean in Sri Lanka.

Mr. Sri Kantha's work will be supervised by Dr. John Erdman who has done research in Sri Lanka. The University of Illinois will administer the grant but will not charge overhead. On completion of Mr. Sri Kantha's work, he will return to Sri Lanka to take part in that country's winged bean program.

The total cost of Mr. Sri Kantha's work for one year is approximately $14,000, made up as follows:

University of Illinois Assistantship	$6,500
Tuition, fees, workers compensation, etc.	3,500
Chemicals, glassware, etc. for research	4,000
	$14,000

Of this amount, the University of Illinois is providing 50 percent, or $7,000.

Winged Bean Growth Center, Universiti Pertanian Malaysia (the Agricultural University of Malaysia), Mr. Weng Kai Choo, Director: "Support and Development of the Winged Bean Growth Center, Malaysia." (1 year grant: $15,000)

The grant was made because of the quality of work performed particularly in the year preceding and the progress being made by the Center. Among the activities to be carried out during the new grant period will be evaluation and documentation of genetic materials obtained from Sarawak and Sabah; continuation of the work on plant breeding; multiplication of seeds of potential accessions for further agronomic work and for collaborative projects; continuation of screening to determine photosensitivity; rhizobium and nutritional studies; continuation of biochemical studies including animal feeding trials; and collaboration on the 2nd International Winged Bean Variety Trials.

As in the past, the Council's grant is intended to promote increased collaboration among and with scientists in other institutions working on winged bean. It is expected that the Center will cooperate closely with The International Dambala (Winged Bean) Institute at Sri Lanka.

As in the year preceding, the counterpart contribution of the Universiti Pertanian Malaysia is estimated to amount to approximately $41,300.

Dr. T. N. Khan, Department ot Agriculture, South Perth, Western Australia: "Expenses of the Research Coordinator, Winged Bean Steering Committee," (1 year renewable grant: $440)

A grant of $600 (less $160 remaining from previous year's grant) was made to Dr. T. N. Khan, Research Coordinator of the Council's Winged Bean Steering Committee to cover clerical and other expenses in connection with carrying out his responsibilities. Dr. Khan was required (a) to complete analysis of the results of the 1st International Winged Bean Variety Trials and to make this analysis available to the Council, the Steering Committee

and the participants in the Trials, and (b) to assist the Council in its efforts to stimulate research by encouraging submissions of proposals by researchers, securing the views of the members of the Steering Committee on the proposals submitted, and forwarding such evaluations to the Committee's Coordinator for action by the Council.

The grant provided funds for technical assistance obtained by Dr. Khan in preparing the data summary and final report of the 1st International Variety Trials, and funds for typing and related production costs, as well as cost of communications.

Dr. Khan received no other compensation for the work he performed as Research Coordinator. Office space, equipment, etc. were provided by the Department of Agriculture, South Perth, Western Australia and by Dr. Khan.

Dr. R. A. Stephenson, Department of Primary Industries, Maroochy Horticultural Research Station, Australia: "Editing and Publication of The Winged Bean Flyer (1 year renewable grant: $828)

Dr. R. A. Stephenson of Australia, is Editor of The Winged Bean Flyer, the Council's semi-annual newsletter. The grant was provided to meet the costs of the Editor in producing this publication. ssues to be prepared between July 1, 1982 and June 30, 1983 were: Vol. IV No. 2, Vol. V No. 1 and preliminary work in preparation of Vol. V No. 2. Total grant was $953, less a balance from previous grant of $125, for a total of $988.

The grant provided funds for secretarial assistance, materials, and postage, telephone and cable costs. Dr. Stephenson received no other compensation for his work as Editor of The Winged Bean Flyer. Office space, equipment, etc. were made available by the Department of Primary Industries and Dr. Stephenson.

International Dambala (Winged Bean) Institute, Sri Lanka: "Meeting of the Board of Directors with Dr. Clarence Gray." (Dinner meeting; July 27 1982: $349.07)

Grant providing round trip airfare, meals, lodging, internal transportation for Dr. Clarence Gray to enable him to participate in dinner meeting with members of the Institute's Board to discuss his assuming the post of Interim Direct General of the International Dambala (Winged Bean) Institute under a two-year contract. Dr. Gray agreed to accept the post.

Sri Lanka Winged Bean Committee, Professor H. P. M. Gunasena, Dean Faculty of Agriculture, University of Peradeniya: "Germplasm Evaluation and Agronomic Studies on Winged Bean." (1 year project: $9,460)

A grant to provide continued support to the Sri Lanka Winged Bean Committee for work on winged bean. The work to be performed will include the following:

(a) Complete the collection of all local winged bean genotypes, continue to assemble foreign winged bean genotypes, and evaluate the suitability of all accessions for green pod, grain and tuber production;

(b) Purify selected outstanding accessions to attempt to identify clear varieties

(c) Multiply outstanding cultivars for distribution, as required, to cultivators and researchers in Sri Lanka and other countries;

(d) Test the adaptability of outstanding cultivars to the dry, wet and intermediate zones of Sri Lanka during different growing seasons in order to determine those best suited to year-round cultivation of winged bean;

(e) Determine agronomic practices suitable for the different cultivars in the various ecological zones of Sri Lanka in order to establish the basic agronomy required for highest yield of desired features; and

(f) Undertake a crop improvement program in order to incorporate most desired features.

Chief investigators will be Dr. Gunasena and Dr. A. Omran, Visiting Professor, Department of Agricultural Biology of the University of Peradeniya. The Committee will work in close cooperation with The International Dambala (Winged Bean) Institute.

Funds provided cover supplies, costs of 2 research assistants and laborers on experimental sites, travel, subsistence, and communications. Because of the continued shortage of seed required by researchers, experimenters and agriculturists in various parts of the world, the project calls for production and distribution, on request, of outstanding cultivars on 5 acres of University farm land. The University farm is adjacent to the land of the Institute.

The University of Peradeniya is providing the services of the professional, clerical and most of the technical staff, office, greenhouse and warehousing facilities, land, agricultural and other equipment, vehicles, etc.

International Dambala (Winged Bean) Institute, Dr. H. M. W. Herath: "Operating Expenses: First Six Months." (6 month project: October 1, 1982 -- March 31, 1983; $17,730)

The purpose of the grant is to provide interim funds for operating expenses for the first six months of the International Dambala (Winged Bean) Institute until additional funds were secured from the UNDP and the Government of Sri Lanka. The funds will cover such expenses as the salaries of the Deputy Director General (Dr. Herath), 2 Secretaries, 2 Field Assistants, 2 Office Laborers, 1 Gardener, 2 Housekeepers, and allowances for staff seconded to the Institute by the Ministry of Agriculture; maintenance costs of the office and guest house; the purchase of an electric typewriter, basic office furnishings and supplies including postage, telephone, cables; purchase of a motorcycle and maintenance; and incidental expenses.

International Dambala (Winged Bean) Institute, Dr. Cyril Ponnamperuma: "Meeting with Officials of the United Nations Development Program (UNDP) On Behalf of the International Dambala (Winged Bean) Institute." (September 27, 1982: $185)

Grant providing reimbursement for round trip airfare and internal transportation, for a meeting in New York City with officials of the UNDP to discuss terms of possible grants to the Institute under the UNDP national and global and regional programs.

International Dambala (Winged Bean) Institute, Dr. Cyril Ponnamperuma: "Meeting with Mr. Andrew Joseph, Head of the Asia Division of the United Nations Development Program (UNDP) On Behalf of the International Dambala (Winged Bean) Institute." (November 20 and 21, 1982: $276.99)

Grant providing reimbursement for personal expenses, specifically round trip by auto, lodging, breakfast, etc., for a meeting in New York City with Mr. Andrew Joseph, Assistant Administrator and Regional Director for Asia and the Pacific, UNDP, to discuss grants to the Institute.

The International Dambala (Winged Bean) Institute, Dr. Cyril Ponnamperuma, Chairman, Board of Directors: "Meeting of the Board of Directors". (November 1982: $9,739.14)

Grant to provide support for international airfare, lodging, meals and incidental expenses of certain members of the Board of Directors of the Institute enabling them to participate in the second meeting of the Board; costs of meeting rooms, luncheon and dinner; and preparation of materials for the meeting. Only five of the 10 members of the Board who attended required travel support.

The members of the Board received no other compensation for their participation in the meeting.

Dr. Benito de Lumen, Department of Nutritional Sciences, University of California: Visit to Philippines on ICDUP Business. (December 1982: $1,193)

Dr. Benito de Lumen, together with Dr. L. Castillo, Department of Animal Science, University of the Philippines, Los Banos, will be leading the Council's project on testing of winged bean for animal feed. At the request of the Council, Dr. de Lumen visited the Philippines to complete discussions with Dr. Castillo and his colleague, Dr. A. Gerpacio, on

details of the project. While in the Philippines, he also, on behalf of the Council, negotiated the donation of space for a 3-panel public informational display prepared by the Council and The International Dambala (Winged Bean) Institute for the meetings of the CHEMRAWN II International Conference in Manila and answered questions on winged bean at the display site; and presented a poster paper at the Conference on nutritional evaluation of winged bean as a component of poultry feed and food. He also conducted seminars on "Biochemical and Nutritional Studies on the Winged Bean" at the University of the Philippines, Los Banos, the Southeast Asian Fisheries Development Center at Tigbauan (on use of winged bean as fish food) and De La Salle University in Manila.

The grant covered the cost of international economy air fare and per diem. Dr. de Lumen donated his time and received no other compensation from the Council for his work in the Philippines.

The International Dambala (Winged Bean) Institute, Dr. Cyril Ponnamperuma: "Meetings and Discussions concerning the Allocation of Land, Buildings and Maintenance, Grants and Support, for The International Dambala (Winged Bean) Institute." (January, 1983: $881.84)

Grant covered the personal expenses of Dr. Ponnamperuma in Sri Lanka for his participation in discussions concerning the allocation to the Institute of land, buildings and maintenance costs by the Government of Sri Lanka; the anticipated grant of funds to the Institute by the UNDP/Sri Lanka Program; and other anticipated support. Discussions took place with the President of Sri Lanka, the Minister of and Secretary for Agriculture, the Chairman of the Land Reform Commission, the Director of Archeology, the Representative in Sri Lanka of the UNDP, and the Deputy Director General of the Institute.

Dr. Ponnamperuma was in India on other business. The Council paid for his air travel from India to Sri Lanka and return. Dr. Ponnamperuma received no other compensation from the Council for his visit to Sri Lanka.

International Dambala (Winged Bean) Institute: "Emergency Expenses for TIDWIBI Property". (February 10, 1983 -- April 9, 1983: $8,760)

Grant providing for the cost for two months of laborers and Estate staff assumed by the Institute following the gift by the Government of Sri Lanka of 483 acres of land on the Pallekale Estate in Kandy, Sri Lanka, together with buildings and improvements. Under Sri Lankan regulations, the Institute on receiving possession of the land must assume the costs for 280 laborers and 6 Estate staff members who have been working on the property.

These costs are expected to be met in the future by other support.

University of Kelaniya, Kelaniya, Sri Lanka, Dr. S. A. Gunasekera, Department of Botany: "Studies in Diseases of Winged Bean in Sri Lanka." (3 year project: $9,850; 1st year: $3,500)

The purpose of the research for which the grant was provided, is to carry out a survey of diseases of winged bean in Sri Lanka with the ultimate aim of limiting and controlling them. Diseases of winged bean can be expected to occur more frequently once there is intensive cultivation of the plant under monoculture, as may become the situation in Sri Lanka. A survey of local diseases of winged bean that might strike and spread and the determination of appropriate methods to control them are essential to planned programs of intensive cultivation.

The methodology and work plan cover:

(a) Survey of various diseases found in winged bean in Sri Lanka, severity, incidence, ecologies of areas found, and causative agents;

(b) Estimation of resistance likely to be present in winged bean cultivars now being grown and new varieties likely to be introduced;

(c) Experimental work on the potential of crop losses suffered as the result of a few important diseases; and

(d) Determination of management methods for these diseases.

Dr. Gunasekera will have the collaboration of Dr. T. V. Price of La Trobe University, Australia, who will serve as co-supervisor of the project. The project supervisors will work in close cooperation with The International Dambala (Winged Bean) Institute and share the findings with the Institute. Although the focus of work in Sri Lanka, the project may have an even wider usefulness.

The grant will cover salaries of a Kelaniya graduate student as research assistant, supplies, materials, operating expenses and internal travel.

The University of Kelaniya will meet the costs of professional services (apart from the research assistant) and clerical staff; office and laboratory space; and some of the vehicles required. Dr. Price will donate the cost of his professional services.

Mr. Chaibundit Lurlarp (Thailand), Department of Agonomy, Oklahoma State University, Stillwater: "Soil Fertility Factors Governing Improved Winged Bean N-Fixation and Production with Oxisols." (30 months: $13,000; 1st year: $5,280)

Mr. Chaibundit Lurlarp of Thailand received a partial grant for the first year of a 2 and one-half year research program at the Oklahoma State University for pursuit of work on soil fertility factors as they affect improved winged bean N-fixation and production with oxisols. The Council provided the grant because of the need for such research in the development of winged bean and because of its expectation that the research will provide information needed to help develop the vast underutilized low fertility soils of the humid tropics. There is still little information available on how soil factors may be manipulated to improve productivity and symbiotic nitrogen fixation of the winged bean.

The objective of the study will be to determine specific soil fertility and management factors that offset deficient-toxicity limitations for improved winged bean productivity with enhanced Rhizobium effectiveness for increased N-fixation and oxisol soil improvement. The proposed field plot and laboratory studies will be closely coordinated with the work carried out at The International Dambala (Winged Bean) Institute in Sri Lanka.

Mr. Lurlarp plans to return to Thailand on completion of his Ph.D. degree to continue research and to teach in the University system. His work at Oklahoma State University will be supervised by Dr. J. Q. Lynd, Professor of Soil Microbiology in the Department of Agronomy. Dr. Lynd is an active worker on winged bean and cooperates closely with the new International Institute in Sri Lanka.

The grant provides tuition costs, a living allowance, and funds for books and supplies. Oklahoma State University provides Mr. Lurlarp with a student assistantship in the Soil Microbiology Laboratory in the Agronomy

Department where his work includes field, greenhouse, controlled environment and laboratory research techniques primarily with legumes; winged bean, leucaena, stylosanthes, and Thailand long bean. The Uni ersity is not requiring payment for overhead costs. (As a matter of policy, the Council does not pay such costs.)

C. Evaluation of International Winged Bean Varietal Trials

The first international winged bean trials were begun in 1978, soon after the first International Winged Bean Symposium held in Los Banos, Philippines. The aims of the trials were to (1) test the adaptation of selected winged bean cultivars under a wide range of environmental conditions, (2) provide sources of germ plasm of this new crop which cooperators could use, (3) identify areas of the world which have a potential for winged bean production, and (4) test the response of winged bean to different environments.

The plan involved testing of 14 standard genotypes and one local control in accordance with an agreed-upon procedure to be followed at each test site. Though preliminary results by some cooperators and by the coordinator of the trials have appeared in The Winged Bean Flyer, the overall analysis has been completed and the report is ready for publication. The original data is being submitted to the International Documentation Center for the Winged Bean, sponsored jointly by the Council and SEARCA*, where it will be available upon request.

Of over 40 kits distributed, data was received from 26 trials, representing 19 countries on 4 continents and one from the South Pacific. Although the majority of locations were in the tropical latitudes, a few were subtropical and 3, at latitudes 31°- 37°, represented marginal environments (Australia, Pakistan and Jinju and Jeju Islands, Korea). Altitudes ranged from sea level to 1360 m.

*The Southeast Asian Regional Center for Graduate Study and Research in Agriculture (Philippines)

The design was a completely randomized block with four replications, each plot consisting of two rows 0.5 m apart and 5 m long. The final report reproduces, in detail, the instructions given the cooperators and summarizes the reports received from each cooperating locality.

The data shows largely seed yield; information on tuber yield is for the most part tentative. Interestingly enough, Taiwan proved to be the best site for both seed and tuber yield, followed by Ghana (Kade), Sri Lanka and Bangladesh in that order for seed, and Los Banos, Philippines and Sri Lanka, in that order, for tubers.

Of the 14 genotypes tested, five varieties were considered best, three from Southeast Asia and two from Papua New Guinea. The three Southeast Asian lines, Nakhon Sawan (a cream-colored seed from Thailand), LBNC1 and LBNC3 (from Indonesia) proved capable of very large seed and tuber yields. The yields of the latter two, however, were somewhat less stable. On the average, Nakhon Sawan appears to give highest seed yield, though this varies dramatically depending on site. All three Southeast Asian genotypes are late maturing, however, and are so sensitive to long day lengths that in some trials they failed to flower. All three grow vigorously and bear large crops of green pods. They can be recommended as seed, green pod and tuber yielding in those environments where the day is short during the growing season and where the growing season is unlimited.

The two additional outstanding varieties, UPS 121 and UPS 122 (also known as Chimbu) from Papua New Guinea proved to be of medium vigour. UPS 122 is next to Nakhon Sawan in seed yield though more consistent. Both Papua New Guinean varieties are recommended mainly as yielders of seed and possibly green pods. UPS 121 has green pods of average length; UPS 122 has long purple pods with a deep purplish-black seed. Both are adapted

more generally to a wide variety of environments and in most locations generally mature in less than six months. They are therefore more acceptable for the double cropping systems of the tropics. Tuber yields of both these varieties are low although their tubers are believed to be superior to those of the Southeast Asian lines.

The trial results show a high yield potential. Extrapolated seed yields of 2 tons per ha were not uncommon. Highest extrapolated seed yields were above 2.5 - 3 tons per ha. Such seed yields were obtained in addition to the extrapolated tuber yields of about 10 t per ha and over. This is a very high overall yield in a crop where little plant breeding as yet been undertaken. The combined yields of tuber and seeds, such as seen in Taiwan, make this pl at attractive as a full year crop.

Overall, the analysis points out the value in recognizing varieties with appropriate potentials in the location of a trial. At almost half the sites the local variety was outyielded by the exotic genotypes, indicating the valuable contribution made to the gene pool. But variability within a site is generally very great and enough high quality data is not available to permit generalizations about areas of the world particularly suited to winged bean or the effect of other physical factors. Because it was not possible, in 1978, to secure large enough quantities of seed from other sources, seeds from Papua New Guinea formed a major component of the seeds used.

The analysis revealed certain other limitations of the trial results:

1) Although a uniform trellis structure was recommended, cooperators introduced local variations. At some locations, the trellis structure failed to support massive vegetative growth, particularly in the rainy

season. (It is now well documented that type and height of the support system can greatly affect yield.)

2) The date of sowing may have greatly affected flowering and consequently yield even in tropical sites showing small seasonal variation in day length.

3) Although recommended plant density was close to the optimum required for lines from Papua New Guinea, the density may have been too great for Southeast Asian lines.

D. Second International Cooperative Winged Bean Varietal Trials

The background to the holding of the Second International Cooperative Winged Bean Varietal Trials and a description of the trials themselves were given in the previous report. In sum, at the second International Seminar on Winged Bean, held in Sri Lanka in 1981, it was agreed to proceed with a second set of trials. Reports from the first set of trials were coming in and being analyzed. These highlighted a number of problems that it was agreed would be corrected in future trials, including the need to broaden the selection of seeds so as secure sufficient genetic diversity and avoid preponderance of Papua New Guinea germ plasm which seem to be specifically adapted to tropical highland conditions. It was also agreed, for example, to encourage standardization of trellis design because of the influence of trellising on growth and yield; to include observations of soil types and nodulation; and to give more emphasis to the tuber.

A total of 24 varieties of Psophocarpus tetragonolobus and one variety of Psophocarpus scandens (which may be useful as a cover crop and for plant breeding) were nominated. The genotypes selected are as follows:

India - 2 types

Indonesia - 5 types

Malaysia - 6 types including one for control
if no local genotype available

Papua New Guinea - 3 types

Sri Lanka - 2 types

Thailand - 5 types

Vietnam - 1 type

(It was hoped to obtain genotypes from Bangladesh but these were not made available in time to be used.)

There are at present 30 participants from 25 countries who are cooperating in the varietal trials, including nine from Africa, six from Latin America, as well as participants from Asia, Czechoslavakia, and the United States. Additional requests for participation are being received and the Council is attempting to secure additional seeds to meet these requirements. Local costs for the trials are expected to be met by the individual cooperators.

A manual providing instructions for the management of this second set of international variety trials and a data book or Fieldbook have been published and circulated to all cooperators. Copies of these are included in the Appendix. Management of the trials are the responsibility of the Trial Coordinator, Mr. Wong Kai Choo, member of the Council's Winged Bean Steering Committee and Director of the Winged Bean Growth Center, Universiti Pertanian Malaysia (the Agricultural University of Malaysia).

At the conclusion of the trials, the Trial Coordinator will prepare a report for distribution. The original data, like that of the first Varietal Trials, will be stored in the International Documentation Center for the Winged Bean, and will be available on request.

E. Information and Documentation Services

The Information and Documentation Center for the Winged Bean was established approximately three years ago to provide information to winged bean researchers and policy makers and to others interested in winged bean developments. It is sponsored jointly by the Council and the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in Los Banos, the Philippines.

During the period under review the Center continued its efforts to strengthen its capacity to provide services. These included:

(a) establishing an inquiry answering service;

(b) Publishing and distributing the Council's semi-annual newsletter, The Winged Bean Flyer and Winged Bean, an Annotated Bibliography

(c) Collecting information, statistical data, articles, theses, etc.

(d) Computerizing its information services.

In addition, the Information and Documentation Center maintained liaison with other international agricultural research centers (IARC's) and the manager of the Center participated, through other support, in the "Handling of Legumes Information Meeting" held at the headquarters of The World Bank in Washington, D.C.

Requests for copies of documents are met directly. Requests for specific information are normally referred to the Institute of Plant Breeding, the University of the Philippines, Los Banos, to the Legumes Project Team Leader at SEARCA, or to researchers working on specific aspects of the plant.

As of the end of the report period, 1500 copies each of the Council's semi-annual newsletter, The Winged Bean Flyer, Vol. 3, No. 2 (August 1981) and Vol. 4, No. 1 (May 1982) have been distributed. Vol. 4, No. 2 will be distributed in May 1983.

The most recent issues of the Flyer have been distributed to scientists research workers, agriculturists, agricultural institutions and policy makers in 97 countries (25 in Asia, 18 in Africa; 30 in Latin America; 9 in Oceania; 13 in Europe; and to the United States and Canada).

The 1981 edition of the Winged Bean, An Annotated Bibliography contains 420 entries. Most of the entries have been abstracted. The bibliography has been distributed to 19 countries (9 in Asia, 2 in Africa, 2 in Oceania, 4 in Europe and to the United States and Canada). The 1983 edition of the bibliography will be published in June.

As of March 1983, the Center had collected 710 copies of papers, articles, theses and monographs on winged bean. Distribution of copies are by microfiche or photocopy. Bibliographic information is entered using the format of the International Information System for the Agricultural Sciences and Technology (AGRIS). A total of 1008 entries have now been made. The IBM/STAIRS (Storage and Information Recetrieval System) software package is used to retrieve bibliographic information.

A systems team of the Agricultural Information Bank for Asia (AIBA), maintained at Searca, is developing the research data bank on winged bean. In the initial and experimental stages, in order to develop the data bank so as to make it as useful as possible, data being collected is limited to the botanical and pathological aspects of winged bean. At present the input form consists of 8 descriptors and 41 numerical information items with a total length of 218 characters. The information is subdivided into 4 sets of data

organization that require four 80-column cards. A validation program is being developed to check the accuracy of encoded inputs.

As of October 1982, the Information and Documentation Center has been able to use the Hewlett-Packard 3000 mini-computer which had been obtained by the Agricultural Information Bank for Asia (AIBA) of SEARCA. Prior to that time, the Center had shared an IBM 370/135 computer with four other institutions. The new computer makes it possible to use the MINISIS software developed by the International Development Research Center of Canada (IDRC)

The Council's semi-annual newsletter, The Winged Bean Flyer, is distributed without charge. Although the Council had planned that, beginning with Volume 4, the Flyer be self-sufficient and made available by subscription only, it has not been possible to secure sufficient subscriptions to meet the cost. A total of 111 subscriptions have been received (at U. S. $6.00 per year plus mailing charges of $2.50 by surface, or $10.00 by air). In order to maintain this important link between researchers in the international winged bean network the Council and SEARCA have reduced expenses for the Flyer and subsidized it temporarily during the period of shortfall.

The International Dambala (Winged Bean) Institute has agreed that it will assume responsibility for operating the Information and Documentation Center for the Winged Bean, including publication of the Flyer. It expects to do so beginning approximately January 1984 and with publication of the next volume of The Winged Bean Flyer, Vol. V, No. 1.

F. Winged Bean Growth Centers

The Council provides partial support to the Malaysian Winged Bean Growth Center, of which it is a co-sponsor with the Universiti Pertanian Malaysia (the Agricultural University of Malaysia) of Serdang, Selangor.

The Center conducts basic studies and practical applications of research findings for use by farmers in Malaysia, Thailand, Indonesia, Singapore and, ultimately, it is hoped, Burma.

Collecting of Germ Plasm. During the reporting period a number of trips were made to collect winged bean seeds within Peninsular Malaysia. To add to the number of Malaysian accessions, a collection trip was made to East Malaysia (Sarawak and Sabah). Funds for this collection trip were secured from The Asia Foundation through the assistance of the Council. A total of 43 accessions were acquired, samples of which were sent to SEARCA which made them available to the Institute of Plant Breeding of the University of the Philippines, Los Banos.

The Malaysian Winged Bean Growth Center now has over 400 accessions of winged bean, both indigenous and foreign. The Center evaluates, documents, maintains and multiplies the accessions in its collection. Evaluation and documentation reveals great variability in agromorphological characteristics among materials from Papua New Guinea, Thailand and Indonesia. Based on this study and because of the great genetic variability among the accessions it was determined that selection based on total dry pod weight and number of pods would be most likely to contribute to seed yield improvement in winged bean.

In addition to participating in the first International Yield Trials, the Center conducted advanced yield trials among selected accessions, testing for yield performance. The Center now recommends at least 12 accessions which are high yielding in seed under Malaysian environmental conditions. At least four showed extrapolated seed yields of between 3-5 tons per hectare. Other accessions gave seed yields of over 2 tons per hectare.

Breeding Program. The focus of the breeding program initially is to develop varieties capable of producing high yields under Malaysian and neighboring environmental conditions. From the Center's available genetic materials seven parents differing in origin but with desirable characteristics have been selected for breeding. All possible crosses have been made among them, with preliminary results indicating the percentage of success to be around 14%. The breeding program is at present being directed by Dr. T. F. Yap who has had more than ten years experience in breeding of tropical legumes.

Studies of Photosensitivity. A number of other studies have been carried out by the Center. The germ plasm in the collection has been screened for photosensitivity. Out of a total of 73 accessions screened, 6 (4 from Thailand, 2 from India) showed insensitivity to photoperiod, flowering even under continuous exposure to light. None of the accessions collected within Peninsular Malaysia showed insensitivity to photoperiod.

Agronomic and Physiological Studies. Studies were conducted to secure additional information on management and utilization. These included studies of plant density, daylength and shading. Preliminary results of the density study indicated that a between-plants density of 50 cm with a between-row distance of 1 meter (or 20,000 plants per hectare) produced optimum seed yield. The day length-shading experiment revealed that flowering is inhibited when plants are shaded. Applying these results to proposed intercropping of winged bean with plantation crops would indicate that where such shading is likely, lower seed yield can result. In such cases, perhaps the aim in cultivation of winged bean should be production of high biomass/high protein, rather than of seed.

In collaboration with the Sime Darby Plantation Group, the largest plantation group in Malaysia, the Center is carrying out a collaborative project in growing winged bean under plantation crops. The objectives of the study are to:

- study the feasibility of winged bean as a biomass producer when grown under a plantation crop;
- determine the contribution of WB in terms of nitrogen fixation on the plantation crop;
- determine the usefulness of WB as a cover crop in the prevention of erosion;
- determine the usefulness of WB biomass as animal feed.

Rhizobium Studies. Rhizobium studies have been initiated with preliminary screening of rhizobial strains on selected winged bean accessions.

Biochemistry. With the collaboration of the Department of Biochemistry, University of Malaysia, genetic materials are being screened for protein, trypsin inhibitor, and oil level. Analysis of 15 accessions each from Papua New Guinea and Thailand show protein contents ranging from 28.8% to 42.5% while trypsin inhibitor contents vary from 3.7 to 8.1 million I.U. per 100 g of seeds. Oil contents varied from 13.6% to 21.4% of fresh seed weight. Autoclaving of the powder from ground seed for 20 minutes at 120° C destroyed the trypsin inhibitor activities almost totally. Other studies confirmed the lower unsaturation of winged bean seed oils as compared with oils of such legumes as soybean and peanut, implying that winged bean seed oil would be more stable than oils of these other legumes.

Collaborative Efforts. In addition to cooperation with the Department of Biochemistry of the University of Malaysia, mentioned above, the Center collaborates with the Malaysian Agriculture, Research and Development Institute (MARDI) in conducting a regional trial at a MARDI station in northwestern Peninsular Malaysia during the dry period, to see how this climatic pattern will affect WB production. The Center also supplies seed samples to farmers and scientists, has established a collaborative research project with the Department of Biology, University of Southampton, England, and has invited cooperation by others in the region in its breeding program.

The Center's responsibility for conducting the 2nd International Cooperative Varietal Evaluation of winged bean is mentioned above under Section D.

G. The International Dambala (Winged Bean) Institute

Mention was made in the preceding report of the decision by the participants in the 2nd International Seminar on Winged Bean, and subsequently, by the Government of Sri Lanka to establish an independent international research center in that country to be devoted to work on winged bean. On February 5, 1982, the Parliament of Sri Lanka officially chartered The International Dambala (Winged Bean) Institute. A copy of that Charter appears in the Appendix.

The Council is principally responsible for the work accomplished in establishing this new body. It encouraged the establishment of such a body during the discussions at the 2nd International Seminar on Winged Bean and, with the support of the assembled scientists, took the initiative of raising this possibility with officials in Sri Lanka, including and most importantly, H. E. the President of Sr. Lanka, Mr. J. R. Jayewardene. Once His Excellency and made the decision in favor of such an institution,

the Government of Sri Lanka requested the Council to assist in planning and organizing the new Institute. ICDUP is the only foreign organization requested to provide this assistance. The Council was largely responsible for drawing up the initial drafts of the Institute's charter and for continuing discussions with Government as the necessary legislation was being drawn up by the Legislative Draftsmen of the Ministry of Justice so as to safeguard the independence and international character of the proposed Institute. The charter incorporates the best features of the charters that govern the operations of the existing international agricultural research institutes.

Again at Government's request, the Council assisted in compiling a list of suggested candidates for membership on the first Board of Directors of the new Institute. (The first Board, as stated in the Charter, and the first Chairman and Vice-Chairman, were appointed by the President of Sri Lanka with the understanding that, once the Board had been appointed, it would be fully independent, with full responsibility for all policies and for all future appointments to the Board or removals from it.) The list of members of the Board also appears in the Appendix. Of the ten members appointed by the President, four are also members of the Board of Directors of ICDUP. The Chairman and Vice-Chairman, respectively, of the Board of the new Institute, are Dr. Cyril Ponnamperuma, Director, Laboratory of Chemical Evolution, University of Maryland and unofficial science adviser to the President of Sri Lanka and Dr. M. S. Swaminathan, Director General, IRRI.*

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*Members of the Board of ICDUP who have been named to the Board of the new Institute are: Dr. Ponnamperuma, Dr. Swaminathan, Dr. Eduardo Alvarez-Luna (Mexico), President of ICDUP; and Mr. Louis Lazaroff, Director General of ICDUP.

The Board of Directors of the new Institute have now met twice. The inaugural meeting was held in Sri Lanka on March 16, 1982, on the grounds which Government had proposed making available to the Institute; the second meeting, on November 6, 1982, in Washington, D.C. At its first meeting, the Board adopted a set of by-laws, elected a Secretary-Treasurer (Louis Lazaroff of ICDUP), adopted a statement of program policy and directions, a tentative budget for the first three years, named a Search Committee to select a Director General and appointed Board member Dr. H. M. W. Herath, Professor and Head of the Department of Agricultural Biology, University of Peradeniya, to be Deputy Director General. (Dr. Herath was subsequently granted leave by the University to assume his new post. He is a member of the Council's Winged Bean Steering Committee.) The Board also agreed to name a Facilities Planner.

In the interim it was agreed that work on winged bean now being conducted by the Regional Centers of the Sri Lanka Department of Agriculture and work carried on by the (non-governmental) Sri Lanka Winged Bean Committee would be integrated into the Institute's research program. This latter work is partly financed by ICDUP with the understanding that responsibility for it would be turned over to the Institute. The Government of Sri Lanka also volunteered to arrange to second officers of the Department of Agriculture to the Institute to assist it in establishing its research program.

On funding, it was agreed that the strategy of the Institute should be to secure financing under the Consultative Group for International Agricultural Research (CGIAR) as early as possible and that, in pursuit of this goal, the first three years of the Institute's work should be considered crucial. During this period the Institute would need to secure funds to meet its capital and recurring costs, sufficient to meet the

requirements of at least the working budget approved, and establish a name for itself as a functioning, efficient and useful international agricultural research center.

Board member Dr. David Hopper, indicated that the Government of Sri Lanka is prepared to seek a loan of up to $5 million from The World Bank for agricultural research which the Government would then make available to the Institute for capital expenditures. Plans were also made to seek support for recurring expenditures from other international agencies, national programs for financing developmental activities, and private foundations.

On February 10, 1983 the Government of Sri Lanka formally handed over to the Institute 483 acres of prime land on the Palekelle Estate, near Kandy, in the central highlands, together with the Circuit and other bungalows, other structures and improvements. (Electric, water, telephone lines and roads are on the property). The value of the land and improvements is estimated, conservatively, at $3,500,000. Government has now also authorized a contribution of Rs. 1,000,000 for the Institute out of its 1983 budget.

Discussions are under way with the UNDP for a contribution of approximately $120,000 out of national program funds and up to $250,000 out of regional programs in support of the first year's work of the Institute. Discussions have now been held with representatives of the ICIPE Foundation, established to assist in the formation of the International Center for Insect Physiology and Ecology, regarding the Foundation's interest in providing scientific and financial support to the Institute. (The Foundation was established by a consortium of national academies of science in a number of European countries, the United States, Israel and Japan.)

Following successful initial discussions between representatives of the Institute and the Foundation, a seminar, sponsored jointly by the two groups, was held to familiarize Foundation representatives with the winged bean and the role of the Institute. The General Assembly of the Foundation will now meet in Helsinki in September to consider a recommendation by several of its member academies that the Foundation broaden both its scope and its title to permit cooperation with the Institute. If the ICIPE Foundation changes its role as proposed, the Institute will be closely linked in its efforts to secure scientific cooperation and financial support with national academies of science in a number of European countries and elsewhere.

Discussions have also been held with a number of other governments and private foundations. The prospects for financial support appear to be very good.

Pending the selection of a Director General, an Interim Director General has been appointed and was expected to assume office in June 1983. Unfortunately, at the end of the period under review, the person selected informed the Board that, for family reasons, he was forced to withdraw. The search for an Interim Director General has been renewed.

The Institute is now functioning. The Deputy Director General has moved his office into the former Circuit bungalow, an historic and handsome structure which will be preserved, and hired staff to assist him. Until new buildings have been constructed, the former Circuit bungalow will serve as the Administration Building for the Institute.

Scientific talent has been identified and scientific staff is being assembled. Scientists from the Faculty of Agriculture and the Postgraduate Institute of Agriculture (located on the opposite side of Kandy from the

Institute) are cooperating in assembling, testing, evaluating and distributing winged bean germ plasm and in conducting physiological, agronomic and plant protection studies. Faculty and students in the University's Department of Biochemistry are carrying out studies in cooperation with the Institute on composition of winged bean parts, and on the preparation, evaluation and testing of products made from winged bean. The University of Peradeniya Farm, which is adjacent to the Institute, is, on the Institute's behalf, multiplying selected varieties of winged bean, since seed is in scarce supply, for distribution to researchers in the region and beyond.

The Institute had advertised in the Sri Lanka press for candidates for the post of Farm Manager. Over 90 applications have been received and interviews have now been scheduled. Approximately 300 laborers and 6 staff are now employed on other Institute duties.

The Institute has negotiated a cooperative program with the Postgraduate Institute of Agriculture at Peradeniya under which two-year fellowships for the M. Phil. in Agriculture will be awarded outstanding young scientists for research on various aspects of production and utilization of winged bean, with use being made of the facilities at the Institute. The physiological and agronomic research carried on by Dr. Herath at the University of Peradeniya has now been taken over by the Institute and is being carried on under his auspices.

The Institute is also cooperating with universities and research institutions outside Sri Lanka in encouraging winged bean work. Negotiations are underway for cooperative work between the Institute and the University of Southampton, England for studies on tissue culture of winged bean in the hope of improving selected features of the plant and producing a self-standing determinate variety. Through the Ministry of Agriculture

and Rural Development of the Government of India, institutions in that country participating in the new All-India Coordinated Project for the improvement of underutilized crops, which includes winged bean, and the Tamil Agricultural University in Coimbatore which is doing special work on the plant, have offered their full cooperation to the Institute in testing winged bean varieties, technology and germ plasm under Indian conditions.

The Department of Agronomy of Oklahoma State University, Stillwater is cooperating with the Institute on the study of soil fertility factors governing improved N-fixation and production with oxisols and will be working with soils from Institute land and preferred accessions in the Institute's possession.

A joint memorandum governing long-term cooperation on research and training has been prepared by representatives of the Institute and the University of Maryland, and is to be presented to the Board of the Institute for consideration. Informal cooperation with that University on eleven research studies covering various aspects of winged bean in such areas as varietal evaluation, agronomy, physiology, plant protection and biochemistry are presently underway. A twelfth and more ambitious cooperative project between the Institute and the University of Maryland covering agronomic studies on winged bean in the greenhouse and in the field has just been funded under the AID Title XII program.

The Board of the Institute encourages a close working relationship with the Council. The Board of the Institute has decided that, during the early years of the Institute's development, while staff will concentrate

their energies on establishing the winged bean scientific research base in Sri Lanka, the Council will, on the Institute's behalf, continue to strengthen and encourage the growth of the network of associated scientists working in other countries. The Institute will provide funds to the Council for this purpose. The Council has thus been requested by the Institute to cooperate with it in undertaking the strengthening of associated research centers in other parts of Asia, in the developing countries of Africa, Latin America and Oceania, and in the developed countries. It is proposed that all such local activities, including national or regional winged bean research bodies that may be established would, like the Winged Bean Growth Center, Malaysia, carry on activities closely related to the emergence of winged bean as a useful component of national agricultural systems. Though such bodies are expected to be independent of the Institute in Sri Lanka, it is hoped that they will establish close links with it (and through it to work in other areas) for scientific support and information, for advisory services, training, germ plasm, new techniques, collaborative activities, etc.

The Council has been working closely with the Institute since its formal establishment in providing it with selected minimal start-up support pending receipt by the Institute of the much larger support expected from major donors.

H. Other Activities

The Council seeks to exert a catalytic effect in getting people at national levels to work on winged bean. It has made a particular effort to encourage work on winged bean by interested researchers in Africa and Latin America, has seen to it that they receive The Winged Bean Flyer, and has provided them with seeds, information and other materials. It has also provided information and materials on request to national agencies, commercial

firms and local public and private agencies proposing to experiment with winged bean for use by low-income farmers. As mentioned in the previous report, it encouraged participation by researchers from both continents at the 2nd International Symposium on Winged Bean, held in Sri Lanka in 1981 and, during breaks in the sessions, brought the groups together, separately, to explore their interest in informal cooperation with one another.

The Council now corresponds with over 45 research workers and others in 24 countries in Africa and over 50 researchers and others in 23 countries in Latin America. In response to the interest shown, it is now making plans for a winged bean workshop on each continent.

Proposed Workshop in Africa and Latin America. Following discussions and correspondence with researchers in Africa and Latin America, as well as with interested national and international agencies in Europe, plans are being made for holding a workshop on winged bean on each continent. Tentative plans call, initially, for holding the workshop in Africa on practical problems of agronomy and cropping systems of winged bean, emphasizing African needs and potentials. The workshop would be sponsored jointly by the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria and the Council. An interim African steering committee, on which the Council will be represented by the African member of its (International) Winged Bean Steering Committee, and the Director General is now being selected to assume responsibility for the arrangements, selection of participants, agenda, etc. In response to suggestions made, the program will include a "planning session" to consider possible future activities. It is hoped that it will be possible to identify areas of winged bean work of particular interest to the African countries represnted, to secure

informal agreement on general areas of research importance on the continent, and to decide on methods of keeping more closely informed of one another's work, of research and practical experiments in other parts of the world, and of methods of cooperating on research. If the African scientists express interest in establishing a modest winged bean center attached, for example, to a particular African institution to serve as the focal point for information, seed procurement, research of local relevance, and for coordination, the Council will attempt to assist in the establishment of such a center. This has been suggested by some. If desired by the African group, the center, like the Winged Bean Growth Center in Malaysia, would be independent of the Institute in Sri Lanka but linked to it informally for information, seed stock, training and other support.

The approach to be followed in organizing the workshop in Latin America would be similar.

In this way, the Council believes it may be possible to help stimulate and organize small regional systems on winged bean.

The Council has secured agreement in principle for support for both workshops from the Deutsche Stiftung für Internationale Entwicklung (DSE) and Misereor, both of West Germany, and from the FAO.

Pilot Program, Latin America. The Council has secured a grant amounting to $25,930 from the BankAmerica Foundation for the first and fourth phases of a four-phase pilot program in Latin America to encourage the growing of winged bean among small holders of low income. It is designed, within 5 years, to provide additional income and employment to small holders in Latin America by launching winged bean as a marketable crop for local processing into edible oil with the residue to be used as a constituent of feed for chickens and swine. Selected winged bean varieties will be

tested in an appropriate area in Ecuador, Panama or Mexico and those deemed outstanding will be multiplied and distributed to 1,000 low income farmers in the area. The crop would be grown under contract farming for the ripe seed, with harvests sold to local oil and feed mill processors.

Concurrently a definitive two-year study of the nutritional effectiveness of the defatted ripe seed meal as a constituent of feed for poultry, swine and cattle will be undertaken by the Department of Animal Science, University of the Philippines, Los Banos, and the Department of Nutritional Sciences, University of California, Berkeley. The Philippine study will be conducted with the cooperation of the feed milling industry in that country.

The overall project is in four phases, estimated to cover a 5-year period:

Phase I. A two-week feasibility study of an appropriate area in Ecuador, Panama or Mexico

Phase II A 3-year preparatory program among 30 farmers in the area designated.

Phase III. A two-year contract farming project covering c. 1,000 farmers in the area.

Phase IV. A 2-year study of the nutritional effectiveness of the oil seed residue as a component of animal feed (to be carried on concurrently with Phase II.)

Based on the data secured as the result of the feasibility study, the first three years would be used to select the winged bean varieties most suitable for the area chosen, determine the means of fitting winged bean into the farming system, perfect the agronomy appropriate to the local

ecology and farming customs, prepare extension information in the local language covering both pre- and post-harvest practices, process sample seeds to secure the oil, test the nutritional effectiveness of the residue as animal feed, cost both processes, and establish the contract farming and marketing system.

Thirty farmers in Phase II will be selected to test 30 outstanding, pure varieties of winged bean. During Phase II these 30 varieties will be narrowed down progressively to the 8 varieties that have demonstrated outstanding performance. These latter will then be multiplied to provide seed stock for the 1,000 farmers participating in the contract farming system. Each farmer participating in the testing and agronomic experiments will be expected in turn to familiarize approximately 30 neighboring farmers with the plant by encouraging observation and discussion (and distribution of seed samples), so that, by the end of this phase, approximately 1,000 farmers in the area will have become familiar with and interested in growing the plant. During this preparatory phase, farmers and their households will also be encouraged to include immature pods and young leaves in the preparation of their traditional foods.

The BankAmerica Foundation will finance Phase I, the feasibility study, and Phase IV, the testing for animal feed. Depending on the findings of the feasibility study the Foundation and other departments of the Bank itself are prepared to consider financing the remaining p tions.

Pure varieties of winged bean appropriate to the ecology of the Latin American area selected, will be obtained through Council colleagues in the Department of Botany, University of Southampton, England, who are members of the Council's international network of scientists cooperating in work on winged bean.

Three members of the Council's Board of Directors, including Nobel Laureate Dr. Norman E. Borlaug and Dr. Eduardo Alvarez Luna participated in the discussions with officials of the Bank of America and the BankAmerica Foundation on the proposed project. (A copy of the proposal presented to the BankAmerica Foundation, including a listing of the data to be obtained in the feasibility study, is included in the Appendix.)

The project is to be replicated in Peru, with Peruvian Government support, sponsored by another member of the Council's winged bean network.

Team Research. In order to stimulate cooperation, intensify research and encourage greater application by scientists participating in the international winged bean research network, the Council is encouraging an informal "team" approach, under its auspices, to certain aspects of the work. It has established two such informal teams, one in Food Science, Nutrition and Biochemistry, the other in Nitrogen Fixation. The first team is headed by Dr. Benito de Lumen, formerly of the Philippines, now in the Department of Food Science, University of California, Berkeley; the second by Dr. William J. Broughton, formerly of Australia and Malaysia, now at the Max-Planck-Institut für Züchtungsforschung in Cologne, West Germany.

At least 55 researchers in 12 countries (in Asia, Africa, Latin America, Europe and North America) are now working on winged bean in the field of Food Science, Nutrition and Biochemistry. At least 17 researchers in 11 countries (in Asia, Latin America and North America) are working on nitrogen fixation of winged bean.

The "team" or "team research" approach is intended to be informal. Under it, all researchers working on a particular aspect of winged bean are encouraged to share findings, consult on those areas requiring the most urgent study and application, and propose research and applied projects for Council and other support. It is hoped this will encourage more opportunity

for young people, promote collaboration on research, and minimize duplication. One person would be in nominal charge and responsible for getting and keeping things moving, for communicating with the other participants on the "team", and for keeping in touch with the Council. The Council would meet the costs of correspondence, etc.

It is proposed to organize additional "teams" in such areas as Tissue Culture and Plant Breeding, Agronomy, Plant Protection, etc. Discussions are under way on selection of a person to head the Tissue Culture and Plant Breeding team.

Cooperation Among U.S. Researchers. Research workers in at least 17 universities in the United States are engaged in research on winged bean. These include researchers at:

Alabama A & M

Brigham Young University

University of California, Berkeley and Davis

Cornell University

University of Florida

University of Guam

Harvard University

University of Hawaii

University of Houston

University of Illinois

Louisiana State University

Agricultural and Mechanical College

Research Extension Station

University of Maryland

University of Missouri

Oklahoma State University, Stillwater

Texas A & M

Utah State University

Virginia Polytechnic Institute

The number is still growing. There is interest also in some field offices of the U.S. Department of Agriculture as well as in the USDA's Mayaguez Institute of Tropical Agriculture in Puerto Rico.

In the light of this expanding interest, the Council has explored with some of these researchers their interest in establishing an informal U.S. group to share information, perhaps encourage combined effort on winged bean research and application among them and, hopefully, with institutions in those developing countries where their respective universities may have a particular interest. Here, too, there may be an advantage in minimizing research duplication.

Because the response of those to whom the Council has broached such an informal grouping has been highly favorable, discussions are being held with representatives of the University of Maryland on that University's willingness to spearhead the group's formation.

Such efforts as described, in Africa, Latin America and the United States, the Council believes will help strengthen the links in its international network of winged bean researchers.

During the period the Council has also received and met requests from certain AID missions for information on winged bean. Most recently, an inquiry was received from Dr. William H. McCluskey, Director of Agriculture and Rural Development, U.S. AID Mission to Jamaica. Materials have been forwarded to Dr. McCluskey and the Council looks forward to further opportunities to be of service to him and his colleagues.

I. Present Directions

Because of its success in encouraging work on winged bean, the Board of Directors of the Council is now expanding the Council's work. The Board has decided to work in the area of medicinal plants, focussing on outstanding, promising medicinal plants that are presently neglected, concentrating, in effect, on the winged beans of the medicinal plant field. The Council's inaugural efforts in this area will be a workshop to be held in Beijing, China in 1984, to be sponsored jointly with the Government of the Peoples' Republic of China and hosted by that government. The workshop will focus on outstanding medicinal plants and their potential in China, India, Mexico and parts of Africa. A small meeting to plan this workshop will be held in China during 1983. Dr. Edward S. Ayensu, member of the Board, is assisting in coordinating this workshop.

In addition, the Council has conducted a survey among plant scientists throughout the world, seeking their suggestions on additional outstanding but neglected plants that need further work. The great many suggestions made have been narrowed down by the Board to a shorter list.[1] Based on an intensive examination of these in turn, the Board will, at its next meeting in the fall of 1983, select three to four plants additional to winged bean for its intensive support. Among the criteria being applied are that at least one of the plants selected be suitable for arid and semi-arid areas, and that energy plants be considered.

J. Administration

In June 1981, Dr. Jose D. Drilon, Jr., the first President of the Board of Directors of the Council and founding member, died after a short illness. In August of that year, Dr. Eduardo Alvarez Luna, Board member from Mexico, was unanimously elected President of the Council to succeed

[1] See Appendix.

Dr. Drilon. During this period also, Dr. Edward S. Ayensu was named Vice-President of the Board for Africa.

Additional members elected to the Board are:

Dr. Cyril Ponnamperuma
Director, Laboratory of Chemical Evolution
Department of Chemistry
University of Maryland

Unofficial Science Advisor to the President of Sri Lanka

Dr. Joseph C. Madamba
Director
Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA)
Philippines

Former Director General, Philippine Council for Agricultural Resources and Research (PCARR).

The By-Laws of the Council have been amended to increase membership of the Board from eight to twelve. The Board will be inviting a distinguished Japanese scientist to be a member.

K. An Overview

Work on winged bean continues to increase. The number of winged bean accessions has grown substantially. It is now estimated that the global winged bean collection may stabilize at around 3000 distinct varieties. But important gaps in the collections remain and doubts have arisen as to the range and thoroughness of the collection techniques employed.

There are continuing differences of opinion regarding the importance of insects and birds in pollination versus the self-pollination attributes of the plant. This has tended to affect the isolation of pure varieties. One colleague in the Council's network, Dr. Nazmul Haq of the Department of Biology, University of Southampton, England has, through careful protective bagging and successive multiplication isolated at least 200 pure lines. Some of these are now being multiplied in Sri Lanka. One

particularly significant variety that has been isolated by Dr. Haq is a white-seeded, high yielding plant from Thailand. The white seed is particularly useful for processing because it contains less tannin and in this variety in particular, in contrast to other cultivars, has a comparatively easily removed hull.

The NifTal or nitrogen fixation program of the University of Hawaii now has a winged bean rhizobial culture collection of 175 strains and/or isolates. The Council encouraged the NifTal Project of the University to work on winged bean and took the initiative of securing their involvement in the winged bean project with the University of Guam supported by the U.S. Department of Agriculture. (The Council had encouraged the University of Guam to apply for funds for winged bean research under the USDA's fund for support of work in tropical agriculture, the USDA's first grant under this fund to the University. It explored its possibility with USDA representatives in the continental U.S. and assisted the University in designing and drafting the project.)

NifTal project personnel will go to Guam in the autumn of 1983 to carry out field trials following the design described in the International Network of Legume Inoculation Trials. Isolates have also been made from Northern Marianas Islands nodules. Winged beans have been planted and inoculated with Northern Marianas Islands soil samples.

NifTal is also experimenting with the use of "natural" trellises, using killed trunks of Leucaena leucocephala, which grows profusely on Guam.

More is becoming known of differences between winged bean genotypes, on variation in agronomic characters, such as days to germination; leaf, pod and seed type; flowering, production of pods, ripe seeds and tubers; on photoperiodicity, responsiveness to temperature, moisture, light and different soils; on yields of immature pods, ripe seeds, tubers; on nitrogen fixing

capacity; on uses as a cover crop, etc. Experience with winged bean as a forage crop and knowledge of tuberization are still limited. We know only certain varieties produce the tuber but are dependent on such factors as planting densities, soils, temperature, growing season and cultivation techniques. Yet little is known of the varieties and techniques employed in Burma which, with Papua New Guinea is one of the few centers of tuber cultivation and use. In discussions with principals involved in the development of the new All-India Coordinated Project for the improvement of underutilized crops, which includes winged bean, the Council has explored the possibility of India's mounting a winged bean collecting expedition in the Indian regions bordering Burma. Winged bean is grown in these regions, apparently using the same techniques as in Burma. But both regions, in India and Burma, are politically sensitive and missions to collect seed and observe cultivation techniques are not readily mounted.

Insufficient work has been done on methods of incorporating the winged bean into existing cropping systems, particularly among small holders, on methods of intercropping and on effects of intercropping and alternate cropping on other plants.

Much remains to be done in plant breeding, in reaching agreement on breeding objectives, in selecting pure lines, in hybridization, etc. Work is being done in only a few places, at Southampton under Dr. Haq, mentioned above, in Sri Lanka under Dr.H. P. M. Gunasena of the University of Peradeniya, with the work now to be coordinated with the programs of The International Dambala (Winged Bean) Institute, and in Malaysia, at the Winged Bean Growth Center under Mr. Wong Kai Choo and at the National University under Dr. B.S.Jalani.

The search continues for a self-standing, dwarf type plant, preferably determinate and day neutral. No self-standing variety of Psophocarpus tetragonolobus has been found though it may well exist in nature. A dwarf

type does exist in P. scandens but thus far it has not proved possible to cross the two species. Tissue culture work designed to produce the dwarf variety was begun by a private U. S. firm but has been temporarily terminated for lack of funds. Some of the most serious work in this direction, using both conventional plant breeding techniques as well as tissue culture is being done by Dr. Haq in England. A member of the Council's Board, Prof. J. P. M. Brenan, formerly head of the Royal Botanic Gardens, Kew, England, visited Dr. Haq on the Board's behalf to see the work underway. The Council expects to provide some support for Dr. Haq's work.

At the same time, Dr. G. Shivashankar, Professor of Agricultural Botany in the Agricultural College, The University of Agricultural Sciences, Bangalore, India, another participant in the Council's network, has reported success in achieving winged bean mutants of a bush type. The dwarf mutants set pods and are fertile. He has now grown at least third generation material and believes he has achieved stability of the mutants. The base material, a local Trivandrum cultivar, was subjected to Gamma radiation over a wide range of k rad units (minimum 10 kr, maximum 50 kr). Most of the fertile mutants were observed in those given 12 kr Gamma radiation treatment. Many are without vines or with few vines that evidently do not provide much hindrance to field cultivation.

Each plant produced by Dr. Shivashankar produces 5 to 6 pods on an average with 5 to 6 seeds in each pod. Except for the changed plant architecture, there are few changes in pod or seed characteristics. The mutants are very early compared to normal winged bean plant types and, according to Dr. Shivashankar, are therefore very promising for the cropping patterns followed in South India. Dr. Shivashankar plans to work on skeletal materials and develop promising agronomic types.

The University of Agricultural Sciences in Bangalore has been given responsibility under the All-India Coordinated Project for improvement of underutilized plants, for research on winged bean and other plants. Dr. Shivashankar's work has been supported by the Bhaba Atomic Research Center and will be continued by ICDUP.

Dr. Norman E. Borlaug, Nobel Laureate and member of the ICDUP Board of Directors, visited Dr. Shivashankar and his colleagues and reported on the work in Bangalore at the December 1982 meeting of the Council's Board. Photographs of the mutant developed by Dr. Shivashankar are available on request.

Although development of a self-standing determinate variety of winged bean is likely to result in large-scale cultivation of the plant, the Council believes it is important to experiment with the possibility of securing high yields at competitive costs with the viny plant, by growing the plant under contract farming by small holders. It believes that carefully designed efforts should be made, using known varieties, appropriate to given areas, to show farmers with small holdings how to increase income by cultivating winged bean. These efforts the Council believes, however, cannot be justified unless they are based on the concurrent development of market strategies. The markets which appear most promising at present are for the ripe seed, to be used in the processing of edible oil with the residue used for animal feed, and for the production of milk.

The Council has helped pioneer such experiments in Thailand, has encouraged its use in Sri Lanka, and is proposing to launch such an experiment in Latin America, as mentioned above. A similar small scale project, in growing seed by small holders for processing into sauce (or kecap) for which there is a market in Indonesia, has started in Java.

A further Council experiment is expected to begin in Thailand by the end of the year, in cooperation with commercial firms in England and Sweden, for the production of the ripe seed to be made into milk. Recent experiments in Singapore, Thailand and Sweden, using Swedish equipment, has resulted in the production of an excellent milk, meeting the exacting standards of soy milk and considered superior in taste to the latter. The project proposed will call for production of ripe seed on a contract basis by small holders of low income, for local processing into milk and local marketing. Depending on the results of the Thailand experiment, the project may be replicated, with Council involvement, in other countries where there is a potential or existing market.

During the period under review, the National Academy of Sciences issued the second edition of its highly popular booklet, The Winged Bean, A High-Protein Crop for the Tropics (Washington, D. C. 1981). The Council assisted in preparing the manuscript for the publication. Release of the second edition resulted in excellent publicity for the winged bean and many requests to the Council for information and materials.

The FAO's Winged Bean Production in the Tropics, FAO Plant Production and Protection Paper 38 (Rome 1982) was also published during this period. The 217 page work is designed to be a comprehensive handbook for scientists, researchers, agronomists, extensionists and others interested in winged bean and includes materials intended to be helpful to those proposing to grow winged bean as a field crop. The publication of this work was a direct outgrowth of the Council's 2nd International Seminar on Winged Bean. The author of the publication is Dr. T. N. Khan of Australia, Research Coordinator of the Council's Winged Bean Steering Committee.

Fund raising for the Council proved unexpectedly difficult during the period. Apart from the consistent and dependable support by the Bank-America Foundation and some small contributions, it proved difficult for the Council to secure general support funds for its own work. For, once The International Dambala (Winged Bean) Institute had been created (less than four months after AID's grant to the Council), it became imperative to expend considerable effort to secure the large-scale financing required for it. The Director General of the Council, because of his role in the establishment of the Institute and his position on its Board, found himself in the position of appealing to the same donors for general support funds for winged bean work by both the Council and the new Institute. It became apparent that in order for the Council to make a distinctive approach for its continuing work and ambitious plans, that it would have to base its fund raising on requests for support of distinct projects. Although it is difficult to develop suitable projects without experienced, project-minded representatives stationed in or visiting the field for extended periods, the Council has been able nevertheless, with the support of members of its winged bean network, to lay the basis for just such work. The ambitious program in Latin America, funded by the BankAmerica Foundation, is one such project. The ambitious project described above, calling for large scale production of winged bean seed by small holders for processing into milk, provides another good basis for securing funds. The plans for workshops in Africa and Latin America, which themselves can generate funds, are further examples which in turn could give rise to good project possibilities on both continents. (As pointed out above, the Council has already secured expressions of interest in support for the workshops themselves from agencies in West Germany and from the FAO.) Further projects on which requests for funds can be based, are the research by Dr. Haq in England and

Dr. Shivashankar in India to improve the nature of the plant.

It should be mentioned here that at the meeting of the ICDUP Board of Directors in June 1982, it was pointed out that while the Institute in Sri Lanka is expected to become the center for work on winged bean, it planned to be linked informally with national and other institutions working on the winged bean in other parts of the world. It was indicated that although the Council stands, in a sense, in a parental relationship to the Institute, the relationship between the Council and the Institute is evolving and both must be flexible in their policies. Ultimately, all responsibility for winged bean affairs, including publication of the Council's newsletter, The Winged Bean Flyer, maintenance of the Council's information and documentation center, support for the Winged Bean Growth Center at the University of Malaysia and similar centers likely to be established in other parts of the world, should be taken over by the Institute.

It was felt, however, that until the Institute is in a position to cooperate with and support the world-wide network of scientists and research institutions working on winged bean, which had been established by the Council, the Council should be expected to maintain and extend that network, particularly in regions in which the winged bean had been relatively unknown to farmers, as in Africa and Latin America. It was therefore decided by the Board of the Council that the relationship with the Institute be brought up at the next meeting of the Institute's Board of Directors and that this relationship be based on the following principle:

> "Because of the need to maintain, strengthen and extend the winged bean network of cooperation and collaboration, and the need to assist in the development of national and

regional programs, the Council continue to conduct this work until the Institute is in a position to assune this responsibility and that the Council be provided with funds for this purpose out of the Institute's budget."

The Council's proposal was presented to the Board of the Institute at the latter's meeting in November 1982 and accepted unanimously.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
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APPENDIX

I. Guidelines for Consideration of Winged Bean Research Proposals

II. Members of the Council's Winged Bean Steering Committee

III. Manual and Data Book For Second International Winged Bean Variety Trials

IV. Charter of The International Dambala (Winged Bean) Institute

V. Additional Underutilized Plants to be Considered by ICDUP Board

VI. Project Proposal Submitted to and Accepted by the BankAmerica Foundation

VII. Sample Project Reports Received:

Winged Bean Growth Center, Malaysia, Report to February 28, 1982

Sri Lanka Winged Bean Committee (University of Peradeniya), Report to July 1982

International Documentation Center for Winged Bean, Report to February 28, 1982

VIII. The Winged Bean Flyer, Vol. 3, No. 2, Vol. IV, No. 1

IX. Financial Statement, December 1978 - December 31, 1981

X. Financial Statement, Year Ended December 31, 1982

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 b an research being undertaken with other resources.

9. References

10. Signature of the Head of Institution

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

WINGED BEAN STEERING COMMITTEE

	Telephone Number	Cable Address	Telex
Dr. Eduardo Alvarez-Luna Apartado Postal 20-577 Mexico 20, D.F.	(905) 593-6067		
Dr. Narong Chomchalow Deputy Governor Research 1 Thailand Institute of Scientific and Technological Research 196 Phanonyothin Road Bang Khen Bangkok, Thailand	5791121-30 5792614 Pvt. Line: 5793507	TISTR (Bangkok, Thailand)	
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WINGED BEAN STEERING COMMITTEE

(Continued)

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WINGED BEAN STEERING COMMITTEE

(Continued)

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Project Manager, International Documentation Center for the Winged Bean: Mrs. J. C. Sison
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SEARCA
College, Laguna 3720, Philippines

*As of July 1, 1982. Until then, can be reached c/o The Rockefeller Foundation, 1133 Avenue of the Americas, New York, NY 10036, USA.

SECOND INTERNATIONAL WINGED BEAN TRIAL

WORKING MANUAL

INTERNATIONAL COUNCIL FOR DEVELOPMENT
O F
UNDERUTILIZED PLANTS

Instructions for the Management of the

SECOND COOPERATIVE WINGED BEAN

[*Psophocarpus tetragonolobus* (L.) DC.]

VARIETY EVALUATION EXPERIMENTS

The Second Series of Cooperative Winged Bean Variety Evaluation Experiments are designed to (1) test the adaptation of selected winged bean varieties under a wide range of environmental conditions; (2) provide sources of germplasm of a new crop which the cooperator may use directly; (3) identify areas which have a potential for winged bean production and (4) test the response of winged beans to different environments.

Each cooperator is requested to study the following instructions very carefully before beginning his experiments, and refer to them as necessary. The results of these experiments are only as good as the data which is returned for analysis. We ask the full cooperation of individuals working on the experiment and sincerely appreciate the effort put forth.

Please return the copy of the Fieldbook data, environmental/management records to the trial coordinator:

Mr. Wong Kai Choo,
Department of Agronomy,
Universiti Pertanian Malaysia,
Serdang, Selangor,
Malaysia.

Description of Experiment

There are 24 varieties in the experiment which are replicated 6 times in a randomised block design (Table 1) Seed is individually packaged for each plot. The variety name, replication number and plot number are printed on each packet. In the seed shipment provided to each cooperator the packets have been randomly allocated to plots and are to be planted according to plot number.

The seeds contained in each packet should be planted in 4 positions arranged squarely at 0.5 m as in Fig. 1. This constitutes one plot. More than sufficient seeds are available in each packet to allow initial planting of 3 - 4 seeds per planting point. Plot to plot distance is kept at 1 m. Any deviation from these instructions should be reported to the Trial Coordinator.

All seeds provided herewith have been pretreated with a fungicide such as Thiram or equivalent. The land required for the experiment is 13 x 28 metres.

Control

Variety Chimbu (UPS 122) has been added as international control. One local variety may be included as local control in this trial by substituting entry UPM 205. However, this should be indicated clearly on the data sheet.

TABLE 1: ENTRIES IN THE 2ND INTERNATIONAL WINGED BEAN TRIAL

No.	Entry	Origin	Remarks
1	12-02	Thailand	Seed and tuber type
2	14-03	Thailand	Seed and tuber type
3	27-02	Thailand	Seed and tuber type
4	28-01	Thailand	Seed and tuber type
5	46-03	Thailand	Seed and tuber type
6	LBN-C26C(T)	Indonesia	Seed type
7	LBN-C26V(B)	Indonesia	Seed type
8	LBN-C33P(C)	Indonesia	Seed type
9	LBN-C8HP(C)	Indonesia	Seed type
10	LBN-C8HH(C)	Indonesia	Seed type
11	UPS 62	Papua New Guinea	Seed type
12	UPS 102	Papua New Guinea	Seed type
13	UPS 122	Papua New Guinea	International control
14	GRWB 11	India	Seed type
15	GRWB 26	India	Seed type
16	SLS 40	Sri Lanka	Seed and green pod type
17	SLS 47	Sri Lanka	Seed and green pod type
18	BINH MINH	Vietnam	Seed type
19	UPM 207	Malaysia	Seed and tuber type
20	UPM 277	Malaysia	Seed type
21	UPM 281	Malaysia	Seed type
22	UPM 282	Malaysia	Seed type
23	UPM 285	Malaysia	Seed type
24	UPM 205	Malaysia	To be substituted by a local control, if available.

Site Selection

Select a well drained uniform field which has had identical crop history. If the terrace or paddy area is not large enough to facilitate the entire experiment divide the experiment into two or more parts and put replicates or sets of replicates in different areas. The experimental site should not be surrounded by crops or structures which are taller or would affect the field environment

Land Preparation

Prepare the land to achieve a fine, deep and friable seedbed. Fertiliser and other soil chemicals can be incorporated during the tillage operations. Level the seedbed prior to planting except where drainage problems are likely to be encountered in which case ridges may be constructed. This should be recorded on Data Sheet 1.

Irrigation

Adequate soil moisture is essential to the production of winged beans. When rainfall is not adequate to prevent moisture stress (wilting) during the growing season, irrigation should be used.

The amount of water used by winged beans is very difficult to predict, because of differences in (1) evaporation, (2) transpiration, and (3) soil type between locations.

The water use rate is very low during the germination and seedling stages, but adequate moisture is essential during this period and a pre-plant irrigation may be necessary in certain areas. Water use increases slowly during the rapid growth stage and reaches a peak during the early reproductive stage. From 65 to 75 percent of the crop's total water needs are used during the reproductive (flowering and pod filling) stage. During the latter stages of maturity water use decreases rapidly.

Fertiliser

If crops are known to respond to phosphorus, potassium or micro nutrients in your area, provide these at a level which will prevent nutrient deficiencies from limiting expression of winged bean yield potential at each location. If the facilities are available, a soil test should be made to determine pH (soil acidity or alkalinity), organic matter, nitrogen, phosphorus and potassium content before fertilisers are applied. N, P and K should be applied at 20, 60 and 60 kg per hectare. Correct Bo,Mo and Al deficiency if necessary.

The pH level should be between 5 and 7 (preferably 6) for optimum winged bean development. In more acidic soil, liming should be done to raise pH to the appropriate level.

Please describe the quantities of plant nutrients used and the method of application on Data Sheet 1.

Field Layout

The randomisation plan is presented in Table 2.

The field layout is shown in Fig. 2. A border row of winged bean should be sown all around the experiment at a distance of 1 m. Seeds for this purpose are supplied and marked with "Border".

If the experimental site is not the correct shape to utilise the above plan, then arrange the replicate to fit the individual site. Always keep all plots within a replicate together.

Plant Support

The winged bean is an herbaceous, viny, climbing grain legume that must be properly supported with a trellis or on other plants - living or dead. Previous experimentation shows that unsupported winged beans produce only about 15 to 25 percent as much seed yields as properly supported plants. A uniform trellis structure is suggested in Fig. 1. Each plot will require 4 stakes. These stakes should be securely rammed in the ground at the four corners of the plot and the four tops should be secured together to form an elongated pyramid. The vertical distance between the joint and the ground should be 2 m. It is suggested that staking be done before sowing seeds.

TABLE 2 RANDOMISATION PLAN

REP I		REP II		REP III		REP IV		REP V		REP VI	
PLOT	ENTRY	PLOT	ENTRY	PLOT	ENTRY	PLOT	ENTRY	PLOT	ENTRY	PLOT	ENTRY
1	LBN-C8HP(C)	25	27-02	49	UPM 277	73	LBN-C8HH(C)	97	LBN-C8HH(C)	121	27-02
2	46-03	26	LBN-C26C(T)	50	LBN-C8HP(C)	74	SLS 40	98	46-03	122	UPM 282
3	UPS 62	27	LBN-C33P(C)	51	UPM 285	75	UPS 122	99	27-02	123	LBN-C33P(C)
4	UPM 207	28	UPS 102	52	LBN-C26V(B)	76	SLS 47	100	LBN-C33P(C)	124	LBN-C26V(B)
5	BINH MINH	29	SLS 47	53	UPS 102	77	UPM 282	101	LBN-C26C(T)	125	GRWB 26
6	LBN-C8HH(C)	30	UPS 122	54	UPM 282	78	UPS 102	102	LBN-C8HP(C)	126	UPM 205
7	GRWB 11	31	28-01	55	GRWB 26	79	BINH MINH	103	UPM 285	127	UPS 62
8	UPM 277	32	12-02	56	27-02	80	UPS 62	104	UPM 207	128	UPM 281
9	UPM 205	33	14-03	57	SLS 40	81	14-03	105	UPS 122	129	12-02
10	SLS 40	34	46-03	58	SLS 47	82	UPM 277	106	GRWB 26	130	SLS 47
11	UPM 281	35	LBN-C26V(B)	59	UPM 281	83	UPM 281	107	UPM 205	131	46-03
12	27-02	36	UPM 285	60	12-02	84	LBN-C26V(B)	108	GRWB 11	132	BINH MINH
13	LBN-C26C(T)	37	LBN-C8HH(C)	61	LBN-C8HH(C)	85	27-02	109	UPS 102	133	LBN-C26C(T)
14	GRWB 26	38	GRWB 26	62	LBN-C26C(T)	86	12-02	110	UPM 277	134	UPM 285
15	12-02	39	GRWB 11	63	GRWB 11	87	GRWB 26	111	SLS 40	135	14-03
16	LBN-C26V(B)	40	BINH MINH	64	46-03	88	LBN-C26C(T)	112	UPM 282	136	UPS 102
17	28-01	41	UPM 277	65	14-03	89	46-03	113	LBN-C26V(B)	137	LBN-C8HH(C)
18	UPS 102	42	UPS 62	66	UPM 207	90	UPM 285	114	14-03	138	LBN-C8HP(C)
19	UPM 285	43	SLS 40	67	UPM 205	91	28-01	115	UPM 281	139	UPM 207
20	UPM 282	44	UPM 281	68	LBN-C33P(C)	92	LBN-C33P(C)	116	BINH MINH	140	GRWB 11
21	14-03	45	UPM 205	69	UPS 122	93	UPM 207	117	UPS 62	141	28-01
22	SLS 47	46	LBN-C8HP(C)	70	28-01	94	GRWB 11	118	28-01	142	SLS 40
23	LBN-C33P(C)	47	UPM 207	71	BINH MINH	95	UPM 205	119	12-02	143	UPM 277
24	UPS 122	48	UPM 282	72	UPS 62	96	LBN-C8HP(C)	120	SLS 47	144	UPS 122

Scarification of Seed

To increase the rate and uniformity of seedling emergence, rub the seeds a few times over fine sandpaper. Alternatively, soak in tap water for 4 hours before sowing.

Planting

Plant the experiment whenever the local conditions are best suited for growth. If possible, trials should be planted as soon as possible after receipt of seed but, if not, seeds should be stored in a refrigerator until planting. A uniform stand is very important in a yield test. A hole 4.5 cm should be made at each corner and care must be taken to hand drop 3 or more seeds per hole. The excess seeds can be planted simultaneously, 2 each in peat pots to be used for gap filling later, if necessary.

Winged beans should be treated with the proper *Rhizobium* bacteria. The shipment of seed contains two packages of recommended inoculants (# 201 and # 202). Use inoculant #201 when your soil pH is 4.5 - 6.5 but with soil pH above 6.5, use inoculant # 202. Wash the seeds to remove fungicide powder prior to adding in a generous pinch of *Rhizobium* compost for each packet of seeds. Mix the seeds and compost thoroughly and plant the seeds immediately. Cover the seeds with soil immediately after planting to prevent death of the bacteria. The inoculants should be kept under refrigeration until used.

Thinning

Thinning to a single, healthy plant per position should be carried out after expansion of the first trifoliate leaf.

Weeds

Maximum yields of crops cannot be achieved until weeds are under control. Controlling only part of the weeds in a crop is usually of little value because of less competition.

The time the weeds are removed from a crop is also important. They should be removed when they are extremely small. Weeds that are allowed to grow to ten centimetres in height have already reduced yields slightly. Where weeds are removed by hand or hand tools, several weedlings per year will be needed.

Plant Management

The majority of the young plants will begin climbing within 2 - 3 weeks after emergence. However, some "training" onto the vertical supports (or drop string) may be desirable. Once the viny leaders reach the main horizontal support they may overrun it and begin encroaching on adjacent rows and plots - especially when vegetative growth is vigorous. This intermingling between plots must be prevented by training vines back onto the appropriate trellis between rows of the same plot.

Insect Pests

Since winged bean is a "new crop" for many areas, they may not be affected by insects for some years. If possible, avoid the use of insecticides. Nevertheless, constant vigilance is essential and if certain harmful insects do build up they can often be controlled with insecticides recommended for other bean crops. However, for leaf feeding caterpillars and beetles, leafhoppers, grasshoppers, sting bugs:

Use 1 pound actual malathion per acre. Spray or dust foliage thoroughly. Treat after enough to keep pest at low density. Foliage loss should not be allowed to exceed 20 percent.

OR Use 1 pound actual carbaryl (Sevin) per acre. Do not use carbaryl in excess of 1 pound per acre as marginal leaf burning can occur.

OR Use orthane at 1.5 g/litre together with Agral.

Remember:

Insecticides are poisonous to humans as well as to insects. Avoid inhalation and prolonged use, and promptly wash arms and face with soap and water or bathe completely after pest control activity is completed.

Harvesting

Winged beans ripen unevenly and sequential pickings will be necessary to prevent loss from shattering. All ripe pods from each plot should be kept in appropriately marked bags. The ripe pods should be dried in the sun for several days before threshing.

Threshing

Several days after harvesting, when all pods are uniformly dry, the seeds can be threshed from the pods by hand or with a suitable machine. The seeds should be dried to a uniform moisture content before yield measurements are recorded. Care must be taken to remove broken pods and other non-seed material before measuring grain yields.

Recording Data

Duplicated copies of the data sheet are provided. You may keep one for your own record and return the other to the Trial Coordinator. These data sheets are designed to be directly punched for computer processing. It is necessary that you justify your data to the right-most column. If decimals are used, used the same column for decimals throughout. The following data are to be recorded:-

Plot No./Entry No.

Enter here plot and entry number sequentially according to the field layout. For entry No. follow Table 1.

Date of Flowering

The date on which first flowers appear

Date of First Harvest of Ripe Pods

Date of Last Harvest of Ripe Pods

Plant Harvest

Record number of plants in each plot at the time of first harvest.

Harvest Data

After the last harvest of pods take the following records:-

Total number of pods;

Dry weight of total pods to nearest gram;

Seed yield: The seed should be dried to a uniform moisture before threshing. After threshing, the seed should be cleaned and the weight of the seed recorded in grams.

Threshing percentage: $\frac{\text{Seed yield}}{\text{Dry pod weight}}$

Hundred Seed Weight

Following grain yield measurements, randomly select 100 seeds from each plot sample and record weight in grams.

Quality of Seed

Examine the seed harvested from each plot and rate according to the following scores considering the amount and degree of wrinkling, defective seed coat (growth cracks), greenishness, and mouldy or rotten seeds. (Threshing or handling damage is not to be considered, nor is mottling or other pigment).

1 = Very good ($<$ 5%) 2 = Good (5-15%)

3 = Fair (16-25%) 4 = Poor (26-35%)

5 = Very poor ($>$ 35%)

Tuber Yield

If growing conditions remain favourable for some time following harvest, tubers may be formed (usually after more than 6 months of growth). The tubers can be found about 10 to 40 cm deep and the harvest sample area should be dug carefully with a digging fork or spade. Only tubers 2 cm or more in diameter should be collected. Weight (in grams) of fresh tubers should be recorded.

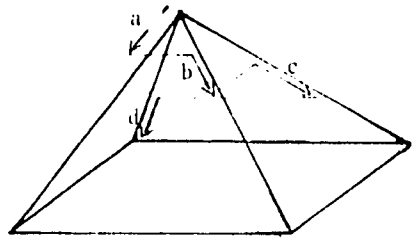
Disease and Pest Assessment

Pests

Plants should be scored for pests at the 1st harvest of ripe pods. For each plot indicate the presence (+) or absence (0) of aphids, spider mites, thrips, and green vegetable bug. For pod borer indicate the proportion of total pods affected, e.g. 2/20 etc. The incidence of any other pests should be noted in the column (other pests).

Diseases

False rust *(Synchytrium psophocarpi)* and leaf spot *(Pseudocercospore psophocarpi)* should be assessed at the mature pod stage just prior to the last harvest. Sample twenty leaves per plot starting from the top of the first plant and wind around the plot towards the bottom of the fourth plant as per diagram. Examine the lower surface of each leaf and use the disease diagram to compare the



percentage leaf area infected with each disease. Record the mean % leaf area diseased for each plot.

Root-knot nematode (*Meloidogyne* spp.) damage is to be assessed when the tubers are harvested. Use the disease key to score the amount of root-knot infection per plot.

The presence of other diseases should also be noted in the column (Other diseases).

Other Observations

Include here any other observations that differentially affect or occur on varieties and polts. These might include animal/bird predations; response to excessive soil moisture or aridity; rate of germination and growth conditions and other factors.

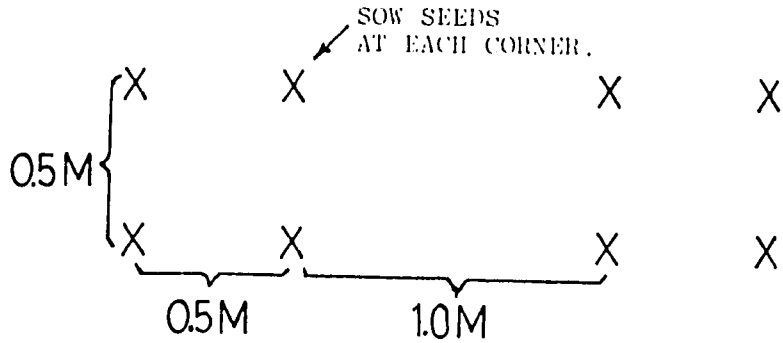
Notes should be taken for all plots in each replicate for each variable to allow complete statistical treatment of the data. Units of measurement (which should be metric - SI units) must be indicated for each variable. Additional information and comments are always welcome.

Documentation of results will include a report by the Trial Coordinator at the 3rd International Winged Bean Symposium and a scientific paper in a journal.

The detailed data will be presented in the form of a booklet which will include names of all the cooperators.

FIG. 1 :

SHAPE & SIZE OF EACH PLOT



TRELLIS STRUCTURE

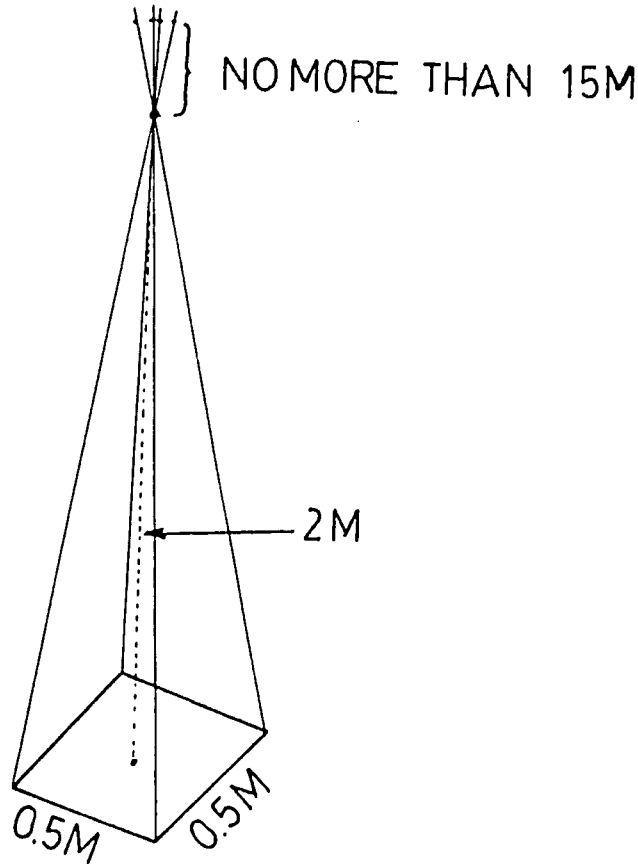
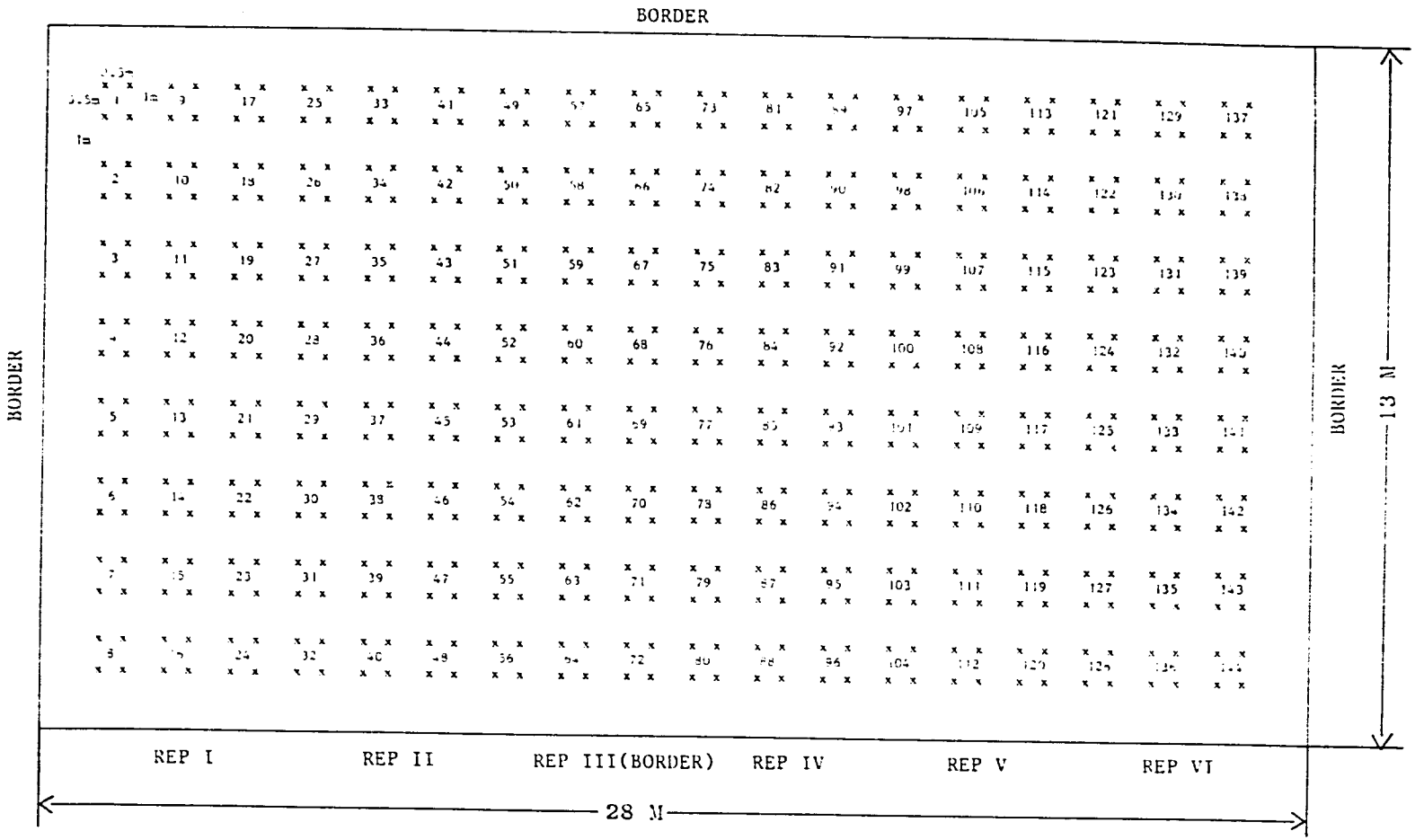


FIG. 2 : FIELD LAYOUT OF SECOND INTERNATIONAL WINGED BEAN TRIAL.



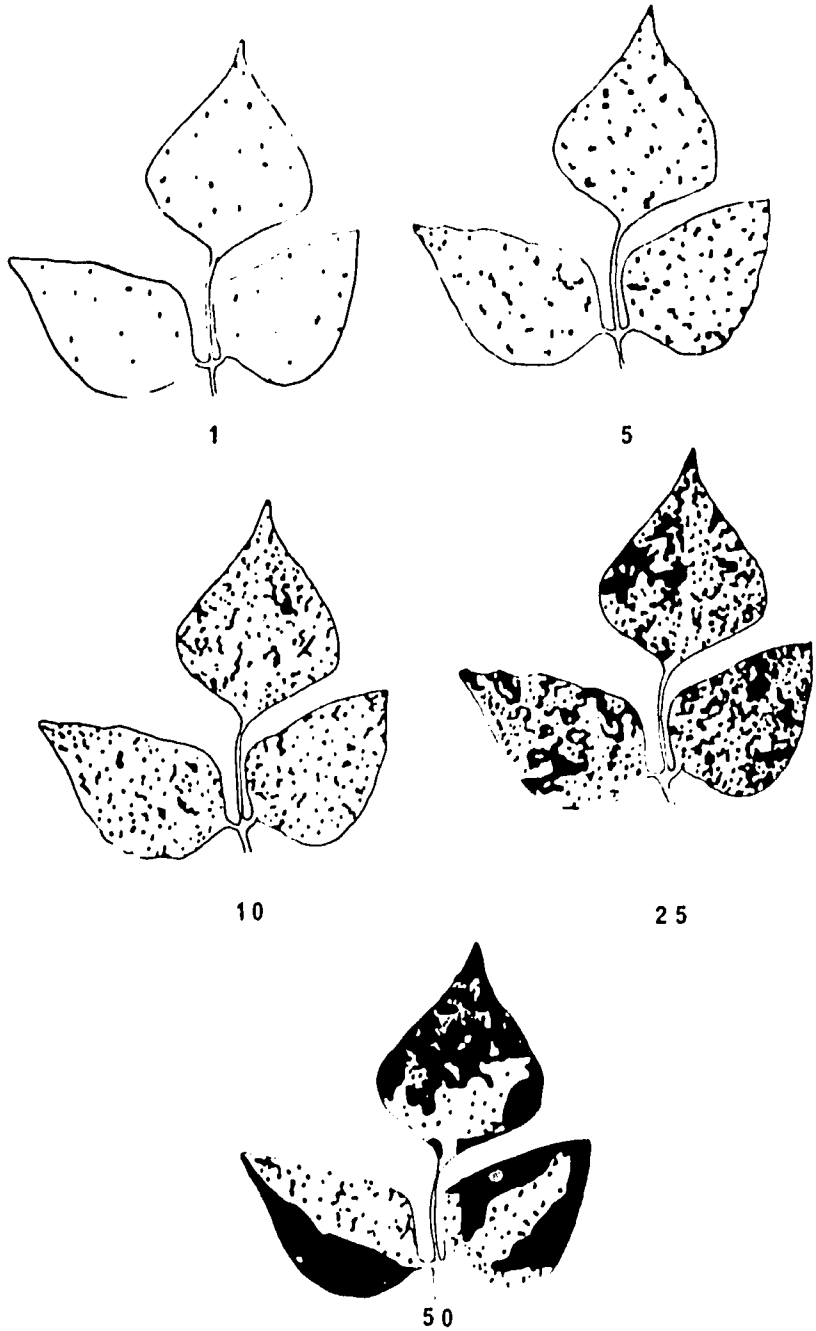


Fig. 3. Disease key for Leaf Spot (*Pseudocercospore psophocarpi*); % leaf area infected.

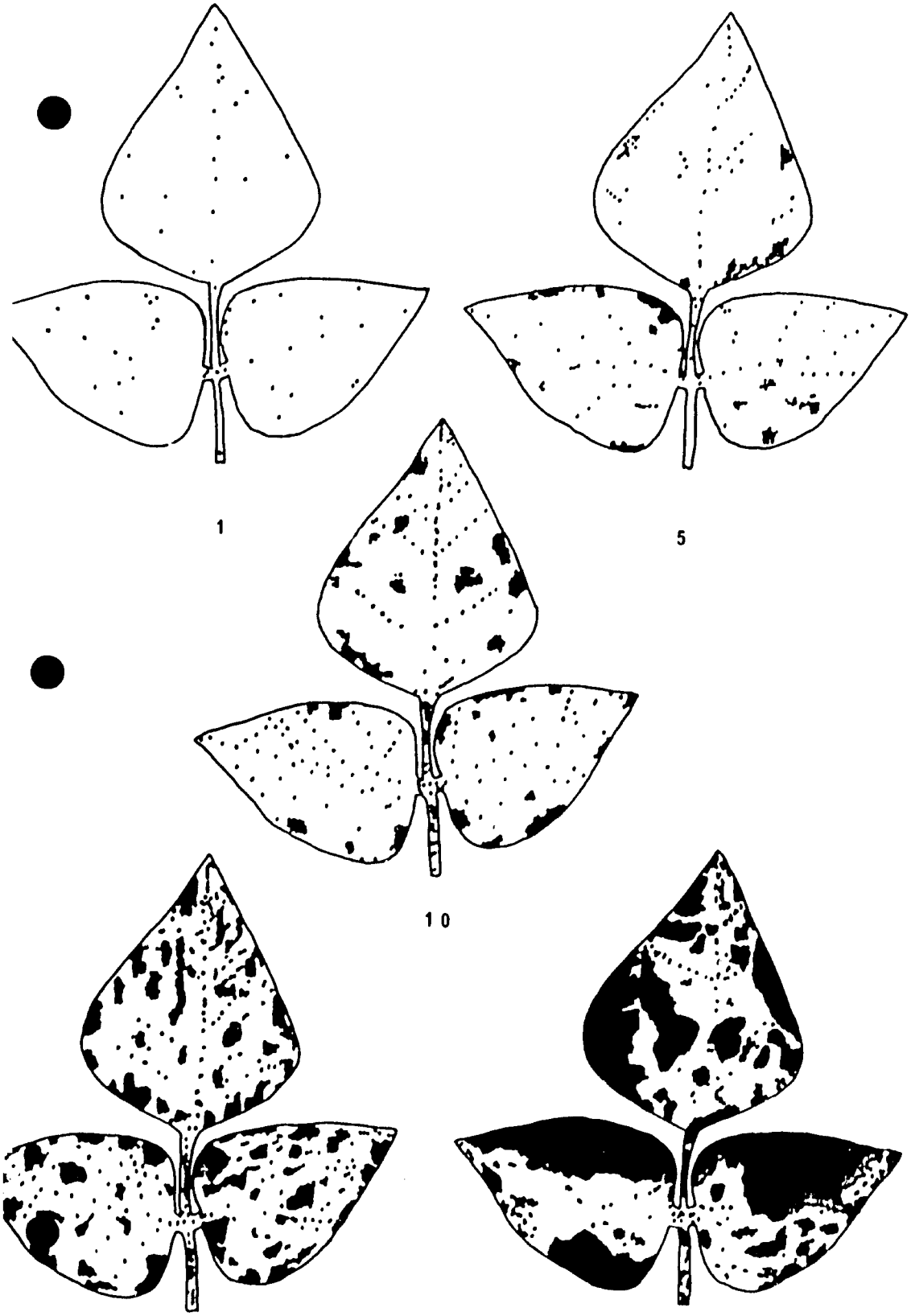


Fig. 4. Disease key for False Rust (*Synchytrium psophocarpi*); % leaf area infected.

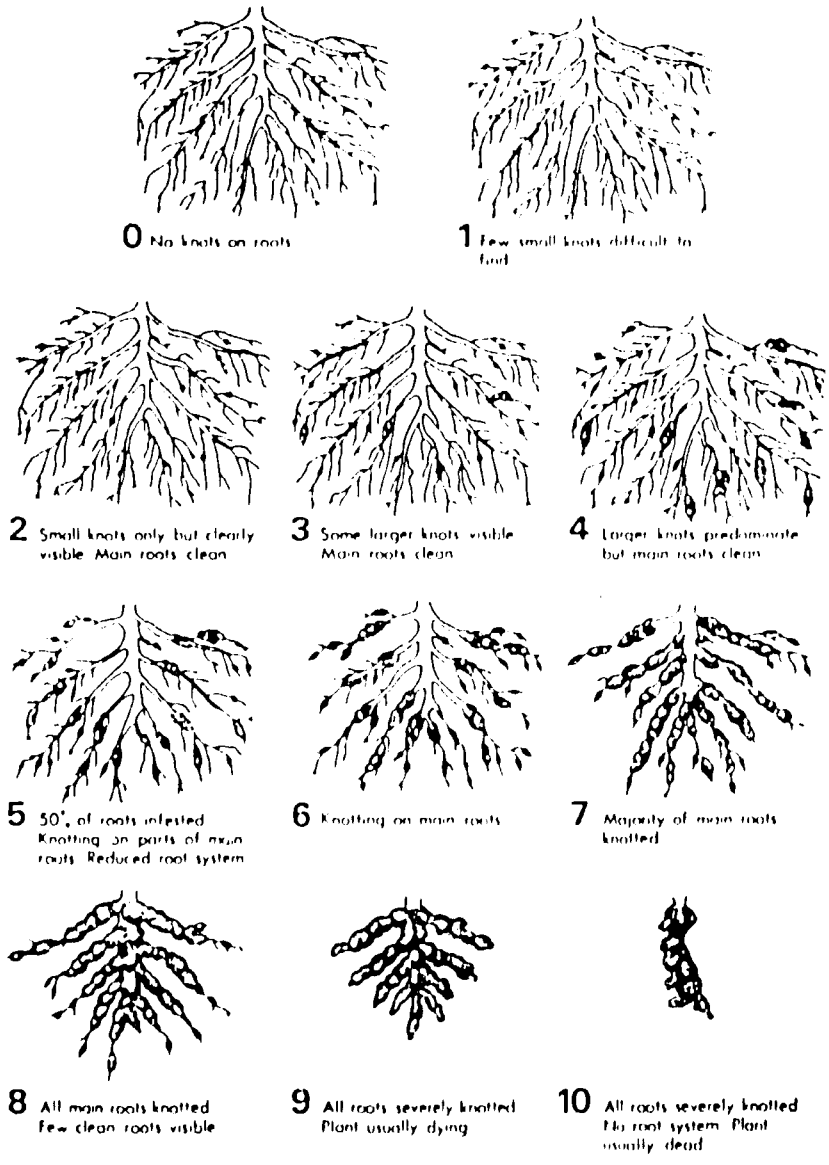


Fig. 5. Root knot nematode rating chart.

SECOND INTERNATIONAL WINGED BEAN TRIAL

DATA BOOK

INTERNATIONAL COUNCIL FOR DEVELOPMENT
O F
UNDERUTILIZED PLANTS

SAMPLE PAGES

SECOND INTERNATIONAL WINGED BEAN TRIALS

There are three data sheets numbered as 1 - 3. Data sheets 1 and 2 have one page each. Data sheet 3 has nine pages. When complete, please return them by Air Mail to the Trial Coordinator at the following address: *(Mr. Wong Kai Choo, Agronomy Department, Universiti Pertanian Malaysia, Serdang, Selangor, MALAYSIA).*

DATA SHEET 1

General Notes

(1) Country _____ (2) Station Name and Address _____

(3) Cooperators _____

(4) Latitude _____ Longitude _____

(5) Elevation _____ (6) Daylength range during trial period _____

(7) Day/night temperature during trial period _____

(8) Soil test results for experimental site:

pH _____ Organic Manure _____ N _____ P _____ K _____ Others _____

(9) Soil type: Sand _____ Silt _____ Clay _____

(10) Fertiliser applied: N- _____ kg/ha elemental form

P- _____ kg/ha elemental form

K- _____ kg/ha elemental form

Micronutrients (if any) _____

(11) Methods of fertiliser application: _____

(12) Construction of ridges: YES/NO (13) Date planted _____ Date of first emergence _____

(14) Inoculum used, if different from the supplied: _____

(15) Precipitation (and irrigation) received during experiment _____

(16) Number of irrigations applied _____ (17) Disease development in general _____

(18) Insect, weed or other pest problems _____

(19) Nodulation: Any deficiency symptoms _____ Occurrence of nodules: Crown (0-7.5cm) _____

Laterals (>7.5cm) _____

(20) Identification of local control, if used: Name/Number _____

Origin/Parentage _____ Other information _____

(21) Comments and Notes (use additional sheets if necessary) _____

DATA SHEET 2:

WATER RECEIVED - RAINFALL OR IRRIGATION

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Date
1													1
2													2
3													3
4													4
5													5
6													6
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24													24
25													25
26													26
27													27
28													28
29													29
30													30
31													31
Total													Total

The amount of water received on the trial site in mm per day.
When complete return to : WB Coordinator

DATA SHEET 3. PAGE 1.

LOCATION _____ DATE OF SOWING _____ COOPERATOR _____

1	2	3			4			5			6	7	8	9	10	11	12	13	14					15					16
		DATE FIRST FLOWERING			DATE FIRST HARVEST			DATE LAST HARVEST											INSECT PESTS (FIRST HARVEST)					DISEASES (PRIOR TO LAST HARVEST)					OTHER OBSERVATION
PLOT NO.	ENTRY NO.	DAY	MONTH	YEAR	DAY	MONTH	YEAR	DAY	MONTH	YEAR	NO. OF PLANTS HARVESTED	NO. OF PODS	DRY WEIGH OF PODS (G)	SEED YIELD (G)	THRESHING %	100 - SEED WEIGHT (G)	SEED QUALITY SCORE	FRESH TUBER WEIGHT (G)	APHIDS	TRIPS	SPIDER MITE	POD BORER	OTHERS	FALSE RUST	LEAF SPOT	POWDERY MILDEW	ROOT-KNOT NEMATODES	OTHERS	
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DATA SHEET 3. PAGE 2.

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PARLIAMENT OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

INTERNATIONAL WINGED BEAN (DAMBALA) INSTITUTE

ACT, No. 7 OF 1982

[Certified on 5th February, 1982]

Printed on the Orders of Government

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International Winged Bean (Dambala) Institute Act, No. 7 of 1982

[Certified on 5th February, 1982]

L. D.—O. 35/81

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF THE INTERNATIONAL WINGED BEAN (DAMBALA) INSTITUTE AND FOR MATTERS CONNECTED THEREWITH OR INCIDENTAL THERETO.

BE it enacted by the Parliament of the Democratic Socialist Republic of Sri Lanka as follows :—

Short title and date of operation.

1. This Act may be cited as the International Winged Bean (Dambala) Institute Act, No. 7 of 1982, and shall come into operation on such date as may be appointed by the Minister by Order published in the *Gazette*.

Estabishment of the Inernational Winged Bean (Dambala) Institute.

2. (1) There shall be established an Institute which shall be called the International Winged Bean (Dambala) Institute (hereinafter referred to as the "Institute") which shall consist of the persons who are for the time being members of the Board under section 5.

(2) The Institute shall, by the name assigned to it by subsection (1), be a body corporate and shall have perpetual succession and a common seal and may sue and be sued in its corporate name.

Principal office of the Institute.

3. The principal office of the Institute shall be at Kandy :

Provided, however, that the Board may, with the concurrence of the Minister, select any other appropriate place in Sri Lanka for the purpose.

Objects of the Institute.

4. The objects of the Institute shall be—

(a) to conduct directly or indirectly all research and related activities necessary for the development and utilization of the Winged Bean (Dambala) internationally as a source of human food as well as livestock feed of international and economic value ;

(b) to promote activities for the training of manpower dedicated to research, training or other activities that will promote the development of the Winged Bean (Dambala) as a commodity of importance to mankind ;

(c) to engage in all activities in connection with the storage, spread and utilization of information relating to the Winged Bean that will contribute to the formulation, growth, utilization and development of technology relating to the Winged Bean (Dambala) ;

A 60777—13,750 (81/12)

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Board of Directors of the Institute.

5. The affairs of the Institute shall be administered by a Board of Directors (hereinafter referred to as the "Board") consisting of not more than fifteen members of whom—

(*a*) two shall be *ex officio* members, namely—

(i) the Secretary to the Ministry of the Minister, and

(ii) the Director-General of the Institute, appointed under paragraph (*a*) of subsection (1) of section 15 ; and

(*b*) the others shall be persons who—

(i) are involved in and interested in promoting the development of the Winged Bean (Dambala) and other under-utilized plants ; or

(ii) appear to have had experience and shown capacity in the sphere of administration, finance, law or any other allied sphere of activity.

The First Board of Directors of the Institute.

6. (1) The first Board of Directors (hereinafter referred to as the "First Board") shall consist of—

(*a*) nine members appointed by the President, in consultation with the Minister (hereinafter referred to as the "appointed members"), who in addition to the requirements set out in paragraph (*b*) of section 5, shall be persons who have international standing in relation to the work of any Institute the objects of which are similar to that of the Institute and who may be selected from—

(i) Sri Lanka ;

(ii) the developing regions of the world ;

(iii) international organizations concerned with under-utilized plants ;

(iv) organizations providing funds for the Institute ; and

(v) countries making a substantial financial contribution to the Institute ; and

(*b*) two *ex officio* members, namely—

(i) the Secretary to the Ministry of the Minister, and

(ii) the Director-General of the Institute, appointed under paragraph (*a*) of subsection (1) of section 15.

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(2) The President may, in consultation with the Minister, appoint a Chairman and a Vice-Chairman of the First Board, from among the members of that Board.

(3) (i) Every appointed member shall, unless he vacates office earlier by death, resignation or removal, hold office for a period of three years.

(ii) An *ex officio* member of the Board shall hold office as long as he holds the post by virtue of which he was appointed a member of that Board.

(4) In the event of the vacation of office of the Chairman, Vice-Chairman or any appointed member of the First Board, the Board may appoint another person to hold such office during the unexpired part of the term of office of the member whom he succeeds.

(5) If the Chairman, Vice-Chairman or any appointed member of the First Board is temporarily unable to discharge the duties of his office by reason of ill health or any other cause, the Board may appoint another person to act in his place as Chairman, Vice-Chairman or as such member.

(6) (*a*) The Chairman may at any time resign his office by letter in that behalf addressed to the President.

(*b*) The Vice-Chairman or any appointed member of the First Board may at any time resign his office by letter in that behalf addressed to the Chairman.

(7) Any appointed member of the First Board may be removed from office by a majority of not less than two-thirds of the votes of the members of the Board without assigning any reason therefor and such removal shall not be called in question in any court.

Appointment of additional members.

7. (1) The First Board may appoint any person as a Director and he shall be an additional member (hereinafter referred to as "additional member") of that Board:

Provided, however, that the total number of Directors shall not at any time exceed the maximum number prescribed by this Act.

(2) Every additional member shall unless he vacates office earlier by death, resignation or removal hold office for a period of three years.

(3) In the event of the vacation of office by any additional member, the First Board may appoint another person to hold such office during the unexpired part of the term of office of the member whom he succeeds.

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(4) If any additional member is temporarily unable to discharge the duties of his office by reason of ill health or any other cause, the First Board may appoint another person to act in his place as such member.

(5) Any additional member may at any time resign his office by letter in that behalf addressed to the Chairman of that Board.

(6) Any additional member may be removed from office by a majority of two-thirds of the votes of the members of the First Board without assigning any reason therefor, and such removal shall not be called in question in any court.

Appointment of subsequent Boards.

8. (1) Every subsequent Board shall consist of not more than fifteen members who shall be appointed by a majority of not less than two-thirds of the votes of the members of the previous Board whom they succeed.

(2) The provisions of section 6 relating to the First Board shall, *mutatis mutandis*, apply to and relation to every subsequent Board appointed under this Act.

Eligibility for reappointment as member of the Board.

9. Any member of the Board who vacates office, other than a member who is removed from office under this Act, shall be eligible for reappointment.

Remuneration of members of the Board.

10. The members of the Board shall be remunerated in such manner and at such rates as may be determined by the Board.

The seal of the Institute.

11. The seal of the Institute—

(a) shall be in the custody of the Chairman of the Board ;

(b) may be altered in such manner as may be determined by the Board ; and

(c) shall not be affixed to any document except with the sanction of the Board and in the presence of two members of the Board who shall sign the document in token of their presence.

Meetings of the Board.

12. Rules may be made under this Act in respect of the meetings of the Board, the quorum therefor and the procedure to be followed at such meetings.

13. (1) The Board may delegate to the Chairman, the Executive Committee or Director-General, any of its powers, duties or functions.

Delegation of powers, duties and functions of Board.

(2) The Chairman, Executive Committee, or Director-General to whom any of the powers, duties or functions of the Board has been delegated under sub section (1) shall exercise, perform or discharge the powers, duties or functions so delegated subject to the general directions of the Board.

14. The Institute shall exercise, perform or discharge such powers, duties or functions as may reasonably be necessary to achieve its objects and in particular may—

Powers, duties and functions of the Institute.

(*a*) receive grants, gifts, and donations in cash or kind whether from local or foreign sources ;

(*b*) acquire, hold, take or give, lease or hire, mortgage, pledge and sell or otherwise dispose of any movable or immovable property ;

(*c*) give grants, endowments or scholarships for the furtherance of the objects of the Institute ;

(*d*) appoint, employ, remunerate and exercise disciplinary control over its officers and servants ;

(*e*) open, operate and close bank accounts and borrow or raise money, with or without security ;

(*f*) enter into and perform or carry out, whether directly or through an officer or agent authorized in that behalf by the Institute, all such contracts or agreements as may be necessary for, or conducive or incidental to, the exercise of the powers. performance of the duties and discharge of the functions of the Institute ;

(*g*) conduct, assist, co-ordinate and encourage research in all aspects of training, education, extension and the overall development programmes pertaining to the Winged Bean (Dambala) primarily and other under utilized plants as may be appropriate, thereafter ;

(*h*) import plant, machinery and equipment required for the purposes of the Institute and receive equipment, funds, personnel and any other assistance for the efficient working of the Institute ;

(*i*) levy fees or charges for any services rendered by the Institute ;

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(*j*) erect or cause to be erected any building or structure on any land belonging to or held by the Institute ;

(*k*) allow the export and import of breeding material from and to Sri Lanka ; and

(*l*) do all such other acts and things as are incidental or conducive to the achievement of the objects of the Institute.

Appointment of the Director-General, Deputy Director-General and other officers of the Institute.

15. (1) The Board shall appoint—

(*a*) the Director-General of the Institute, and

(*b*) the Deputy Director-General of the Institute, who shall not be a member of the Board but be a person qualified in relation to the work of the Institute.

(2) The Director-General shall—

(*a*) be responsible for the management and administration of the Institute in accordance with the policies and decisions of the Board ;

(*b*) exercise, perform and discharge such powers, duties and functions as may be delegated to him ; and

(*c*) appoint to the staff of the Institute such officers and servants as may be necessary for the purposes of the Institute.

(3) The Deputy Director-General shall assist the Director-General in the exercise, performance and discharge of his powers, duties and functions under this Act.

(4) The conditions of employment including the remuneration of the Director-General and the Deputy Director-General shall be determined by the Board.

Powers of the Board in regard to appointments to the staff of the Institute.

16. Subject to the other provisions of this Act, the Board may—

(*a*) appoint, dismiss and excercise disciplinary control over the staff of the Institute ;

(*b*) fix the wages or salaries or other remuneration of the staff ;

(*c*) determine the terms and conditions of service of such staff ; and

(*d*) establish and regulate provident funds and schemes for the benefit of such staff and make contributions thereto.

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17. No act or proceeding of the Board shall be deemed to be invalid by reason only of the existence of any vacancy in the Board or defect in the appointment of any member of the Board.

Acts or proceedings of the Board deemed not to be invalid by reason of any vacancy or defect in the appointment of a member.

18. Subject to the other provisions of this Act, the Board shall exercise, perform and discharge the following powers, duties and functions :—

Powers, duties and functions of Board.

(a) to act as the policy-making body of the Institute and lay down or approve in principle its major programmes ;

(b) to approve the budget and review the financial condition of the Institute ;

(c) to raise funds for the administration of the Institute and to receive financial aid from local as well as foreign organizations and agencies for the operation of the Institute ;

(d) to review and evaluate such progress reports of the Institute as may be submitted by the Director-General ;

(e) to delegate any of its powers, duties and functions to the Director-General or any of the Committees ; and

(f) to take all such measures as may be necessary for the achievement of the objects of the Institute.

19. The Board may make rules in respect of all or any of the matters for which rules are authorized or required to be made under this Act.

Power of Board to make rules.

20. (1) The Board may appoint an Executive Committee, a Technical Advisory Committee and such other Committees, as it may deem necessary for the purpose of assisting and advising the Board in the exercise, performance and discharge of its powers, duties and functions as well as assisting the Board in any or all of the matters which the Board considers necesary for the purpose of giving effect to the principles and provisions of this Act.

Power of Board to appoint Committees

(2) The Technical Advisory Committee shall in general assist the Board to formulate its policy and assist the Director-General to implement and execute the policies and decisions of the Board.

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(3) The Director-General of the Institute shall be the *ex officio* Chairman of the Technical Advisory Committee and a member of the Executive Committee.

(4) The term of office and specific powers, duties and functions of every Committee established under this section shall be determined by the Board.

(5) The Board may make rules in respect of the procedure to be followed at the meetings of the Committees, including the quorum for such meetings.

Fund of the Institute.

21. (1) The Institute shall have and maintain its own fund.

(2) There shall be paid into the Fund of the Institute—

(a) all such sums of money as may be provided by such organizations as are concerned with the establishment of the Institute ;

(b) all such sums of money as may be received by the Institute in the exercise, performance and discharge of its powers, duties and functions ; and

(c) all such sums of money as may be received by the Institute by way of income, loans, donations, gifts or grants from any source whatsoever whether in or outside Sri Lanka.

(3) There shall be paid out of the Fund of the Institute all such sums of money required to defray any expenditure incurred by the Institute in the exercise, performance and discharge of its powers, duties and functions.

Withdrawal and investment of moneys of the Fund.

22. The mode and manner of withdrawal of any moneys from the Fund of the Institute and the investment of any moneys of the Fund shall be made by the Board in accordance with such rules as may be made from time to time for that purpose and no sum shall be withdrawn except in accordance with such rules.

Institute to be exempt from payment of tax.

23. (1) The Institute shall be exempt from the payment of—

(a) any stamp duty on any instrument executed by or on behalf of or in favour of the Institute where but for such exemption the Institute would be liable to pay the duty chargeable in respect of such instrument ;

(*b*) customs duty on any goods, vehicles, plant and machinery imported by the Institute if the import of such goods, vehicles, plant or machinery is considered by the Minister and the Minister in charge of the subject of Finance, to be conducive to the advancement of the objects of the Institute ;

(*c*) any wealth tax payable under the Inland Revenue Act, No. 28 of 1979 ; and

(*d*) any rates and taxes under the Development Councils Act, No. 35 of 1980, the Municipal Councils Ordinance or the Urban Councils Ordinance.

(2) Any employee of the Institute who is not a citizen of Sri Lanka shall be exempt from—

(*a*) the payment of customs duty on any goods or vehicles imported by him for his personal use ; and

(*b*) income tax or wealth tax payable under the Inland Revenue Act, No. 28 of 1979.

Financial year of the Institute and audit of accounts.

24. (1) The financial year of the Institute shall be the calendar year.

(2) The Board shall cause proper books of accounts to be kept of the income and expenditure, assets and liabilities and all other transactions of the Institute.

(3) The accounts of the Institute shall be audited by qualified auditors appointed by the Board.

(4) The Board shall determine the remuneration of the auditors of the Institute.

Government to make available premises for use of the Institute.

25. The Government may provide for the use of the Institute such land, buildings and other facilities as may be deemed necessary.

Protection for action taken under this Act or on the direction of the Board.

26. (1) No suit or prosecution shall lie—

(*a*) against the Board for any act which in good faith is done or purported to be done by the Board under this Act ; or

(*b*) against any member, officer, servant or agent of the Institute for any act which in good faith is done or purported to be done by him under this Act or on the direction of the Board.

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(2) Any expense incurred by the Board in any suit or prosecution brought by or against the Board before any court shall be paid out of the Fund of the Institute and any costs paid to, or recovered by, the Board in any such suit or prosecution shall be credited to the Fund.

(3) Any expense incurred by any person as is referred to in paragraph (*b*) of subsection (1) in any such suit or prosecution brought against him before any court in respect of any act, which is done or is purported to be done by him under this Act or on the direction of the Board shall, if the court holds that such act was done in good faith, be paid out of the Fund of the Institute, unless such expense is recovered by him in such suit or prosecution.

No writ to lie against person or property of members of the Board or an officer of the Institute.

27. No writ against person or property shall lie against any member of the Board or any officer, servant or agent of the Institute in any action brought against the Institute.

Dissolution of the Institute.

28. (1) Where the Board is of opinion that the Institute shall be dissolved, it may, by resolution passed by two-thirds of its members, decide to dissolve the Institute.

(2) The Minister may, on any such decision made by the Board, dissolve the Institute by Order published in the *Gazette* and appoint one or more persons to be the liquidator or liquidators of the Institute.

(3) The provisions of sections 20 and 21 of the Finance Act, No. 38 of 1971 shall, thereupon, *mutatis mutandis*, apply to the liquidation of the Institute.

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ADDITIONAL UNDERUTILIZED PLANTS

TO BE CONSIDERED BY THE BOARD OF DIRECTORS, ICDUP

OCTOBER 1983

(The Board has agreed to select 3 to 4 additional plants from the following list, for which it will assume responsibility.)

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

18 MEADOW PARK COURT, ORINDA, CALIFORNIA 94563 U S A

February 24, 1983

(415) 254-9212
CABLE UNDEVPLANT
ORINDA CA

Dear Colleague:

You will recall that at the meeting of our Board of Directors in Los Banos in December 1982, we agreed to consider additional underutilized plants and narrowed down the list suggested for consideration at that meeting. We also agreed that, in order to make our final selection at our next meeting, descriptive materials on all these plants would be compiled and sent you.

Enclosed are materials on these plants as well as on two additional plants suggested by Dr. James Duke of the U. S. Department of Agriculture, Beltsville, Maryland, namely: Stachys sieboldii (Chinese artichoke) and Solenostemon rotundifolius (Hausa potato). A copy of the revised list of plants is also enclosed.

These materials were compiled by Dr. Ayensu. Please let me know if you require anything further.

With best wishes.

Sincerely yours,

Louis Lazaroff
Director General

encs

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ARID AND SEMI-ARID ZONES

Bambara Groundnut (Secondary interest)

(*Voandzeia subterranea*)

Tropical Africa (Southwest and Central Africa, Southeast Asia

Possible Research Contacts:

K. Amuti, S. Sinnadurai, Department of Crop Science, University of Ghana, Legon
Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, Paris, France
B. N. Okigbo, IITA, Ibadan, Nigeria
S. K. Karikari, Ahmadu Bello University, Zaria, Nigeria
Dr. Hugh Popenoe, International Programs in Agriculture, University of Florida, Gainesville

Buffalo Gourd

(*Cucurbita foetidissima*, *Cucurbita palmeta*)

Arid lands, Sonora Desert of Mexico, Southwest USA

Possible Research Contacts:

W. P. Bemis, Department of Plant Sciences, University of Arizona, Tucson
L. C. Curtis, L. C. Curtis & Sons, Inc., Watkinsville, Georgia
USDA, Southern Regional Research Center, New Orleans, La.

Chenopods (Brenan: For taxonomic work.)

(*Chenopodium spp.*)

Indian plains, high hills of Himalayas, USA, Andean Region of South America

Possible Research Contacts:

Dr. K. L. Mehra, National Bureau of Plant Genetic Resources, New Delhi, India
Himachal Pradesh University, Simla, India

Euphorbia

(*Euphorbia spp.*)

Plains, high hills, arid and semi-arid areas

Possible Research Contacts:

Dr. O. P. Gautam, Indian Council of Agricultural Research
Dr. Melvin Calvin, University of California, Berkeley
Gujerat Agricultural University, Dantiwara, Gujerat, India

Guar (Secondary interest)

(*Cyamopsis tetragonoloba*)

Semi-arid areas (USA, Pakistan, India, Australia, Brazil, South Africa, Indochinese Peninsula)
Tolerates moderate salinity.

Possible Reseach Contacts:

Dr. G. A. White, Agricultural Research Center, USDA, Beltsville, MD.
J. Kirby, Department of Agronomy, Oklahoma State University, Stillvater, Oklahoma
Prof. Theodore Hymowitz, Department of Agronomy, University of Illinois
Dr.R. S. Paroda, Central Arid Zone Research Institute, Jodhpur, India
Dr. K. L. Mehra, National Bureau of Plant Genetic Resources, New Delhi, India

Jackbean

(*Canavalia ensiformis*)

Drought-ridden regions of Arizona and Mexico in ancient times. Can be grown in wide range of conditions, from warm parts of temperate zone to hot, tropical rainforest areas.

Possible Research Contacts:

P. R. Goldsworthy, IITA, Ibadan, Nigeria
R. Bressani and M. R. Molina, Instituto de Nutricion de Centro America y Panama (INCAP), Guatemala City, Guatemala
S. Sastrapradja and I. Lubis, Lembaga Biologi Nasional, Bogor, Indonesia
E. Westphal, University of Agriculture, Wageningen, The Netherlands

Lablab Bean

(*Lablab purpureus*)

Highly adaptable; varieties for arid, semi-arid and humid regions.

Possible Research Contacts:

G. P. Wilson, Agricultural Research Station, N. S. W., Australia
Dr. H. S. Mann, Central Arid Zone Research Institute, Jodhpur, India
H. A. B. Parpia, Food Industries Service, FAO, Rome, Italy
George A. White, Agriculture Research Service, USDA, Beltsville, Maryland

Tepary Bean

(*Phaseolus acutifolius*)

Semi-arid, torrid zones

Possible Research Contacts:

R. S. Felger, Arizona-Sonora Desert Museum, Tucson, Arizona
G. F. Freytag, Mayaguez Institute of Tropical Agriculture, Mayaguez, Puerto Rico
J. G. Waines, Department of Plant Sciences, University of California, Riverside, California

Ye-eb Nut

(*Cordeauxia edulis*)

Arid, semi-desert regions

Possible Research Contacts:

Mohamed W. Awaleh, National Range Agency, Mogadisho, Somalia
J. B. Gillett, East African Herbarium, Ainsworth Hill, Nairobi, Kenya
C. Hemming, Centre for Overseas Pest Research, London, England
Director, Conservatoire et Jardin Botaniques, Chambésy-Geneve, Switzerland

HUMID TROPICS AND SUB-TROPICS

Amaranth

(*Amaranthus caudatus*, *Amaranthus cruentus*, *Amaranthus hypochondriacus*)

Andean regions of Argentina, Peru and Bolivia; Guatemala; Mexico; Indian plains, Himalayan Hills

Possible Research Contacts:

National Bureau of Plant Genetic Resources, New Delhi, India
Center for the Study of Andean Cultivars, University of Cuzco, Peru
Mexican National Institute of Agricultural Research
Organic Gardening Research Center, Rodale Press, Emmaus, Pennsylvania
Dr. Donald Plucknett, CGIAR, The World Bank, Washington, D. C.

African Yam Bean

(*Sphenostylis stenocarpa*)

Central, Western and parts of Eastern Africa

Possible Research Contacts:

O. C. Ezedinma, Dr. J. N. C. Maduewesi, Department of Crop Science, University of Nigeria, Nsukka, Nigeria
E. V. Doku, Crop Science Department, University of Ghana, Legon, Ghana
Dr. B. N. Okigbo, IITA, Ibadan, Nigeria

Calliandra

(*Calliandra calothyrsus*)

Humid tropics, Central America, Indonesia

Possible Research Contacts:

K. F. Wiersum, Department of Tropical Silviculture, Agriculture University, Wageningen, The Netherlands
Soekiman Atmosoedarjo, Perum Perhutani, Jakarta, Indonesia
Hua Seng Lee, Forest Department Headquarters, Kuching, Sarawak, Malaysia

Cocoyam

(*Xanthosoma sagittifolium*)

Native to the Americas; tropical regions such as West Africa, Asia, Pacific

Possible Research Contacts:

H. Irizarry, Agriculture Experiment Station, Puerto Rico
R. B. Volin, Agriculture Research and Education Center, University of Florida, Homestead, Florida
J. A. Spence, University of the West Indies, St. Augustine, Trinidad

Leucaena

(*Leucaena leucocephala*)

Lowland, subhumid, humid tropics

Possible Research Contacts:

Dr. James L. Brewbaker, Department of Horticulture, University of Hawaii
Arturo C, Alferez, College of Agriculture, Unive-sity of the Philippines, Los Banos, Philippines
Ramon Claveran-Alonso, Instituto Nacional Investigaciones Agricolas, Mexico City, Mexico
Setijati Sastrapradja, Lembaga Biologi National, Bogor, Indonesia
Donald L. Plucknett, CGIAR, The World Bank, Washington, D. C.

Lablab Bean

(*Lablab purpureus*)

See above, p. 2.

Mexican Yam Bean

(*Pachyrhizus erosus*)

Humid tropics (Mexico, South America, West Indies, Philippines, Indonesia)

Possible Research Contacts:

A. Luse, L. P. Song, CIAT, Cali, Colombia
Charles A. Schroeder, University of California at Los Angeles, Los Angeles, California
J. A. Laborde and A. Diaz, Instituto Nacional de Investigaciones Agricolas (INIA), Mexico City, Mexico
Warwick E. Kerr, H. Noda, Instituto Nacional de Pesquisas de Amazonia, Manaus, Amazonas, Brazil

~~Pejibaye~~

~~(Guilielma gasipaes)~~

~~Central America, Northern South America~~

~~Possible Research Contacts:~~

~~Department of Agriculture, Bangkok, Thailand~~
~~R. K. Soost, Department of Botany and Plant Sciences, University of California, Riverside, California~~
~~Mayaguez Institute of Tropical Agriculture, Mayaguez, Puerto Rico~~

Rice Bean

(Vigna umbellata)

Lowland tropics, East and Northeast regions of India, Himalayan foothills, Burma, China

Possible Research Contacts:

Dr. O. P. Gautam, Indian Council of Agricultural Research, New Delhi, India
Hyo-Guen Park, Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan
IITA, Ibadan, Nigeria
K. P. S. Chandel, National Bureau of Plant Genetic Resources, New Delhi, India
R. Lantican, University of the Philippines at Los Banos, College, Laguna, Philippines
Robert Gunn, U.S.D.A., Beltsville, Maryland

Sesbania

(Sesbania grandiflora)

Tropical Africa, Southeast Asia, China, sub-tropics, Australia

Possible Research Contacts:

Department of Botany, Kasetsart University, Bangkok, Thailand
H. G. Higgins, H. F. Phillips, A. F. Logan, CSIRO, South Melbourne, Victoria, Australia
S. R. D. Guha, Forest Research Institute, Dehru Dun, New Forest, India
Herbarium Bogoriense, National Biological Institute, Bogor, Indonesia

Sword Bean

(Canavalia gladiata)

See Jack Bean, above, p. 2.

HUMID TROPICS AND SUB-TROPICS (CONTD.)

Taro

(*Colocasia esculenta*)

Wet humid tropics, Egypt, Philippines, Hawaii, Caribbean; marshy, waterlogged, salinified regions

Possible Research Contacts:

Dr. D. L. Plucknett, CGIAR, The World Bank, Washington, D. C.
R. B. Volin, Agricultural Research and Education Center, University of Florida, Homestead, Florida
W. J. Cable, University of the South Pacific, School of Agriculture, Apia, Western Samoa
William Theobald, Pacific Tropical Botanic Gardens, Honolulu, Hawaii

Rubber

(*Hevea brasilensis*)

Humid tropics. Suggested at Board Meeting, December 11, 1982.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

PROJECT PROPOSAL FOR BANKAMERICA FOUNDATION

Summary: The BankAmerica Foundation is requested to make a grant to the International Council for a survey of the potential of introducing winged bean in a Latin American country to provide increased income and employment for small holders and increased revenue for local processors of edible oil and animal feed. The cost of the proposal, including continuing support for one year for the Council's broad program of work, is $ 28,180.

The winged bean, though new to many parts of Latin America, has the potential of providing improved nutrition and income for farmers with small holdings. Its immature green pods, young leaves, ripe seeds and tubers are rich sources of protein, vitamins and minerals. All these plant parts can be consumed in the home. But the ripe seed has the additional potential of being easily processed to produce marketable products bringing the farmer additional income. For, using techniques developed for the soybean, the ripe seed can produce a polyunsaturated edible oil, leaving behind a protein and lysine-rich residue suitable for converting into flour or animal feed for chickens, swine and cattle.

The BankAmerica Foundation is requested to make a grant to the International Council for the first step only of a 3-phase program whose purpose is the introduction of winged bean as a new and income-producing crop in a Latin American country. The details of the subsequent phases of the program, Phases II and III, which have been developed conceptually, will be based upon the data determined in Phase I. Financing for Phase II and Phase III will be obtained from interested supporters.

The relationship of Phase I to the other phases of the overall program is as follows:

Phase I. Information Gathering: A three-week survey to secure basic data, followed by testing of the processing of oil from ripe seed, determining its nutritional content, and determining the nutritional effectiveness of winged bean defatted flour and cake as feed for chickens and swine.

Phase II. Evaluation and Production of Seed, Development of Agronomic Practices: A 3-year preparatory program among 30 farmers to test the effectiveness of 30 selected winged bean varieties, followed by multiplication of seed of the 4 to 8 varieties judged outstanding; assembly of inputs required for Phase III.

Phase III. Production, Processing and Marketing: A 2-year contract farming program involving c. 1,000 farmers in the same area, for production of ripe winged bean seed from locally tested varieties, local processing and sale of ripe seed into edible oil and defatted meal or seed cake for animal feed.

Based on data secured as the result of the survey, the subsequent three years would be used to select the winged bean varieties most suitable for the area chosen, to perfect the agronomy appropriate to the local ecology, to prepare extension information in the local language covering both pre and post-harvest practices, to multiply the 4 to 8 outstanding varieties for distribution to farmers, to assemble other inputs required for Phase III, the Production, Processing and Marketing phase, and to establish the contract farming system. (The total amount of land expected to be used by each of the 30 participating farmers is estimated at 60 X 10 m = 600 m^2 or .06 Ha.)

The contract farming program will begin in the fifth year. It is proposed that each of the 1,000 farmers participating would devote up to half a hectare of land to the production of winged bean.

Conservative estimates of the yield of ripe winged bean seed indicate that a harvest of approximately 2 metric tonnes per hectare can be expected. Oil content of winged bean seed is estimated at between 15 and 20%. Varieties with oil yield at the maximum level will be selected for the program. Protein content of ripe winged bean seed is estimated at 40%. Assuming that each of the 1,000 farmers participating in the contract growing scheme will devote one-half hectare to winged bean, yield and gross income per farmer can be estimated as follows:

Total production of ripe winged bean seed on one-half Ha	1,000 kg
Total oil anticipated	200 kg
Total protein and other residues in remaining oil cake or meal	800 kg

At current market prices in Mexico, for example, vegetable oil sells at c. U. S. $2.00 per kg; seed cake at c. U.S. $.50 per kg. The present average gross annual income of the Mexican farmer is estimated at U. S. $1,000. Although final estimates will depend on the information secured in the survey, it is estimated at present that the total value of farmer input in Phase III of this program may be approximately U. S. $436 per half hectare. Given present oil and feed prices, and allowing for a fair profit to the processors, his return can be expected to be at least 30% over his investment.

THE SURVEY (PHASE I)

The survey or information gathering phase which would be administered by the Council, will include a 3-week intensive field study by a specialist of the country which had been designated as the site for the program. The site of this intensive field study will be determined jointly by the Council and the BankAmerica Foundation. Sites presently being considered by the Council are, in order of preference, southern Mexico, the coastal area of Ecuador, and Panama.

The purpose of the 3-week survey would be to secure needed data including

estimated costs of Phases II and III of the program. It will be expected to yield as much of the following information as can be obtained:

Climate

Quality of soils

Availability of water

Transportation network

Feasibility of seed importation

Costs of inputs in Phase II (stakes, fertilizer -- nitrogen, phosphorus, potassium -- pesticides, fungicides)

Compensation to farmers in Phase II for loss of revenue in using land to grow winged bean

Gross annual income of farmers

Size of farmer land holdings

Minimum wage of field workers

Extension services available (for farm and household)

Retail and wholesale prices of cooking oil on local market (soybean, peanut, sesame, oil palm, rape, etc.)

Retail and wholesale prices of alternative animal feeds available locally with c. 30 - 40% protein level (soybean, fishmeal, etc.)

Local edible oil processing and feed mill industries (possibility of experimental processing of winged bean seed for oil; possibility of factoring in winged bean price and nutritional data into feed milling industry computers)

Existence of contract farming practices; feasibility of establishing contract farming system for winged bean

Anticipated cost estimates for farmers participating in contract farming system for production of ripe winged bean seed (1/2 Ha per farmer) - Phase III

Anticipated cost estimates for operators of contract farming system

Anticipated cost estimates for processing of winged bean into oil and animal feed

Anticipated price to farmer per kg of ripe winged bean seed (assuming harvest of 2t per Ha)

Additional estimated costs - Phase II
Personnel: short-term and long-term specialists, locally recruited wherever possible
Minimum equipment: motorcycle, jeep, hoses and sprayers, pod chopper, dehuller

Additional estimated costs - Phase III
Short-term and long-term specialists, locally recruited wherever possible

Loan funds required - Phase III
(farmers, contract farming operators, possibly processors)

Availability of local cooperating institution to share through provision of equipment, personnel, facilities, funds (agricultural university, research institution or station, etc.)

Cost of final report and evaluation

OVERALL PROGRAM

Developed schematically, the overall program would proceed as follows:

FIRST YEAR (Phase I; Beginning of Phase II)

Phase I: Survey in country selected for program (3 weeks); testing of processing of ripe seed into oil (locally); testing of oil content and palatability (University of California, Berkeley); tests of residue as animal feed (University of the Philippines, Los Banos in cooperation with the University of California, Berkeley)

* * *

Phase II: Selecting and testing 30 winged bean varieties (5 kg of each) on 30 farms in different areas; each farm to serve as demonstration area for c. 30 neighboring farmers. (In first year may select only up to 15 farmer observers. Some of these may get seed one way or another for planting on their own.) Determination of agronomy appropriate to area.

Introduction of immature winged bean pods, young leaves, and ripe seeds in preparation of traditional foods.

SECOND YEAR (Phase II)

Narrowing down of number of varieties to 15, continued testing for performance and agronomy on same 30 farms; observations by c. 30 farmers per farm.

Continued use of green pods, young leaves, ripe seeds in traditional dishes.

THIRD YEAR (Phase II)

Narrowing down of number of varieties to 4 to 8 outstanding

performers and continued testing for performance and appropriate agronomy on same 30 farms; observations by neighboring farmers.

FOURTH YEAR (Phase II)

Determining and procuring inputs required for reproduction of up to 8 selected varieties for seed stock for 1,000 farmers under Phase III of program.

Planting of 4 to 8 varieties to produce seed stock for Phase III.

Selecting 1,000 farmers prepared to plant winged bean on one-half Ha under contract farming system.

Developing extension materials for pre and post-harvest practices.

Collecting inputs for distribution to farmers.

Establishing contract farming system.

Establishing arrangements for local processing of oil and animal feed.

FIFTH YEAR (Phase III)

Introduction of contract farming program among 1,000 farmers, each planting one-half Ha.

SIXTH YEAR (Phase III)

Continuation of contract farming program.

Evaluation.

ESTIMATED COSTS

The estimated budget for the proposal being submitted to the BankAmerica Foundation covering Phase I or the Information Gathering phase of the program, including the survey, processing and nutritional tests of the oil, and nutritional tests of the animal feed, and for continuation of the basic support grant for the Council, is as follows:

1. Information Gathering (Phase I)

a) Survey - specialist (locally recruited), fee and local expenses @ U.S. $250 per day for 21 days	$5,250	
Local travel	750	
ICDUP administrative expenses and overhead	1,500	
		$ 7,500
b) Study of oil processing (local) and of nutritional quality of oil (Department of Nutritional Sciences, University of California, Berkeley); study of nutritional performance of ripe winged bean seed cake (defatted meal) on chickens and swine (Department of Animal Science, University of Philippines, Los Banos with cooperation of Department of Nutritional Sciences, University of California, Berkeley), two years*		
Research assistants	2,850	
Field laborers (2)	2,400	
Honoraria, project leaders	2,400	
Travel	1,750	
Supplies and materials	4,600	
ICDUP overhead	1,680	
		15,680
2. Basic Support Grant, International Council for Development of Underutilized Plants		5,000
TOTAL		$ 28,180

*The University of the Philippines, Los Banos, will meet other staff costs, costs of facilities, laboratory services, provide equipment, etc. Its contribution is expected to amount to approximately U. S. $20,000 in kind. The University of California, Berkeley, will contribute $3,000 toward the overall cost of its participation, provide the services of a senior member of its staff, and waive overhead fees.

We would be pleased to answer any questions you may have about this proposa

July 13, 1982

WINGED BEAN GROWTH CENTER, MALAYSIA.

FINAL REPORT

Submitted To International Council
for Development of Underutilized Plants.

1. INTRODUCTION

The Winged Bean Growth Center, Malaysia, was set up in December 1979 jointly by UPM and International Council for Development of Underutilized Plants (ICDUP) from an initial grant from the Asia Foundation. The primary task of the Center is to develop and thereafter to provide knowledge and uses of elite lines of winged bean for the small farmers to improve their nutrition and income. At the same time the Center sets out to encourage active co-operation and collaboration among Institutions and Agencies within and outside the country to work on the winged bean.

This report summarises the activities of the Center under the sponsorship of the Council, through its grant of US$15,000/- for the period from March 1, 1981 through February 28, 1982. It includes the projects accomplised as well as those initiated and in progress during the grant period, together with co-operation effected.

2. WINGED BEAN RESEARCH LABORATORY

The Universiti Pertanian Malaysia, in recognition of the importance of winged bean work, has provided a Winged Bean Research Laboratory within its campus. It is well equiped with the necessary scientific instruments for our winged bean work. It has also two cold rooms for short and long term storage facilities. A laboratory assistant is employed solely in charge of the laboratory.

3. STAFF AND LABOUR

During the initial period of the grant we have

difficulty in recruiting a full-time graduate in carrying out the work under the sponsorship of the Council. As such a number of part-time assistants (mainly freshly graduated students) have been employed. The duration of their work at the Center has been very inconsistent. During the second half of the grant period, we managed to get a full-time graduate for our work. Even then we do employed students during their short vacation to help out in the field.

Because of the labour intensive requirement for winged bean crop in the field, we have tried to maintain a force of three to four labours solely for the Council's programme.

4. PROGRESS ACHIEVED DURING REPORTING PERIOD

4.1 GERMPLASM COLLECTION AND EVALUATION

During the reporting period, a number of trips were made to collect winged bean seeds within Peninsular Malaysia. This has further increased our Malaysian collection. To make our Malaysian collection as complete as possible, a collection trip was made to East Malaysia (Sarawak and Sabah) during the last two weeks of the grant period (February 17 through February 28). This trip was funded by SEARCA through the help of ICDUP. A total of 43 accessions were collected throughout Sarawak and Sabah. Seed samples of this collection were sent to SEARCA which in turn would be turned over to the Institute of Plant Breeding of University of Philippines, Los Banos, Philippines.

The Center to-date has collected and acquired over 400 accessions, both indegineous and foreign. These materials are now being carefully maintained and multiplied at the Center.

Evaluation and documentation of our germplasm collection have also been carried out. We have completed two seasons of evaluation of our germplasm under our climatic conditions. The first evaluation was on 262 accessions while the subsequent one, conducted during the reporting period, was on 364 accessions Part of our results is presented in Table 1.

Great variability in agromorphological characteristics were observed among materials from Papua New Guines, Thailand and Indonesia. Among Malaysian collection (mainly from Peninsular Malaysia) maximum variability in morphological characteristics was shown by those obtained from the north-west state of Perlis and north-east state of Kelantan. From the north-western state materials with distinct leaflet shape from deltoid to lanceolate were found whereas from the north-eastern region, variation in seedcoat colour ranging from cream, tan, reddish, brown and dark brown were observed. Materials from the rest of Peninsular Malaysia were rather homogeneous with tan seedcoat, deltoid leaflet shape, consistently green vine, blue flower with green calyx and green pods including the wings.

4.2 VARIETAL EVALUATION AND ADVANCE YIELD TRIALS

A varietal trial which was set up in July 1980 and completed in early 1981 was reported in our first half-yearly progress report. Fifteen accessions were tested out in a Randomized Complete Block Design with 4 replications. Each plot consisted of 2 rows of 5m, with plants spaced 50cm apart. The evaluation was based on the morphological characteristics, seed yield and other agronomic characteristics. Correlation analysis was carried out to measure the associations between various characteristics. Path coefficient analysis was also performed to determine the direct and indirect effects of these

characteristics on seed yield. Narrow-sense heritability was estimated for these characteristics.

Summarising the results, it was found that great variations existed among accessions with respect to morphological characteristics and incidence of diseases, significant differences in almost all the agronomic characteristics were obtained among the accessions. Accession 203 (Tpt 6) was highest in seed yield (2200 kg/ha) followed by Accession 105 (UPS 122) and Accession 207 (UPM 207).

Seed yield was significantly correlated to total dry pod weight, number of pods per plot and 100-seed weight.

Path coefficient analysis indicated that total dry pod weight, 100-seed weight and leaflet size had positive direct effects on seed yield while the rest had indirect positive or negative effects.

All the characters considered in this study showed high narrow, sense heritability.

Based on this study, and due to the great genetic variability among the accessions, selection based on total dry pod weight and number of pods will give the best contribution towards seed yield improvement in winged bean.

In addition to the varietal trial, two advanced yield trials have also been completed during the reporting period. The first was started on March 24 where 28 accessions were tested for yield performance, while the second trial, involving 27 accessions, was started on October 12. In both these trials, each plot consisted of a single 5-meter row with between row distance of 1m and plants spaced 25cm apart. A Randomized Complete Block Design with 4 replications was used. Analysis of results of the first trial has been completed while that of the second trial is in progress.

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From the results we have obtained from the above trials, we are now able to recommend at least 12 accessions which are high yielding in seed under our environmental conditions. The agronomic characteristics of these potential accessions are shown in Table 2. At least four accessions showed extrapolated seed yields of between 3-5 tons per hectare. The other accessions gave seed yields of over 2 tons per hectare.

4.3 BREEDING PROGRAMME

This breeding programme is aimed to provide information on the mode of inheritance of some selected agronomic characters with the main objective of developing high seed yielding varieties from our available genetic materials. From our germplasm evaluation we have selected seven parents differing in origin and with desirable characteristics. These parents are Accession 62c, 102c, 234c, 238a, 242c, 290a and 306b and their relative performance of some agronomic characters are shown in Table 2. The parents were planted in October 1981 in three separate plots with one week difference in the date of sowing between plots. All possible crosses were made among the seven parents during the month of January 1982. Preliminary results indicated the percentage of success in the crosses made to be around 14%. Some of the F1 seeds have already been harvested while others will be harvested when ripe. The F1 seeds and their parents will be planted out soon to obtain genetic informations.

The breeding programme is at present handled by Dr. T.F. Yap who have more than ten years experience in breeding of tropical legumes. Attached is a copy of Dr. Yap's work on long beans (Vigna sesquipedalis) in Malaysia.

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4.4 SCREENING GENETIC MATERIALS FOR PHOTOSENSITIVITY

Todate we have completed three seasons of screening our germplasm for photosensitivity. The first batch was planted on 3rd April 1981, the second batch was started on 8th July 1981 while the third batch was started on 23rd October 1981. The primary aim of this screening is to identify accessions among our collections which are insensitive to photoperiod. Because of the large germplasm collection, we have to screen the materials in batches. Five replicated plants of each accession were grown individually in vermiculite-grit mixture in 9-litre plastic buckets with drainage holes. The plants were subject to continuous light treatment by extending the natural daylight with about 12h of low intensity light from incandescent bulbs strung above the plants. The lighting being controlled by a time switch. Recordings of flowering of the plants were carried out.

Out of a total of 73 accessions we have screened, 6 accessions showed insensitivity to photoperiod. They flowered even under continuous lighting. The 6 accessions are Accessions 202, 205, 180, 183, GRWB 26 and GRWB 11. The first 4 accessions are from Thailand while the other 2 accessions are from India. To confirm our findings, we are repeating the testing on these accessions again. None of the accessions collected within Peninsular Malaysia showed insensitivity to photoperiod.

4.5 AGRONOMIC AND PHYSIOLOGICAL STUDIES

These studies have been included in our activities to supply additional information with regard to management and utilization aspects of the winged bean. They included a plant density study and a daylength and shading study. Both these trials were started in July 1981. Preliminary results from the plant density study indicated that between-plant distance

of 50 cm with between-row distance of 1 meter (giving density of 20,000 plants per hectare) produced optimum seed yield. The daylength-shading experiment indicated that when winged bean plants were shaded, flowering would be inhibited. This implies that planting winged bean in between plantation crops could result in lower seed yield if the plantation crops cause shading on the winged bean crop. If winged bean need to be planted in between plantation crops, perhaps one should aim for winged bean biomass production instead of seed production. The winged bean biomass has been reported to high in protein.

4.6 RHIZOBIUM STUDIES

These activities have been initiated with the return (from study leave) of one of our academic staff who is specialized in this field. Preliminary screening of rhizobial strains on different winged bean accessions has just started.

4.7 SCREENING GENETIC MATERIALS FOR PROTEIN, TRYPSIN INHIBITOR AND OIL LEVEL. (COLLABORATION WITH UNIVERSITY OF MALAYA)

This screening is carried out in collaboration with the Department of Biochemistry, University of Malaya. Protein analyses are still being continued for more genetic materials while analyses for oil content have resumed after a short stop. A complete analysis on protein trypsin inhibitor and oil contents of 15 accessions from Papua New Guinea and 15 accessions from Thailand is presented in Tables 3, 4 and 5. These results show protein contents ranging from 28.8% to 42.5% while trypsin inhibitor contents vary from 3.7 to 8.1 million I.U. per 100 g of seeds. Heat treatment of the ground seed powder in an autoclave for 20 minutes at 120°C and 15 psi destroyed almost completely these trypsin inhibitor activities. The oil (contents) vary from 13.6% to 21.4% of the fresh seed weight. Saturated fatty acids account for 31% to 37% of the total fatty acids

and behenic acid (22:0) alone constitutes about 14% to 17% of the saturated fatty acid content. Unsaturated fatty acids account for 63% to 69% of total fatty acids; oleic and linoleic acids together constitute about 57% to 64% of the unsaturated fatty acids.

The high protein contents together with the easily destroyable anti-nutritive factor implies an obvious advantage when winged bean seeds are used in animal feed. In addition, the comparatively lower unsaturation of winged bean seed oils implies that the oils would be more stable than oils of other legumes such as soybean and peanut.

In addition to screening the genetic materials for protein, trypsin, inhibitor and oil contents, other biochemical studies have also been initiated. These include fractionation of winged bean seed proteins and studies on phosphorus compounds in winged bean seed, with special emphasis on phytate phosphorus. The final logical step in promoting wind bean seeds as potential protein source is to go into feeding trials in animals. We are at a stage of embarking on a programme of poultry feeding trial.

4.8 WINGED BEAN AS BIOMASS PRODUCER UNDER PLANTATION CROP.

(COLLABORATION WITH SIME DARBY PLANTATION GROUP)

The Winged Bean Center has been approached by Sime Darby, one of the largest plantation group in this country, to carry out a collaborative project in growing winged bean under plantation crops. The objectives of this project are:

i) to study the feasibility of winged bean as a biomass producer when grown under plantation crop.

ii) the beneficial contribution of winged bean, mainly in term of nitrogen fixation, on the plantation crop.

iii) the usage of winged bean as a cover crop in between plantation crop for the view of prevention of soil erosion.

iv) usage of the winged bean biomass as animal feed.

Two sessions of discussions have taken place between the two parties. Collaboration will be such that the Center provide winged bean seed materials and agronomic advice while Sime Darby will provide a new planting of rubber areas. The project is scheduled to begin in October 1982.

4.9 REGIONAL TRIAL. (COLLABORATION WITH MALAYSIAN AGRICULTURE RESEARCH AND DEVELOPMENT INSTITUTE)

An attempt was made to set up a regional trial at one of the MARDI station in the north-western region of Peninsular Malaysia in July/August, 1981. This area was selected because of a distinct dry period (December to March) which is absent in other parts of Peninsular Malaysia. We are interested in finding out how this sort of climatic pattern affects winged bean production. The trial was unfortunately not laid out because of lack of communication and supervision. However, we will be including this trial in our future programme.

4.10 OTHER COLLABORATIVE EFFORTS.

The Center has been supplying seed samples to farmers and scientists requesting ~~for~~ seeds. A collaborative research project has also been set up between the Center and the Department of Biology, University of Southhampton, England. Invitation to participate in our breeding programme has been extended by our plant breeder to other institutions.

4.11 INTERNATIONAL CO-OPERATIVE VARIETAL EVALUATION.

At the Second International Seminar on Winged Bean at Colombo, Sri Lanka, in January 1981, the Winged Bean Center, Malaysia, has been nominated to co-ordinate the Second International operative Winged Bean Varietal Evaluation. The trial is designed to (1) test the adaptation of selected winged bean varieties under a wide range of environmental

conditions, (2) provide sources of germplasm of a new crop which the co-operators can use directly, (3) identify areas which have a potential for winged bean production, and (4) test the response of winged bean to different environments.

It was agreed that seeds of 24 lines were to be contributed by Thailand, Papua New Guniea, Sri Lanka, India, Malaysia, Indonesia and Bangladesh. Unfortunately, some of the countries were late in sending their seeds. The Center has put in great effort to produce sufficient seeds for the trial.

Sufficient seeds have now been produced or acquired. They are now being packed into small packets for despatch. A list giving the 24 lines to be tested in the International Trial is presented in Table 6. The origins together with the number of lines are as follows: Malaysia 6, Thailand 5, Indonesia 5, Papua New Guinea 3, India 2, Sri Lanka 2 and Vietnam 1.

A total of 30 co-operators from all over the world will be participating in the Trial (Table 7). The breakdown of regions and countries of these co-operators are:

North & Central America : U.S.A. 2, Costa Rica 1, Guatemala 1. Puerto Rico 1, Mexico 2, Guam 1.

South America : Ecuador 1.

Europe : Czechoslovakia 1.

Asia : Philippines 1, Malaysia 3, Bangladesh 2, India 2, Pakistan 1, Indonesia 1.

Africa : Zaire 2, Ghana 1, Malawi 2, Mauritius 1, Liberia 1, Comores 1.

Australia & Oceania : Western Australia 1, Papua New Guinea 1.

A manual of standards and procedures to be followed by all the co-operators is being prepared by the Center. The target date of sending out the seeds and the manuals to all the co-operators will be May 1982.

5. FUTURE PROGRAMME

The work at the Center will be continued to achieve the goal of developing and promoting the winged bean to meet the increasing needs for plentiful and nutrition food. Among the future activities of the Center are:

a) Evaluation and documentation of genetic materials from Sarawak and Sabah.

b) Continuation of breeding programme. This includes planting of F1 seeds and their parental materials; genetic analysis of the dialled cross population; and basing on the genetic and physiological information obtained, certain promising lines will be followed by the pedigree or other conventional breeding methods, example, bulk population or backcross. With the availability of funds, a separate programme will be developed to produce lines with high tuber yield. The ultimate step will be the conducting of regional trials of high yielding lines obtained by this hybridization-selection programme.

c) Multiplication of seeds of potential accessions for further agronomic work and for the supply of seeds for collaborative projects (e.g. biomass production under plantation crops).

d) Continuation of photosensitivity screening.

e) Rhizobium and nutritional studies.

f) Continuation of biochemical studies and embarkment on feeding trials.

g) Collaborating the International Trial.

6. GRANT REQUESTED

For future programme of the Center for the period March 1982 through February 1983, a grant of US$ 15,000/- is requested from the Council. This fund will be used as follows:

		US$
1)	Services: 3 labours @ about $110/month -	3,800.00
	Research assistant -	4,800.00
	Part-time assistant -	1,500.00
		10,100.00
2)	Small equipments and expendable agricultural supplies -	3,000.00
3)	Travel -	1,500.00
4)	Postage, film, duplication, stationary -	400.00
	TOTAL:	15,000.00

TABLE 1 : COMPARISON OF QUANTITATIVE CHARACTERISTICS OF GERMPLASM. (PARTIAL RESULTS ONLY)

CHARACTER	ORIGIN/SOURCE	NO. ACC EVALUATED	RANGE	MEAN
FLOWERING	PAPUA NEW GUINEA	31	38-78	56.0
	INDONESIA	28	53.115	68.5
	THAILAND	35	51-104	68.9
	MALAYSIA	36	64-118	74.4
PODS/PLANT	PAPUA NEW GUINEA	30	5-44	19.3
	INDONESIA	17	8-63	26.3
	THAILAND	30	6-110	37.4
	MALAYSIA	32	15-70	30.8
POD YIELD (G)	PAPUA NEW GUINEA	30	7.8-153.2	55.1
	INDONESIA	17	30.6-275.0	106.9
	THAILAND	30	23.3-254.3	97.9
	MALAYSIA	-	- -	-
POD LENGTH (CM)	PAPUA NEW GUINEA	30	7.9-19.1	13.2
	INDONESIA	17	12.7-22.3	17.5
	THAILAND	30	10.5-26.8	17.2
	MALAYSIA	32	14.0-24.1	19.3
SEEDS/POD	PAPUA NEW GUINEA	30	6.0-14.3	8.3
	INDONESIA	17	6.0-15.0	9.0
	THAILAND	30	5.0-16.2	9.2
	MALAYSIA	32	8.9-15.7	9.6
SEED YIELD/ PLANT (G)	PAPUA NEW GUINEA	30	9.6-102.7	33.7
	INDONESIA	17	21.5-241.1	79.1
	THAILAND	30	15.1-318.2	99.6
	MALAYSIA	32	40.8-232.0	90.9

TABLE 2 : AGRONOMIC CHARACTERISTICS OF POTENTIAL WINGED BEAN ACCESSIONS.

Acc. No.	Source	Total seed yield per plant (g)	Total pod no per plant	Mean seed no per pod	Mean pod length (cm)	100-seed weight (g)	Days to 1st flowering	Extrapolated seed yield per hectare (kg) (20,000 plant)
234c	Indonesia	257.6	67	12.1	17.7	33.8	63	5152
102 c	Malaysia	255.4	82	10.1	15.0	34.6	72	5108
242 b	Malaysia	216.8	58	12.6	21.7	36.2	100	4336
62 c	Nigeria	180.7	80	10.4	16.7	20.7	90	3614
290 b	Thailand	144.1	59	11.9	18.2	28.6	66	2882
158 b	P.N.G.	127.3	47	11.2	16.3	23.2	64	2546
239 a	Indonesia	121.4	53	9.6	16.9	27.2	62	2428
15 d	Thailand	120.5	30	12.0	21.4	37.2	64	2410
91 a	Indonesia	112.3	46	11.1	18.6	21.1	58	2246
306 a	P.N.G.	112.0	36	9.4	16.0	27.7	64	2240
238 a	Indonesia	109.5	39	9.0	17.6	28.4	84	2190
20b	Thailand	103.6	37	9.7	19.1	29.8	69	2072

TABLE 3 PROTEIN, TRYPSIN INHIBITOR AND OIL CONTENTS OF THE WINGED BEAN SEEDS.

New Guinea varieties	Protein (%)	Trypsin inhibitor (million I.U.)	Oil (%)	Thai varieties	Protein (%)	Trypsin inhibitor (million I.U.)	Oil (%)
023(a)	42.5	6.2	17.1	173b(d)	35.3	5.1	17.4
046(b)	37.0	6.6	18.1	157(e)	30.5	5.7	15.7
048(a)	34.1	4.6	21.4	192(a)	32.9	6.3	16.1
051(b)	35.1	4.0	18.9	202(d)	30.1	6.1	18.8
079(c)	35.7	6.3	16.5	190(a)	33.6	5.6	18.1
079(e)	35.7	7.6	24.8	181(b)	37.1	3.7	14.1
201(a)	34.9	4.7	16.6	186(d)	31.1	7.4	13.6
195(b)	34.2	7.9	16.2	184(b)	36.4	7.4	16.3
039(a)	36.0	8.1	17.9	187(e)	34.9	6.8	16.7
034(b)	37.0	8.0	17.8	157(d)	32.2	7.3	15.5
025(a)	33.6	7.5	19.0	185(e)	24.9	6.9	14.2
029(b)	37.0	5.6	18.4	188(c)	34.5	6.6	15.9
050(a)	32.9	4.6	17.3	205(c)	33.7	6.3	16.6
044(a)	33.6	5.0	18.9	195(c)	28.8	6.9	18.1
042(a)	36.5	5.5	17.9	188(d)	34.5	6.6	13.7

TABLE 4 FATTY ACID COMPOSITION OF WINGED BEAN SEED OILS.

New Guinea varieties	Fatty acids (area %)											Total sat.	Total unsat.
	14:0	16:0	16:1	18:0	18:1	18:2	20:0	20:1*	22:0	22:1	24:0		
023(a)	0.1	7.7	0.1	4.2	29.8	34.2	1.6	2.6	15.5	0.8	3.3	32.4	67.5
046(b)	T	7.6	0.2	5.4	33.5	29.2	1.9	2.5	15.8	0.4	3.5	34.2	65.8
048(a)	0.1	10.2	0.1	5.0	34.9	28.0	1.6	2.2	14.7	0.6	2.7	34.3	65.8
051(b)	0.1	8.8	0.2	5.2	31.1	29.8	1.8	2.9	16.3	0.6	3.2	35.4	64.6
079(c)	0.1	8.5	0.1	4.9	30.7	32.1	1.6	2.6	15.9	0.5	3.7	34.7	65.1
079(e)	T	8.1	0.1	5.1	30.2	29.7	1.9	2.6	17.4	0.7	3.9	36.4	63.3
201(a)	0.1	4.7	0.2	7.4	39.3	23.9	1.8	2.4	15.6	0.6	3.9	33.5	66.4
195(b)	T	7.5	0.2	5.5	30.5	29.3	1.4	4.3	16.5	0.7	3.9	34.8	65.0
039(a)	T	7.9	0.3	5.3	33.3	28.3	1.3	3.6	15.3	0.6	4.0	33.8	66.1
034(b)	T	8.1	0.3	6.5	30.1	27.5	1.7	4.1	16.6	0.7	4.3	37.2	62.7
025(a)	T	7.6	0.2	5.8	37.1	25.2	1.2	4.0	15.3	0.5	3.0	32.9	67.0
029(b)	0.1	7.8	0.2	5.8	34.0	26.9	0.5	3.7	15.6	0.6	4.4	34.2	65.4
050(a)	0.1	8.5	0.1	5.9	33.1	27.4	0.8	3.8	16.3	0.5	3.2	34.8	64.9
044(a)	0.2	7.6	0.5	5.6	34.3	27.4	1.2	4.0	15.0	0.6	3.5	33.1	66.8
042	T	8.5	0.1	5.5	29.6	29.3	0.7	4.2	16.8	0.8	4.2	35.7	64.0

*20:1 co-elutes with 18:3

T = trace, less than 0.1%

sat. = saturated, unsat. = unsaturated

TABLE 5 : FATTY ACID COMPOSITION OF WINGED BEAN SEED OILS.

Thai varieties	Fatty acids (area %)											Total sat.	Total unsat.
	14:0	16:0	16:1	18:0	18:1	18:2	20:0	20:1*	22:0	22:1	24:0		
173(d)	T	7.5	0.1	5.3	32.1	29.4	0.6	4.0	16.1	0.6	4.1	33.6	66.2
157(e)	T	7.8	0.1	5.3	35.8	27.1	0.7	4.1	15.2	0.4	3.3	32.3	67.5
192(a)	T	8.3	0.1	4.6	30.7	29.4	0.7	4.4	16.1	0.7	4.6	32.1	62.5
202(d)	T	6.8	0.2	8.4	35.8	24.1	0.7	3.8	15.1	0.5	4.5	35.5	64.4
190(a)	T	7.4	0.2	7.3	34.9	25.3	1.1	4.0	15.6	0.5	3.6	35.0	64.9
181(b)	T	8.0	0.1	4.7	33.4	30.6	0.8	3.8	14.7	0.5	3.2	31.4	68.4
186(d)	T	8.3	0.1	4.7	32.1	31.5	0.7	4.4	14.2	0.4	3.3	31.2	68.5
184(b)	T	8.0	0.2	5.1	34.4	28.7	0.4	3.9	14.7	0.8	3.8	32.0	68.0
187(e)	T	6.9	0.2	5.1	35.1	27.9	0.8	3.9	15.4	0.8	3.7	31.9	67.9
157(d)	TT	7.7	0.2	4.9	38.0	26.3	1.0	3.6	14.6	0.5	3.0	31.2	68.6
185(c)	T	7.6	0.1	6.4	37.9	24.9	1.3	3.7	14.7	0.3	2.8	32.8	66.9
188(c)	T	8.1	0.1	4.7	28.6	32.4	0.7	4.3	16.2	0.4	4.4	34.1	65.8
205(c)	T	6.7	0.2	4.6	33.5	29.7	0.4	4.3	16.4	0.4	3.6	31.7	68.1
195(c)	T	7.1	0.1	5.4	31.8	28.1	0.8	4.4	16.7	1.1	5.5	35.5	64.5
186(c)	T	7.1	0.2	4.6	32.9	28.6	0.7	4.3	16.4	1.0	4.0	32.8	67.0
188(d)	T	8.7	0.1	5.8	31.7	28.7	0.9	4.1	14.9	0.6	4.3	34.6	65.2

*20:1 co-elutes with 18:3

T = trace, less than 0.1%

sat. = saturated, unsat. = unsaturated

TABLE 6 : WINGED BEAN LINES FOR INTERNATIONAL TRIAL.

Source	Lines
1. Thailand	12-02
2.	14-03
3.	27-02
4.	28-01
5.	46-03
6. Malaysia	UPM 207
7.	UPM 205
8.	UPM 277
9.	UPM 281
10.	UPM 282
11.	UPM 285
12. Indonesia	LBN-C26C(T)
13.	LBN-C26V(B)
14.	LBN-C33P(C)
15.	LBN-C8HP(C)
16.	LBN-C8HH(C)
17. Papua New Guinea	UPS 62
18.	UPS 102
19.	UPS 122
20. India	GRWB 11
21.	GRWB 26
22. Sri Lanka	SLS 40
23.	SLS 47
24. Vietnam	Binh Minh

TABLE 7 : LIST OF PARTICIPANTS OF SECOND INTERNATIONAL CO-OPERATIVE WINGED BEAN VARIETAL EVALUATION.

1. Professor J.J. Paulus,
Department of Biology, University Campus,
B.P. 190, Kinshasa XI, Zaire.

2. Dr. Sharafot Hossain Khan,
Head, Plant Breeding Division,
Bangladesh Agriculture Research Institure,
P.O. Chandan, Joydelipur, Decca,
Bangladesh.

3. Mr. S.K. Karikari,
Department of Crop Science,
University of Ghana, P.O. Box 44,
Legon, Ghana.

4. Dr. P.K. Gopalakrishnan,
Professor of Horticulture, College of Horticulture,
Kerala Agricultural University, Trichur,
Kerala State,
India.

5. Mr. Chanika,
Chitedze Agricultural Research Station,
P.O. Box 158, Lilongwe-Malawi,
Central Africa.

6. Dr. Quazi Abdul Fattah,
Professor of Botany, University of Dacca,
Bangladesh.

7. Dr. V. Kesavan,
Department of Agriculture, P O. Box 4820,
University of Papua New Guinea,
Papua New Guinea.

8. Dr. S. Sastrapradja,
National Biological Institute,
Bogor, Indonesia.

9. Dr. Chin-Tian Lee,
College of Agriculture and Life Sciences,
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Guam 96910.

10. Dr. Gustavo A. Enriquez,
CATIE, Turrialba, Costa Rica,
Central America.

11. Dr. Keertee Ruhee,
School of Agriculture, University of Mauritius,
Re'duit, Mauritius.

12. Dr. M. Aslam,
Director Advanced Studies,
University of Agriculture, Faisalabad,
Pakistan.

13. Dr. V.E. Dalpadado,
Practical Agricultural School,
NAPO, Tena, Ecuador,
South America.

14. Dr.Guillermo Hernandez Bravo,
Instituto Nacional de Investigaciones,
Agicolas, S.A.R.H., Apartado Postal 6-882,
Mexico.

15. Dr. K.P.S. Chandel,
National Bureau of Plant Genetic Resources,
I.A.R.I. Campus,
New Delhi-110012, India.

16. Dr. Lethel Telek,
Research Chemist,
Mayaguez Institute of Tropical Agriculture,
P.O. Box 70, Mayaguez, Puerto Rico 00708.

17. Ing. Roberto Jarquin,
Division de Ciencias Agricolas,
Y De Alimentos, Carretera Roosevelt,
Zona 11-AP Postal 1188,
Guatemala, Central America.

18. Dr. Mallik A-As-Saqui,
Head, Division of Field Crops,
Central Agricultural Research Institure,
P.O. Box 32, GBARNGA, Bong County,
Liberia, West Africa.

19. Professor Frank Pospisil,
Zahradnicke Obory,
Agronomicka Fakulta, Oddeleni,
LEDNICE na Morave, Czecholovakia.

20. Professor A.A. Duncan,
Center Director,
Institute of Food and Agricultural Science,
University of Florida, Homestead, Florida 330331,
U.S.A.

21. Dr. Jacques Grison,
Conseiller Technique Principal,
F.A.O. B.P. 289, Moroni, Comores.

22. Mr. L.D.M. Ngwira,
Senior Agronomist,
Ministry of Agriculture,
Chitexze Agricultural Research Station,
P.O. Box 158, Lilongwe, Malawi,
Central Africa.

23. Mr. M. Cote,
Institute Technique Agricole,
B.P. 43, Ngandajika, Kasai Oriental,
Republique de Zaire.

24. Dr. Jean Pierre Hallet,
c/o The Pygmy Fund,
P.O. Box 1067, Malibu, CA 90265,
U.S.A.

25. Dr. Francisco Cardenas Ramos,
Co-odinator Nacional deRecursos Geneticos,
INIA Arcos de Belen No. 799 piso,
Mexico I, D.F.

26. Dr. Dely P. Gapasin / Dr. Ponciano A. Batugal,
Crops Research Division,
Philippines Council For Agricultural & Resource Research,
Los Banos, Laguna,
Philippines.

27. Dr. Graham Eagleton,
Department of Agriculture,
Kunnunarra,
Western Australia.

28. Dr. B.S. Jalani,
Department of Genetics,
Universiti Kebangsaan Malaysia,
Kuala Lumpur,
Malaysia.

29. Mr. Voon Boon Hoe,
Tarat Agricultural Station,
Department of Agriculture,
Sarawak,
Malaysia.

30. Mr. K.C. Wong,
Department of Agronomi & Horticulture,
Universiti Pertanian Malaysia,
Serdang, Selangor,
Malaysia.

UNIVERSITY OF PERADENIYA

My No. Ag/D/210/RA

Your No:

OFFICE OF THE DEAN
FACULTY OF AGRICULTURE
PERADENIYA

TELEPHONE 08 8041

AUG 30 1982

August 19 1982

Mr.Lou Lazeroff
Director
International Council for Development of
Under utilized Plants
18, Meadow Park Court
Orinda, California 94563
USA.

Dear Lou,

I am forwarding herewith a Progress Report upto July 1982, on winged bean research undertaken, together with a statement of the finances.

The report includes, not already completed as well as on-going research. There are 11 trials and one acre of seed production area in progress. These trials are expected to continue till end of October. The new plantings have also being planned for mid-October. The progress on plant breeding research conducted by Dr.Omran is also progressing well. Two more students have registered for Ph.D. research on winged bean breeding. They will be attached to the Postgraduate Institute of Agriculture from October 1982.

At present there are six trial locations, Kandy, Matara, Batticaloa, Mahailluppalama and the Coconut Research Institute at Lunuwila and Ambalangoda. The trial locations cover the wet, intermediate and dry zones of Sri Lanka. The labour bill per month amounts to about Rs.3000/- and inspite of the transfer of funds to consumables which is a heavy head of expenditure, the excess expenditure is Rs.867/50. However, I have spent Rs.2084.62 out of the consumables for the postage of seed materials by air mail at your request.

It would be desirable to add on to the consumables vote an extra amount of Rs.5000/- for postage of seeds, or fund seperately for postage. There are many requests for seeds from all over the world, and it keeps on increasing.

The balance as at present under all heads of expenditure is given, and the total amounts to about Rs.9429.96 which is sufficient for payments of August and September. It is very essential to continue the research and the seed production program. I have included a seperate budget for seed production. At this moment funds are a serious constraint and I appreciate if you could approve the budget as early as possible.

With kind regards,

Yours sincerely,

H.P.M.Gunasena
Dean/Agriculture

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Winged Bean Research Program

Financial Statement as at 15.7.82

Item of Expenditure	Allocation Rs.	Expenditure Rs.	Balance Rs.
1. Consumables	10,000.00 *10,300.00	21,167.50	-867.50
2. Labour	25,000.00	21,879.00	3121.00
3. Germ plasm collection	10,000.00	9,083.54	916.46
4. Staff Travel	10,000.00	6,990.00	3010.00
5. Research Assistant	9,600.00	6,350.00	3250.00
6. Equipment	12,000.00 (Rs.10,300/- transferred to consumables)	1,700.00	Nil
Total:	76,600.00	67,170.04	9429.96

* Rs.2084.52 spent from consumables vote for air mailing seeds.

Revised Budget Estimate (One Year only)

A. Research Program

	Rs. Cts.
(a) Supplies and requisites	
Laboratory chemicals, Agro-chemicals fertilizer, stakes wire netting, fuel for tractors etc.	40,000.00
(b) Travel and Subsistence	
Travel to experimental sites. for research cordinators, Research Assistants Transport of plant material for sampling and analysis to laboratories, Transporting materials etc.	30,000.00
(c) Packeting and Postage of Seed Samples to overseas cooperations	5,000.00
(d) Personnel	
2 Research Assistants Rs.800/= P.M.	19,200.00
Labour (for all experimental sites	40,000.00
	134,200.00

B. Seed Production Program

Items	Rs. Cts.
1. Land Preparation	1,000.00
2. Planting	1,000.00
3. Weed Control	1,000.00
4. Fertilizer	1,000.00
5. Cost of Stakes, Coir rope etc.	2,000.00
6. Harvesting, Cleaning, inclusive materials for Storage	3,000.00
7. Seed Storage certification & bagging	1,000.00
Total per acre	10,000.00
Funds required for 5 acres	50,000.00
Total	134,200
	50,000
	184,200

Contd.....

The seed Production will be handled by the Coordinator as close supervison is required. The demand for seed is very high, both by local growers, and foreign institutions. The seeds will be certified prior to issue in order to maintain quality and avoid disappoinment.

The estimated seed yield per acre is around 1500 - 2000 lbs.

PROGRESS REPORT - WINGED BEAN RESEARCH

1. Germplasm Collection from Various Districts of Sri Lanka:

Objective: (1) To study the farmer practices and experiences on growing Winged bean in various districts.
(2) To collect traditionally grown winged bean seeds from various districts and study the variations in morphological and reproductive characteristics.
(3) To multiply the collected seeds samples and produce sufficient seeds for agronomic research.

Procedure: Two of my Research Assistant travelled over 14 districts and met five to six farmers, who grow winged bean tradionally as a home garden crop. The districts includes the following:

1. Colombo 2. Galle 3. Matara 4. Hambantota
5. Matale 6. Anuradhapura 7. Jaffna 8. Vavuniya
9. Puttalam 10. Gampaha 11. Kurunegala 12. Kandy
13. Kegalle 14. Ratnapura.

The annexed form was used when collecting the data from farmers (Annex. 1). These samples were labled SLS-55 to SLS-103. Although there were 49 samples. The other districts will be undertaken for the study when more funds become available.

The collected samples were grown in a multiplication plots at Gannoruwa and sufficient seeds were collected for yield evaluation trials.

The yield trials are being carried out at the Experimental Station of the University at Dodangolla, Kundasale.

Winged bean Germplasm Collection in Sri Lanka

Selection No.	District	Village (From where the sample was Collected
SLS - 55	Colombo	Maharagama
SLS - 56	Galle	Kattiyagoda
SLS - 57	Galle	Galle
SLS - 58	Galle	Kalahe
SLS - 59	Galle	Kalahe
SLS - 60	Galle	Kalahe
SLS - 61	Galle	Kalahe
SLS - 62	Galle	Kalahe
SLS - 63	Galle	Kalahe
SLS - 64	Galle	Maharambe

Selection No.	District	Village (from where the sample was collected)
SLS - 65	Galle	Maharambe
SLS - 66	Matara	Sultanagoda
SLS - 67	Matara	Piladuwa
SLS - 68	Hambantota	Tangalle
SLS - 69	Matara	Thompawila
SLS - 70	Matale	Ratalawewa
SLS - 71	Matale	Welagedara
SLS - 72	Matale	Bambawa
SLS - 73	Matale	Galewela
SLS - 74	Anuradhapura	Katkulam
SLS - 75	Jaffna	Malape
SLS - 76	Jaffna	Chunnakam
SLS - 77	Jaffna	Chunnakam
SLS - 78	Jaffna	Alaweddy West
SLS - 79	Jaffna	Urathopuram
SLS - 80	Vavuniya	Vavuniya
SLS - 81	Puttalam	Sirigampola
SLS - 82	Puttalam	Dunkannawa
SLS - 83	Gampaha	Dewuldeniya
SLS - 84	Kurunegala	Giriulla
SLS - 85	Kurunegala	Aturuwela
SLS - 86	Colombo	Nittambuwa
SLS - 87	Kurunegala	Kuliyapitiya
SLS - 88	Kandy	Kandekumbura
SLS - 89	Kandy	Barigama
SLS - 90	Kegalle	Yatiyantota
SLS - 91	Kegalle	Karawanella
SLS - 92	Kegalle	Dehiowita
SLS - 93	Ratnapura	Eheliyagoda
SLS - 94	Kegalle	Ruwanwella
SLS - 95	Kegalle	Attale
SLS - 96	Kegalle	Galigomuwa
SLS - 97	Matara	Nupe
SLS - 98	Gampaha	Walpitamulla
SLS - 99	Gampaha	Ja-Ela
SLS - 100	Matale	Ukkuwela
SLS - 101	Matale	Mahawela
SLS - 102	Kandy	Bokkawela
SLS - 103	Gampaha	Kotugoda

Winged bean Germplasm Collection in Sri Lanka

Selection NO.	Seed Colour	100 Seeds Weight(g)
SLS - 55	Dark Brown	45.41
SLS - 56	Dark Brown	50.00
SLS - 57	Dark Brown	40.44
SLS - 58	Dark Brown	35.48
SLS - 59	Light Brown	36.28
SLS - 60	Dark Brown	31.10
SLS - 61	Dark Brown	36.88
SLS - 62	Dark Brown	38.01
SLS - 63	Light Brown	32.80
SLS - 64	Dark Brown	40.40
SLS - 65	Light Brown	34.12
SLS - 66	Dark Brown	39.12
SLS - 67	Light Brown	36.04
SLS - 68	Light Brown	37.80
SLS - 69	Light Brown	48.80
SLS - 70	Light Brown	40.00
SLS - 71	Light Brown	32.80
SLS - 72	Light Brown	35.20
SLS - 73	Dark Brown	36.92
SLS - 74	Light Brown	34.60
SLS - 75	Light Brown	38.64
SLS - 76	Dark Brown	36.80
SLS - 77	Light Brown	39.24
SLS - 78	Dark Brown	48.64
SLS - 79	Dark Brown	44.60
SLS - 80	Light Brown	42.60
SLS - 81	Light Brown	31.60
SLS - 82	Light Brown	34.68
SLS - 83	Dark Brown	37.27
SLS - 84	Light Brown	33.33
SLS - 85	Light Brown	31.60
SLS - 86	Dark Brown	38.80
SLS - 87	Light Brown	43.04
SLS - 88	Light Brown	38.56
SLS - 89	Dark Brown	35.00
SLS - 90	Dark Brown	51.24
SLS - 91	Light Brown	38.80
SLS - 92	Light Brown	19.24

Selection NO.	Seed Colour	100 Seeds weight (g)
SLS - 93	Light Brown	38.04
SLS - 94	Dark Brown	39.60
SLS - 95	Light Brown	32.40
SLS - 96	Dark Brown	35.20
SLS - 97	Light Brown	32,00
SLS - 98	Light Brown	44.30
SLS - 99	Dark Brown	38.76
SLS - 100	Light Brown	40.44
SLS - 101	Dark Brown	36.52
SLS - 102	Light Brown	38,84
SLS - 103	Light Brown	38.80

As the study has been undertaken for the first time, no definite conclusion could be reached, yet the following information is apparent.

(1). That in every district so far showed winged bean is grown as a home garden crop. It was also noted that some farmers grow it as a small market garden crop for selling the fresh pods at local fairs . Most of the farmers will unable to answer the questions asked according to the structural questionire used. The answers were so unreachable, that it was felt as an unwarrented and hence only seed samples were collected with intension that they will be subjected to a detailed analysis of morphological and reproductive characteristics. The seed colour which was an obvious character ranged from light to dark brown. The 100 seed weight was between 31.10 - 50.00 g.

Annex : 1

Collections of winged bean locally:

Name of person : (Collector) :
Sample No :
District :
Village :
Farmer's Name :
Type of flowers :
Colour of flowers :
Colour of pods :
Flowering time :
Time of planting :
Breeding period :
Harvest :
Duration of Cultivation : :
Growth characters of vine :
Whether tuber produced :
Whether tuber used for consumption :
Any problems in cultivation :
Drought resistant :

Trial - 2 : Variety Evaluation.

Objective : To study the performance and compare the yields of dry pods seeds in 35 varieties (13 Local and 22 introduced varieties) of Winged bean at three Locations in Sri Lanka.

Location : Gannoruwa, Pelwehera and Maha-Illuppallama.

Varieties : Papua New Guinea : UPS - 31. UPS - 32. UPS - 45. UPS - 46. UPS - 47. UPS - 53. UPS - 62. UPS - 66. UPS - 99. UPS - 102. UPS - 121. UPS - 122. UPS - 139 and Chimbu (15).

Nigeria TPT - 1. TPT - 2 TPT - 3. TPT - 8 (4)

Indonesia LBNC - 1. LBNC - 3 (2)

Thailand 25 - 01 Thailand (2)

Sri Lanka. SLS - 1. SLS - 3. SLS - 6. SLS - 7- SLS - 8 SLS - 11. SLS - 16. SLS - 29. SLS - 37 SLS - 40. SLS - 41. SLS - 44. SLS - 47. (13).

Fertilizer : 125 Kg/ha. Sulphate of Amonia.
300 Kg/ha. Super Phosphate.
80 Kg/ha. Muriate of Potash.

The fertilizers were applied at the basel.

Plot size : 40 m x 19 m.
Net plot " : 5 m x 1 m.

Replicate size : 40 m x 5 m.

Spacing : 50 cm between rows.

25 cm between plants within rows.

Method : The selected land of 40 m x 19 m was ploughed and levelled. Three replicate plots of 40 m x 5 m was prepared having a gap of 1 m. between each and 1 m. space around the plots. In each replicate 30 plots of 5 m x 1 m was prepared having a gap of 60 cm. between each plots.

Contd.....

A basal fertilizer of 62.5 g. of Sulphate of Amonia, 150 g. of Super Phosphate and 40 g. of Muriate of Potash was applied to each plot and mixed with soil. 40 planting holes were prepared in each plot having a distance of 50 cm. between rows and 25 cm. within holes. Planted 2 seeds per hill. Each plot had one variety and the main plot had three plots of one variety.

Observations :

1. No. of days to germinations (60%)
2. Hight of plants weekly (5 selected plants from each plot).
3. No. of nodes weekly (5 selected plants from each plot).
4. No. of days to flower (60% of plant).
5. No. of days to first harvest.
6. Dry pod yield/plot (5 harvest).
7. Weight of dry pods/plot (5 harvests).
8. Weight of seeds/plot (5 harvests).
9. Weight of 100 seeds of each plot.

2. Multilocations Varietal Evaluation Trials.

The local collections and the introductions were evaluated in three locations, namely Gannoruwa (Wet Zone), Pelwehera and Maha-Illuppallama (Dry Zone). The trials were started in October (Maha Season) of 1980. The total dry pod number, Dry pod yield (Kg/ha), Seed yield (Kg/ha), 100 seeds weight (g), Number of days to 60% germination, Number of days to first flowering and harvest are given in tables 1,2,3,4,5 and 6.

1. Total number of dry pod per plant.

The total number of dry pod per plant varied widely among varieties. At Gannoruwa the highest pod number was recorded for 25 - 01 (113) followed by Thailand (109),UPS 31 (106), UPS 62 (106) and UPS 122 (107). The lowest pod number was recorded for UPS 121 (46). (Table 1).

At Pelwehera UPS 139 had 202 pods per plant. The others which produced more than 100 pods were UPS 121, TPT 6 (101), LENC 3 (112), 25-01 - (121), Thailand (107), SLS 3 (128), SLS 40 (107), SLS 18 (123) and SLS 47 (142). At Maha-Illuppallama the varieties which produced more than 100 were LENC 1 (115), SLS 6 (115), SLS 11 (101), SLS 29 (101), SLS 37 (104) & SLS 40 (101).

Contd.....

2. Total weight of dry pod (Kg/ha).

Total weight of dry pod include the husk and the seed, and it varied widely with the pod number.

At Gannoruwa the highest yield of dry pods were recorded for LENC 1 (7012 Kg/ha) and Thailand (7204 Kg/ha). The yields ranged from 2156 - 4476 Kg/ha for UPS varieties, while for SLS varieties it was from 3744 - 5824 Kg/ha. (Table 2).

At Pelwehera SLS 6,25,18,47,1,36,11 and 40, 25 - 01, Thailand, UPS 139 and TPT 8 yielded over 6,000 Kg/ha. Here SLS varieties performed better than the introductions.

At Maha-Illuppallama SLS 11, 29, 37,40 and Thailand gave highest yield (5000 Kg/ha) and at this station too SLS varieties gave high yields.

3. Total weight of seeds (Kg/ha).

The total dry weight of seeds is the economic component of the Winged bean (Table 3).

At Gannoruwa 25-01 had a seed yield of 3836 Kg/ha, while Thailand and LENC 1 had seed yields of 3396 and 3112 Kg/ha respectively, followed by LENC 3 (3236 Kg/ha), UPS 139 (3114 Kg/ha) and the rest ranged from 880 - 2582 Kg/ha.

At Maha Illuppallama SLS 11 gave the highest yield (3246 Kg/ha) followed by SLS 29 (3077 Kg/ha), SLS 29 (3077 Kg/ha) and SLS 37 (3019 Kg/ha).

In all locations SLS, LENC and 25-01 varieties performed better than UPS & TPT varieties.

4. 100 Seed weight (grams).

The 100 seed weight is essentially a variety character, however environmental changes could cause its variation.

At Gannoruwa UPS 121 & 122 gave highest 100 seed weight (36-39 g.). SLS 44, 11, 8,& 7 also had seed weight of 30 g. At Pelwehera LENC 1 and 3 , UPS122, SLS 3, 7 & 40 gave over 32 g. SLS 11, 41,47, TPT 2 had a 100 seed weight of over 32 g. at Maha Illuppallama (Table 4).

5. Number of days to seed germination.

Generally germination was earlier in UPS varieties than SLS varieties. The range for all varieties was 6 - 13 at all locations. (Table 5).

Contd.....

6. Number of days to first flowering.

Generally UPS varieties flowered earlier than SLS varieties (Table 6). In UPS varieties range was from 53 - 65 days. While in SLS varieties it was from 60 - 72 days.

7. Number of days to first harvest.

UPS varieties could be harvested before other introduced varieties and local selections.

Table : 1 A.

Total No. of dry pods (5 harvests)

Variety	Gannoruwa (10,000)	Pelwehera (10,000)	Maha-Illuppallama. (10,000)
UPS - 31	108.0	84.0	39.2
UPS - 32	50.4	36.6	34.8
UPS - 45	93.2	52.0	45.6
UPS - 46	-	-	57.2
UPS - 47	62.8	54.4	48.4
UPS - 53	-	97.4	33.0
UPS - 62	106.0	85.2	51.6
UPS - 66	-	-	59.3
UPS - 99	54.4	98.0	37.4
UPS - 102	106.8	99.8	61.8
UPS - 121	48.2	101.8	78.4
UPS - 122	58.4	80.0	75.0
UPS - 139	-	202.4	89.2
Chimbu	-	-	44.0
TPT - 1	79.2	96.0	90.8
TPT - 2	50.4	82.4	72.0
TPT - 6	-	72.2.	80.0
TPT - 5	-	100.8	78.8
LENC - 1	79.8	89.6	112.8
LENC - 3	66.o	111.6	-
25 - 01	113.2	121.0	-
Thailand	109.2	107.4	92.4
SLS - 1	71.2	59.6	98.2
SLS - 3	-	128.2	-
SLS - 6	58.0	79.2	114.8
SLS - 7	77.2	90.4	82.0
SLS - 8	64.4	-	-
SLS - 11	80.8	93.0	101.4
SLS - 18	-	123.0	-
SLS - 29	-	-	100.8
SLS - 37	70.4	95.6	104.2
SLS - 40	69.6	107.0	100.3
SLS - 41	72.0	75.0	85.0
SLS - 44	58.4	91.0	96.88
SLS - 47	72.2	142.2	98.0

Contd....

Table : 1.

Total Weight of Dry Pods Kg/ha.

Variety	Gannoruwa	Pelwehera	Mahs-Illurpallama.
UPS - 31	3466.0	2852.0	1644.0
UPS - 32	2576.0	2021 .8	1852.0
UPS - 45	4476.0	2592.0	2222.0
UPS - 46	-	-	1930.0
UPS - 47	3608.0	2476.0	2003.8
UPS - 53	4124.0	3156.0	3310.4
UPS - 62	4144.0	2816.0	2166.2
UPS - 66	-	-	2264.4
UPS - 99	2324.0	4434.0	3381.1
UPS - 102	3364.0	2802.0	2939.6
UPS - 121	2156.0	5158.0	5442.2
UPS - 122	2852.0	5257.0	3613.8
UPS - 139	-	6136.0	2996.6
Chimbu	-	-	3470.6
TPT - 1	6040.0	5694.0	4834.2
TPT - 2	3740.0	5074.0	3947.2
TPT - 6	-	4380.0	5806.2
TPT - 8	-	6014.0	3880.6
LBNC - 1	7012.0	5628.0	5320.0
LBNC - 3	5356.0	5496.0	-
25 - 01	5864.0	7676.0	-
Thailand	7204.0	6479.0	3779.22
SLS - 01	4332.0	7220.0	3834.6
LSS - 03	-	7842.0	-
SLS - 06	5356.0	8362.0	4300.2
SLS - 07	5624.0	6776.0	3800.0
SLS - 08	3844.0	-	-
SLS - 11	5532.0	6228.0	6614.4
SLS - 18	-	6846.0	-
SLS - 29	-	-	6570.4
SLS - 37	4884.0	6270.0	6343.6
SLS - 40	4764.0	6662.0	6047.4
SLS - 41	5068.0	5452.0	4920.8
SLS - 44	5736.0	5856.0	6017.2
SLS - 47	4860.0	6656.0	5605.0

Contd.....

Table : 2.

Total Weight of Seeds Kg/He (5 harvests)

Variety	Gannoruwa	Pelwehera	Maha-Illuppallama.
UPS - 31	1556.0	1252.4	1200.0
UPS - 32	980.0	706.8	793.6
UPS - 45	1768.0	1064.0	713.6
UPS - 46	-	-	855.2
UPS - 47	1576.0	996.0	933.6
UPS - 53	2000.0	1704.0	1006.6
UPS - 62	2048.0	1339.0	1124.6
UPS - 66	-	-	1029.4
UPS - 99	1148.0	1846.0	987.4
UPS - 102	1648.0	1508.0	1356.6
UPS - 121	1556.0	2136.0	2513.2
UPS - 122	2244.0	2262.0	2464.2
UPS - 139	-	3114.0	2007.8
Chimbu	-	-	1362.6
TPT - 1	2864.0	2410.0	2211.2
TPT - 2	1540.0	1936.0	2749.8
TPT - 6	-	1674.0	2654.4
TPT - 8	-	1452.0	1650.0
LENC- 1	3122.0	1916.0	2735.6
LENC- 3	2492.0	3236.0	-
25 - 01	3936.0	3526.0	-
Thailand	3396.0	2770.0	2978.2
SLS - 01	2008.0	3300.0	2691.2
SLS - 03	-	2740.0	-
SLS - 06	1656.0	1790.0	913.4
SLS - 07	2576.2	2606.0	2613.6
SLS - 08	1660.0	-	-
SLS - 11	2562.0	2346.0	33240.0
SLS - 18	-	2422.0	-
SLS - 29	-	-	3076.6
SLS - 37	2120.0	2530.0	3019.0
SLS - 40	2216.0	2562.0	2958.2
SLS - 41	2232.0	1516.0	3315.0
SLS - 44	2356.0	2326.0	2512.6
SLS - 47	2416.0	2470.0	2726.6

Table : 3

100 Seeds Weight of Winged bean Varieties:

Variety	Gannoruwa	Pelwehera	Ambalantota-Illuppallama
UPS - 31	18.23	22.76	28.00
UPS - 32	24.99	26.83	26.00
UPS - 45	28.00	23.70	31.00
UPS - 46	-	-	28.00
UPS - 47	24.80	23.10	23.40
UPS - 53	28.00	28.76	30.00
UPS - 62	29.60	29.00	24.00
UPS - 66	-	-	26.00
UPS - 99	28.40	28.23	26.00
UPS - 102	22.50	21.83	22.00
UPS - 121	38.29	28.50	30.00
UPS - 132	39.19	22.93	27.00
UPS - 139	-	21.80	20.00
Chimbu	-	-	29.00
TPT - 1	29.03	29.80	28.00
TPT - 2	29.36	31.83	32.00
TPT - 6	-	28.63	26.00
TPT - 8	-	26.50	28.00
LENC - 1	31.40	32.13	34.00
LENC - 3	35.80	33.99	-
25 - 1	31.80	30.03	-
Thailand	33.20	40.40	22.00
SLS - 1	29.33	31.20	27.00
SLS - 3	-	32.26	-
SLS - 6	29.30	18.76	20.00
SLS - 7	35.33	33.20	30.00
SLS - 8	30.96	-	-
SLS - 11	34.83	30.50	34.00
SLS - 18	-	31.26	-
SLS - 29	-	-	24.00
SLS - 37	29.50	29.43	23.00
SLS - 40	30.99	32.46	26.00
SLS - 41	31.00	31.76	32.00
SLS - 44	33.79	31.50	27.00
SLS - 47	29.03	30.40	32.00

Contd.....

Table : 4

No: of Days to Germination (60%)

Variety	Gannoruwa	Pelwehera	Maha-Illuppallama.
UPS - 31	8	7	9
UPS - 32	8	8	9
UPS - 45	7	6	7
UPS - 46	-	-	7
UPS - 47	9	7	9
UPS - 53	8	9	9
UPS - 62	9	10	12
UPS - 66	-	-	9
UPS - 99	7	9	9
UPS - 102	11	9	10
UPS - 121	8	11	10
UPS - 122	7	7	7
UPS - 139	-	8	8
Chimbu	-	-	9
TPT - 1	12	11	12
TPT - 2	8	9	7
TPT - 6	-	11	12
TPT - 8	-	10	11
LENC- 11	12	10	8
LENC- 3	10	9	-
25 - 01	10	10	-
Thailand	11	10	10
SLS - 1	10	11	11
SLS - 3	-	9	-
SLS - 6	12	10	12
SLS - 7	13	10	11
SLS - 8	11	-	-
SLS - 11	8	11	9
SLS - 28	-	11	-
SLS - 29	-	-	12
SLS - 37	11	11	8
SLS - 40	12	11	11
SLS - 41	7	8	8
SLS - 44	10	10	9
SLS - 47	10	8	7

Contd.....

Table : 5.

No. of Days to Flower.

Variety	Gannoruwa	Peiwehera	Mahe-Illupallama.
UPS - 31	55	54	65
UPS - 32	60	53	62
UPS - 45	56	56	63
UPS - 46	-	-	63
UPS - 47	56	54	60
UPS - 53	59	59	66
UPS - 62	58	55	65
UPS - 66	-	-	54
UPS - 99	57	52	64
UPS - 102	61	54	55
UPS - 121	59	56	60
UPS - 122	59	56	54
UPS - 139	-	62	63
Chimbu	-	-	64
TPT - 1	66	66	66
TPT - 2	63	66	59
TPT - 6	-	65	69
TPT - 8	-	60	69
LENC- 1	64	63	72
LENC- 3	67	65	-
25 - 01	59	64	-
Thailand	61	60	66
SLS - 1	67	63	65
SLS - 3	-	68	-
SLS - 6	66	67	67
SLS - 7	66	61	68
SLS - 8	67	-	-
SLS - 11	65	66	67
SLS - 18	-	65	-
SLS - 39	-	-	65
SLS - 37	63	61	66
SLS - 40	67	64	69
SLS - 41	67	64	61
SLS - 44	67	64	67
SLS - 47	66	61	63

Contd.....

Table : 6.

No. of Days to first Harvest (From planting)

Variety	Jannoruwa	Felwehera	Madhu-Illupallama.
UPS - 31	103	86	95
UPS - 32	103	86	95
UPS - 45	103	86	114
UPS - 46	-	-	99
UPS - 47	103	86	95
UPS - 53	113	111	101
UPS - 62	103	86	95
UPS - 66	-	-	95
UPS - 99	103	86	94
UPS - 102	103	96	95
UPS - 121	103	96	95
UPS - 122	103	96	95
UPS - 139	-	111	104
Chimbu	-	-	104
TPT - 1	113	111	95
TPT - 2	113	96	105
TPT - 6	-	111	95
TPT - 8	-	111	111
LBNC - 1	113	111	114
LBNC - 3	113	111	-
25 - 31	113	111	-
Thailand	103	111	106
SLS - 1	113	111	108
SLS - 3	-	111	-
SLS - 6	113	111	105
SLS - 7	113	111	108
SLS - 8	103	-	-
SLS - 11	103	111	113
SLS - 18	-	96	-
SLS - 29	-	-	123
SLS - 37	121	111	108
SLS - 40	119	111	114
SLS - 41	113	111	109
SLS - 44	103	111	116
SLS - 47	113	111	110

1981-82 Studies - Dr. A. Omran.

A. Preliminary study on winged bean earliness and crossing.

A crossing plot was raised during 1981 for 10 of the collections representing different geographical areas and different plant characters.

1.	SLS-3	Sri Lanka
2.	6	" "
3.	11	" "
4.	44	" "
5.	UPS-31	Papua New Guinea
6.	102	" "
7.	121	" "
8.	Thailand	Thailand
9.	LBNC-3	Indonesia
10.	TPT-1	Nigeria.

The earliest lines were those of Papua New Guinea (50-65 days to first flower) followed by Thailand (67 days) then the Sri Lankan lines (77-87 days) and last Indonesian and Nigerian lines (87-89 days).

The ten varieties were crossed in all possible combinations with a success of 33.51%. All lines showed no different when used as males or females but UPS-102 showed superiority as a male parent. Since it was the only winged bean lot in the area, the birds picked most of the formed pods.

B. Evaluation of 25 lines of winged bean.

Experiments started at Peradeniya (Yala 1981) and Batticaloa (Maha 1981-1982). The collection consisted of:

8	Lines	from	Sri Lanka
10	"	"	Papua New Guinea
2	"	"	Indonesea
3	"	"	Nigeria
2	"	"	Thailand.

The Peradeniya results indicated that the Papua New Guinea lines were earlier, had longer internodes, higher numbers of seeds per pod and maximum pod length. The Sri Lankan lines possessed higher numbers of branches. The Indonesian lines showed ovate-lanceolate leaflets and semi-flat pods while the others had deltoid leaflets and mostly rectangular pods. Pod and stem colours varied from green to purple with a relationship between stems and pods in anthocyanin pigmentation.

The Batticaloa experient was affected by drought. However, observations on earliness showed that the the Papuwa New Guinea lines are still the earliest to flower while the Sri Lankan lines varied between early, late and very late.

Contd..page 2...

1982-83 studies

A. Diallel cross.

To study the genetic parameters and combining ability behaviour of winged bean lines. Difficulties in emasculation and crossing are being studied and tackled. Hybrid seeds should be available for planting during the yala season 1983.

B. Evaluation of lines

The same 25 lines of the previous season are evaluated in 3 locations during the Maha and Yala seasons to study genotype-environment interactions and stability of the lines and varieties. Seed characters and protein analysis will be carried out.

AC:sdes.

(65)

SEARCA

SOUTHEAST ASIAN REGIONAL CENTER FOR GRADUATE STUDY AND RESEARCH IN AGRICULTURE
College, Laguna 3720, or P.O. Box 720 MCC, Makati, Metro Manila, Philippines, Tel. Nos.: 2317, 2290 Cable Address: SEARCA, Manila

THE INTERNATIONAL DOCUMENTATION CENTER FOR THE WINGED BEAN

8 March 1982

Mr. Louis Lazaroff
Director-General
International Council for
Development of Underutilized
Plants
18 Meadow Park Court
Orinda, California 94563
U. S. A.

Dear Lou:

As indicated in the Letter of Agreement between SEARCA and ICDUP of September 1981, we are sending you the half-year progress report on the activities of the International Documentation Center for the Winged Bean. We will, in our year-end report to the Council in September, give more detailed information on the data bank we are developing, as we would have the capability to retrieve data from the computer file by that time.

We have been receiving inquiries, particularly from local researchers on the winged bean, as to when the proceedings of the second international seminar will be published. Please inform us of developments on this.

Russ informs me that he will be sending the manuscript for v. 4, no. 1 of the Winged Bean Flyer shortly. If we are able to come out with the issue in late April or early May, we would then be up-to-date.

All the best.

Yours sincerely,

J. C. SISON
Project Manager

cc: R. A. Stephenson

THE INTERNATIONAL DOCUMENTATION CENTER FOR THE WINGED BEAN
Progress Report Covering the Period from
1st September 1981 - 28th February 1982

1. Introduction

Well into its third year of operations, the International Documentation Center for the Winged Bean continues to strengthen its capability for providing information to winged bean researchers and to those interested in winged bean work.

The Center's activities during the period under review concentrated on the following areas: inquiry-answering service, publication of *The Winged Bean Flyer* and the *Winged Bean Bibliography*, collection development, and computerization of information services. In addition, liaison with other international agricultural research centers (IARCs) was effected in November, 1981 through the attendance of AIBA in the Handling of Legumes Information Meeting held at the World Bank Headquarters in Washington, D.C. in conjunction with CGIAR Week.

2. Inquiry-answering Service

Perhaps as an offshoot of the publication of the Documentation Center's activities in *The Winged Bean Flyer*, the number of requests for copies of documents and for information have been on the rise. For the period from September 1, 1981 to February 28, 1982, forty-one requests for information and/or copies of documents have been received. Requests dealing with specific research information are

usually referred by the Center to the winged bean researchers at the Institute of Plant Breeding, U.P. at Los Baños, to the Legumes Project Team Leader at SEARCA, or to the scientists working on specific aspects of the winged bean plant (e.g. Dr. T.V. Price for pests and diseases of winged bean). The senior staff member of AIBA who coordinates the winged bean project handles such requests from users all over the world.

3. Publications

3.1 The Winged Bean Flyer

As with v. 3, no. 1, one thousand five hundred copies of v. 3, no. 2 were printed. This issue of *The Flyer* has so far been distributed to 912 persons in 97 countries. Requests for copies of the newsletter are still coming in for the current issue as well as for the earlier ones.

The present issue, for the most part, contains the abstracts of the papers presented during the Second International Seminar on the Winged Bean held in Sri Lanka. Table 1 shows the distribution of *The Winged Bean Flyer* (v. 3, no. 2) by region as of February 1982.

3.2 The Winged Bean Bibliography

The 1981 edition of the bibliography was published in October last year and is composed of 420 entries. The text was computer-formatted, as well as the author, keyword and geographic indexes. Most of the entries in

Table 1. Distribution of the Winged Bean Flyer (v. 3, no. 2) by region as of February 28, 1982

Region	No. of Countries v. 3(2)	No. of copies v. 3(2)
Asia		
East Asia	5	24
South Asia	5	114
Southeast Asia	8	110
Southwest Asia	7	8
Africa	18	111
Europe	13	77
Central America	7	21
North America	3	284
South America	12	52
Oceania	7	72
Pacific Islands	2	2
Caribbean	6	25
West Indies	4	12
TOTAL	97	912

Table 2. Distribution of the Winged Bean Bibliography (1981 edition) by region as of February 28, 1982

Region	No. of Countries 1981 edition	No. of copies 1981 edition
Asia		
South Asia	3	3
Southeast Asia	6	15
Africa	2	2
Europe	4	4
North America	2	14
Oceania	2	5
TOTAL	19	43

the bibliography are with abstracts. Of the 500 copies printed, 43 copies have been distributed so far to users in 19 countries. Table 2 shows the distribution pattern of the bibliography by region and country.

4. Collection Development

The Center continues to gather copies of literature on the winged bean. It now has close to 600 copies of papers, articles, theses and monographs on the legume in its collection. Users may avail of the materials they request in either microfiche

or photocopy form.

5. Computerized Information Services

5.1 Bibliographic Data base

The Center uses the AIBA method of entering bibliographic records into the winged bean data base. This format is that developed and used by the International Information System for the Agricultural Sciences and Technology (or AGRIS). A total of 800 citations have been entered into the data base. The IBM/STAIRS (Storage and Information Retrieval System) software package is being used to retrieve bibliographic information from the data base.

5.2 Research Data Bank

Work on the development of the research data bank on the winged bean is being carried out by the systems team at AIBA.

To make the development work on the data bank as manageable as possible, it was decided to limit the data to be collected to the botanical and pathological aspects of the winged bean for the duration of the experimental phase of the work.

For present purposes, the input form consists of 8 descriptors and 41 numerical information with a total length of 218 characters. The information is subdivided

into 4 sets of data organization that require four 80-column cards (see attached data bank input form).

As an initial step, data from studies published in *The Winged Bean Flyer* are being encoded as test data for inclusion in the bank. Meanwhile, a validation program is being developed in order to check the 'correctness' of the encoded inputs before the initial data bank is created.

The experience gained in this exercise would be helpful in getting more 'feel' for the data and will be a big factor in the detailed design of the data bank management system.

The speed of the development of the winged bean data bank depends on the nature and direction of the future implementation of AIBA's computerization goal. To attempt to develop a software for the data bank would require excessive man-hours of development and a bigger budget allocation.

At this point, there are two possible directions which the Center could take as far as developing the computer system for the data bank is concerned. If AIBA will be able to acquire a Hewlett-Packard 3000 minicomputer (it has plans for getting one in the very near future), the MINISIS software developed by IDRC could very well be used for the data bank. On the other hand, if AIBA would still have to use the

present IBM 370/135 computer (which it shares with four other institutions) it would still explore the use of the EXIR software for data storage and retrieval The implementation of the latter alternative would be slow because the present computer configuration available for AIBA's use is already overloaded.

THE INTERNATIONAL DOCUMENTATION CENTER FOR THE WINGED BEAN
Data Bank Input Form
(Draft)

I. Information on Contributor(s)

1. Accession Number (1–7)
2. Date of Information (8–13) — 80: 1
3. Contributor(s) ID (14–18)
4. Name of Contributor(s) (19–38)
5. Address (39–53)

II. Collection Data

1. Accession Number (1–7)
2. Collection Number (8–14)
3. Botanic Name (15–35; 36–45)
4. Local Name (46–61)
5. Cultivar/Variety (62–77) — 80: 2
6. Collection Date (1–7; 8–11)
7. Country of Origin (12–13)
8. Country of Collection (14–15)
9. Province/State (16–25)
10. Station (26–35)
11. Altitude (m) (36–39)
12. Source of Collection: (roadside (1), shifting cultivation (2), farm land (3), backyard (4), markets (5), others _____ (6))
    (specify)
    (40–41) — 80: 3

III. Botany

1. a) Plant Type: (poor (1), sparse (3), moderate (5), good (7), luxuriant (9)) [8]

   b) Plant height (cm) [9–11]

2. Percent Germination [12–15]

3. Days to Emergence [16–17]

4. Days to first flower formation [18–20]

5. Days to first pod formation [21–22]

6. Leaf:

   a. Color of leaves:

      (green (1), greenish purple (2), purple (3), others _____(4)) [23]
      (specify)

   b. Leaf length (cm) [24–26]

   c. Leaf width (cm) [27–29]

   d. Leaflet shape:

      (oviate (1), deltoid (2), ovate-lanceolate (3), lanceolate (4), long-lanceolate (5)) [30]

7. Stem color:

   (green (1), greenish purple (2), purple (3), others _____(4)) [31]
   (specify)

8. Flower

   a. Calyx colour:

      (green (1), greenish purple (2) purple (3), others _____(4)) [32]
      (specify)

b. Corolla colour:

(white (1), light blue (2), blue (3), bluish purple (4), others _____(5)) 33
(specify)

9. Pod Characters

a. Pod colour:

(cream (1), light green (2), green (3), dark green (4), pink (5), purple (6), others _____(7)) 34
(specify)

b. Pod specks: (absent (0), present (1)) 35

c. Wing colour: (light green (1), green (2), dark green (3), light purple (4), purple (5), dark purple (6) others _____(7)) 36
(specify)

d. Pod surface texture:

(very smooth (1), very rough (9)) 37

e. Pod shape:

(rectangular (1), semi flat (2), flat on sides (3), flat on suture (4)) 38

f. Pod length (cm) 39 41

g. Pod width (cm) 42 43

h. Pod per plant 44 45

10. Seed Characters

a. Seed colour: (Royal Horticultural Society (UK), colour charts)) 46 49

b. Seed mottling: (absent (0), present (1) 50

c. Hilum colour: (Royal Horticultural Society (UK), colour charts) 51 54

d. Seed shape: (round (1), oval (2), others _____(3)) 55
(specify)

e. Seed size (cm) 56–58

f. Seed yield per pod (g) 59–61

g. 100 seed weight (g) 62–65

h. Seeds/pod 66–68

i. Shelling percentage 69–70

11. Tuber

1. Presence (1) or absence (0) of tuber 71

2. Tuber size (in cm) 72–73

a. Diameter (at the widest point) 74–75

b. Length 76–77

3. Tubers per plant 78–79 80 4

4. Tuber yield per plant (g) 1–7 8–12

12. Photoperiod sensitivity:

(sensitive (1), insensitive (0)) 13

13. Shattering in the field:

(none (1), moderate (5), complete (9)) 14

IV. Reaction to Pests and Diseases

1. Disease susceptibility:

(false rust (1), pseudo cercospora (2), powdery mildew (3), viruses (4), root rot (5), others _____ (6) or above
(specify)

1st column	1 - 9
2nd column	Pathogens
3rd column	Parts

1st 2nd 3rd 15–17

2. Pest reaction:

(nematodes (1), pod borer (2), leaf miner (3), aphids (4), mites (5), others _____ (6)) or above
(specify)

1st column	pest
2nd column	parts
3rd column	degree

1st 2nd 3rd 18–20 80 5

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the winged bean flyer

Edited by
RUSS A. STEPHENSON

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I. EDITORIAL

Contributors will be relieved to know that, in this issue, all outstanding reports have been included. The large delay in including some of this material is regretted. It is hoped that the information on the Second International Winged Bean Seminar which dominated *The Winged Bean Flyer* Vol. 3 No. 2 will compensate for this.

All contributions to *The Flyer* are appreciated and we look forward to your continuing support. Vol. 4 No. 2 is due to be published later this year and more articles, letters and reports are required to make it a worthwhile issue.

I had hoped to present a report on the establishment of the new Winged Bean Research Institute in Sri Lanka in this issue but legislative delays have forced the postponement of the inaugural Board meeting. I anticipate that a comprehensive report will be available for Vol. 4 No. 2. Other important developments arising from the Sri Lankan meeting are the Second Series of International Variety Trials and the publication of the full proceedings of the Seminar. Progress reports should be available for Vol. 4 No. 2. It should also be possible to present a preliminary report on the survey questions which were included in Vol. 3 No. 2. If you have not returned your survey forms, please do so promptly.

It is my intention that, from this year onwards, two issues of *The Winged Bean Flyer* will be produced regularly each year. This can only be achieved by your cooperation in sending in material of interest. You can assist by including a concise summary of lengthy papers or reports. This would relieve the editor of an onerous task and reduce the possibility of misinterpretation of material submitted. Summaries, generally, should be restricted to about one-half a typed quarto page. It would further assist the editor if correspondents would ensure that their country of residence is included in their address. Printed letterheads are often not designed for international use.

Finally, I trust *The Winged Bean Flyer* is proving to be of interest to readers. If you have any suggestions which would make it a more effective organ of communication between winged bean workers, please send them to the Editor.

II. INAUGURATION OF INTERNATIONAL DAMBALA (WINGED BEAN) INSTITUTE

The International Dambala (Winged Bean) Institute was formally chartered by the government of Sri Lanka in early February 1982 as an Independent International Agricultural Research Body. This is the first international institute devoted to work with an underutilized plant. The members of the first board of directors, appointed by H.E. The President of Sri Lanka, consist of the following:

Dr. Cyril Ponnamperuma
(Chairman)
Director, Laboratory of Chemical
Evolution
University of Maryland
U. S. A.

Dr. M.S. Swaminathan
(Vice-Chairman)
Director General, IRRI
Philippines

Dr. Eduardo Alvarez-Luna
President, International Council
for Development of Underutilized Plants
Mexico

Dr. Alexander Grobman
Chief, Instituto Nacional de Investigacion
y Promocion Agropecuaria (INIPA)
Peru

Dr. H.M.W. Herath
Head, Department of Agricultural Biology
University of Peradeniya
Sri Lanka

Dr. W. David Hopper
Vice President, South Asian Region
The World Bank

Mr. Louis Lazaroff
(Secretary-Treasurer)
Director General, International Council
for Development of Underutilized Plants
U. S. A.

Dr. R.J. Olembo
Director, Environmental Management Service
United Nations Environment Program
Kenya

Dr. Victor Rabinowitch
Director, Board on Science and Technology
for International Development
National Academy of Sciences
U. S. A.

Mr. Ranjan Wijeratne
Secretary, Ministry of Agricultural Development
and Research
Sri Lanka

The government of Sri Lanka is providing the International Institute with approximately 483 acres of prime land six miles east of Kandy in the central part of Sri Lanka. There are buildings on the land which can readily be converted to institute use. Roads, electric, telephone and water lines are in place.

On March 16, 1982, the institute was formally inaugurated with the first meeting of the Board of Directors, held on the land being provided the institute. Among other business conducted, the board appointed a search committee to select a Director General. An interim Director General will be named pending selection of the Director General. The board also appointed Dr. H.M.W. Herath of the University of Peradeniya, Sri Lanka, to be Deputy Director General.

The next meeting of the board will be held in November. Funding for the institute is expected from The World Bank, the Government of Sri Lanka, and other national and international development agencies which have expressed interest in providing support.

III. APPOINTMENT OF NEW MEMBER, BOARD OF DIRECTORS, ICDUP

Dr. Joseph C. Madamba, the new Director of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA),

the Philippines, has been elected to the Board of Directors, The International Council for Development of Underutilized Plants. Prior to his appointment to SEARCA, Dr. Madamba was director of the Southeast Asian Fisheries Development Center Institute of Aquaculture (SEAFDEC-IA) and served as Director General of the Philippine Council for Agriculture and Resources Research and Development (PCARRD).

Dr. Madamba was one of the architects of PCARRD. He has served with distinction also at the international level as a member of the Technical Advisory Committee (TAC) of the consultative group for International Agricultural Research, and is now Secretary-General of the International Federation of Agricultural Research Systems for Development (IFARD), Philippines and member, Board of Trustees, of the International Council for Research in Agro-Forestry (ICRAF) in Kenya.

Dr. Madamba is noted for his rich and unique experience in agricultural research, development and education.

IV. LETTERS TO THE EDITOR

1. Breeding for white winged beans?

We have analyzed some 30 different lines of mature winged bean seed from various regions of Asia (Papua New Guinea, Malaysia, Indonesia, Thailand and Burma). We have found that the seed protein profiles, as determined electrophoretically in sodium dodecyl sulfate using polyacrylamide gradient gels, are essentially identical (also found previously for some 80 lines from Papua New Guinea (1)). Furthermore, the levels of the anti-nutritional factors (trypsin and chymotrypsin inhibitors and hemagglutinins) are very similar in these lines. Therefore, from a protein quality point of view there are as yet no marked differences to recommend one winged bean line over another.

With respect to the seed, the only distinguishing feature of interest is the colour of the seed coat. Protein extracts prepared at pH 8 from whole seed meal of light coloured seeds (e.g. Thailand lines MHS 10, MHS 19, NLZ and CR 6) produce clear to pale coloured

extracts. Darker seed varieties (e.g. UPS 122, UPS 102, Tpt 1) produce yellow to brown extracts while UPS 66 produces a deep purple extract which turns dark brown on standing. The light coloured extracts resemble those obtained from soybean and would be favoured as grain legume product by the food processing industry. The lower tannin content of the light coloured seeds may also yield enhanced levels of available protein. As the protein content of all the winged bean lines tested so far is similar, it may be desirable to select (amongst other desirable plant characteristics) for white seeds with a view to greater acceptability by consumers and processors alike.

(1) Gillespie, J.M. and Blagrove, R.J. *Aust. J. Plant Physiol* 5, 371-5 (1978).

A.A. Kortt & R.J. Blagrove
Division of Protein Chemistry
C.S.I.R.O.
Parkville, Melbourne, Vic. 3052
AUSTRALIA

2. Names given to the winged bean.

Thanks for the copy of "*The Winged Bean Flyer*", Vol. 3, No. 1, December, 1980 which I received only on 5-10-1981. In this issue in Article IV names given to the winged bean on page 8, last line, the typographical error may be corrected "Chau-dhari-phali" instead of "Choud-haari phali". Other names by which it is called in different part of India are:

Choughula sem - INDIA - Orissa & Madhya Pradesh

Kattu Avarai - INDIA - Tamilnadu

Errachi Avarai - INDIA - Kerala

Rakkai Avarai - INDIA - Kamataka

R. Rajendran
Indian Institute of Horticultural
Research (I.C.A.R.)
P. O. Box 8025
255 Upper Palace Orchards
Bangalore -560080
INDIA

3. Plant Breeding Abstracts

Would you be able to arrange for us to be placed on the mailing list (for *The Winged Bean Flyer*) and if, as I suppose, it contains items of interest to breeders would you also be able to grant us permission to summarize such items in Plant Breeding Abstracts?

Miss O. Holbek
Director
Commonwealth Bureau of Plant
Breeding and Genetics
Department of Applied Biology
Pembroke Street
Cambridge CB2 3DX
ENGLAND

4. Winged bean research register

I am preparing a doctorate in the University of Pierre and Marie Curie, Paris and am conducting my research in the Phytotron Laboratory of the National Centre of Scientific Research in Gif/Yvette. I have been working on the winged bean using the tissue culture method since the past three years. With two other colleagues, I have published an article on "Direct *in vitro* bud formation from fragments and thin cell layers of different organs of the winged bean" (in press in Z Pfalzenphysiologie) and am in the process of writing up another article. I will be grateful if you can inform me of how I can go about becoming a member of "the winged bean research programme" and be included in the information and circulation list.

Mr. H. Lie-Schricke
Centre National de la Recherche
Scientifique
Le Phytotron
91-Gif-sur-Yvette (Fssonne)
FRANCE

5. Photoperiod insensitivity

The enclosed photographs show that my selections for flowering under long day conditions do pretty well. On ETH-Selection I, first flowers appeared after 64 days with a range of 60 - 69 days. For ETH-Selection II, the values werc 58 days (55-60). Both were selected within TPT-8. Plants were grown in a sixteen hour photoperiod and day/night temperatures around 27/23°C. As far as space is availabie in the controlled environment units, I grow them also in lower and higher temperature (range about 20 - 30°C). Flowering was not impared but only slightly hastened in the higher temperatures or slightly slowed down in the cooler environments. I will distribute seed to whoever has good use for it.

Dr. J. Rüegg
Institut für Pflanzenbau
Swiss Federal Institute of
Technology (ETH)
Zürich, SWITZERLAND

V. MORE ABSTRACTS FROM THE SECOND WINGED BEAN SEMINAR

1. Beaumont, J.H.; Bodger, D.; Caygill, J.C.; Coward, L.D.G.; Davis, J.B.; Dench, J.E.; Brancis, B.J.; Hammonds, T.; Harris, R.V.; Jones, M.R.; Machin, D.H.; McFarlane, N.; Parr, W.H.; Poulter, N.H.; Quaraishi, A.R.; Southwell, K. and Wood, J. Food uses of the winged bean. 15 p. 10 tables.

The seeds are hard, and decortication is a problem, but oil of good quality can be obtained by an efficient expeller and simple bleaching operation or, on a large scale by solvent extraction and conventional refining. No highly toxic fatty acids were noted. The resulting meal or cake might be used as an animal food ingredient, but much more work is required to define adequate heat or other processing conditions required to bring its nutritive value up to the potential indicated by its chemical composition. Protein isolates with excellent functional properties can be prepared from winged bean meals but in rather poor yields. The tubers, primarily because of their relatively high protein content, would appear to be a good food source but again, there are indications of antinutritional factors which require further study.

2. Chomchalow, S.; Visuttipitakul, S.; Piraman, P.; Tojun, P.; Juntarasami, M.; Boonmalisont, D.; Poonsawasdi, S.; Norman, B.; Tiensri, S. and Kachasenee, P. Inoculum production for winged bean and other grain legumes in Thailand.

The type of legume inoculant produced by TISTR is suitable for large scale commercial production since it is produced using universally accepted procedures and the product can be stored for a long time. Moreover, it is convenient in long distance transport which is beneficial in a country like Thailand. At TISTR the inoculants for winged bean, peanut, mungbean, and ipil-ipil stored in a cold room at 12° - 15° were still effective after five months, having more than 85% nodulation in the greenhouse. Soybean inoculant, however, was good for only three months in storage with 84% nodulation in the greenhouse, and percentage of nodulation dropped readily thereafter. Storage can be improved by lowering the temperature, adding supplementary nutrients, and adjusting the moisture content in the carrier. The farmer's field tests on the inoculants produced by TISTR indicated an increase on the average of 14-27% over the uninoculated treatment. Further studies need to be done in order to arrive at the target of 30 increase in the yield.

3. Flechtmann, C.H.W. Observations on winged beans in São Paulo, Brazil. 6 p.

Winged beans grow satisfactorily during the summer in São Paulo, Brazil (approx. Latitude 23°S - Tropic of Capricorn). The aerial part of the plant can be attacked by the insects such as *Podalia* sp. caterpillars, Lepidoptera, Megalopygidae, *Caliothrips phaseoli* (Hood, 1912) and *Ichinothrips mexicanus* Moulton 1911 - Thysanoptera, Thripidae. *Diabrotica speciosa* (Germar, 1824) - Coleoptera, Chrysomelidae, Galerucinae. *Acrosternum* sp - Hemiptera, Pentatomidae and Mites (Acari) *Polyphagotarsonemus latus* (Banks, 1904) - Prostigmata, Tarsonemidae.

Tetranychus urticae Koch, 1844 and *T. desertorum* Banks, 1900 - Prostigmata, Tetranychidae. The roots are hosts to *Meloidogyne incognita* (Kofoid - White, 1919) Chitwood, 1949 and *M. javanica* (Treub, 1885) Chitwood, 1949 - Nemata, Heteroderidae. Stored seeds are not attacked by *Lasioderma serricorne* (Fabr., 1792) and *Tribolium castaneum* Herbst, 1797, however, these beetles develop large populations on the dry tissues of the pods.

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

Although CIAT does not support any research program on winged bean some materials of this species which had been stored in the germplasm bank of the Center were evaluated as part of a cooperative project with the University of Papua New Guinea and IITA from Ibadan, Nigeria. In 1976, scientists were invited to send their most promising winged bean materials for a second evaluation under CIAT's climatic conditions namely, 1000 mm rainfall, latitude 3°N, 1000 m (asl), and 24°C mean temperature. The best materials, out of 32 actually sent, were previously selected on the basis of adaptation, resistance to insect pests and diseases, yield per plant and other agronomic characteristics and then evaluated in a yield experiment with two replications conducted during the first planting season of 1979 at CIAT. Results were discussed.

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

The 68 winged bean accessions evaluated showed considerable variability in protein and nitrate % and vigor of second year vegetative growth. Protein content of vegetative growth ranged from 11 to 32% with a mean of 22%. Nitrate content ranged from 0.01 to 1.02%. The 3 *Psophocarpus scandens* accessions evaluated tended to have about the same protein %, lower nitrate % and greater vegetative growth than *P. tetragonolobus*.

6. Kim Ki-June. Experimental adaptation of winged beans in different latitudinal locations in Korea.

A possible mutant type of UPS-63 variety, K-K#1, was tested for the effect of planting dates at three locations, Seoul, Jinju and Jeju in Korea and the effect of mulching and the planting densities at two locations, Jinju and Jeju was observed. In the southern-most location, Jeju, K-K#1 was two to six days earlier in initial flowering as compared to the Seoul location, the northern-most location. It was considered that the relatively higher temperature and shorter day-length in Jeju caused flowering to hasten and thus higher yield. Mulching plants at planting time increased the germination rate due mostly to higher soil temperature.

Mulching also helps to conserve soil water, to destroy weeds, and, as a result promotes higher yield. Maximum yield was obtained from the 75 row spacing and 35 cm between hills within row. In a higher latitudinal country like Korea, day-length is longer during the growing season, temperature is lower at planting time and after September. It would be possible to grow winged beans for green feed and vegetable pods. If a variety flowered early to reach full maturity, it should have enough potential to grow economically in Korea.

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

Winged bean, also known as Goa bean or Four-angled bean, has interested plant breeders recently because of its high protein content in seed as well as tuber and the moderate oil content in its seeds. Even though winged bean is being grown in scattered pockets in some of the States of India, its importance and use were not recognised by the majority of the people. This crop could be used to solve the problem of malnutrition. With the object of popularising the importance and use of the winged bean crop in the State, and also to develop high yielding strains suitable to different agro-climatic conditions, the division of Agricultural Botany, Agricultural College, Hebbal, Bangalore has started a collection of different genotypes of winged bean from various sources. As a result, about 64 genotypes including two local strains viz., CFTRI-1 and T. local were received from I.A.R.I., New Delhi; IIHR; Bangalore; NBPGR Regional Station, Amaravathi; California; Puerto Rico and Sri Lanka.

8. Syukri, H.Z. "Winged bean trials in Indonesia".*

Winged bean variety trials were conducted at two locations: Cipanas, at 1100 m above sea level, and Pasarminggu at 30 m above sea level. The experiment at Pasarminggu failed to produced dry pods, due to heavy rain. Data from the experiment at Cipanas are reported. Fifteen varieties of winged bean were tested, nine of which were local varieties collected from Kalimantan and Java, one variety derived from Papua New Guinea, while the other five varieties were provided by the National Biological Institute, Bogor. The first flowering date for all local varieties ranged from 65 to 76 days while the range for the other varieties was from 87 to 99 days. Local varieties produced higher yields than those which were introduced. A variety collected from Sambas, Kalimantan produced the highest yield: 1969 kg per hectare dry seed. Beside yield, the number of days to the last harvest, the number of pods per plant and the average length per pod, weight of 100 seeds and disease index of false rust were recorded.

*The abstract received by the Editor was not accompanied by a title.

VI. RESEARCH ABSTRACTS

A. AGRONOMY

1. Banerjee, A. and Bagchi, D.K. Preliminary studies on winged bean, a high protein crop for the tropics. (To be presented at the Indian Science Congress (Agriculture Section), 1982.

The growth behaviour and nitrogen retention of winged bean at two stages of growth were conducted in the fields of the Indian Statistical Institute, Calcutta. The data reveal a slow initial growth of the plant, and the period the plant takes to grow to full maturity from the time of sowing, was observed to be remarkably more than other bean crops. Good yields of its various parts and high nitrogen concentration both at the green and mature pod stage, suggest that the crop may prove to be a good protein yielding crop in this region. However, as a source of leaf proteins, it did not perform well. The crop demands special attention as it is well suited to varied soil types and climatic conditions suggesting its cultivation for protein yields as a food crop and also for soil conservation.

2. Benya, E.G.; Lesseps, R.J. and Hutton, Beth G. The winged bean (*Psophocarpus tetragonolobus*) in South East Louisiana.

Seeds were sown about 1 June 1977 and vegetative growth patterns, flowering habits, pod set, bean production and fleshy root production were subsequently noted. After 12 weeks vegetative growth was profuse and healthy, but there was no flower bud formation. The first flower bloomed in a semi-shaded area on 16 September, the vines then being 108 days old. Abscission of flowers after blooming occurred for about 2 weeks (a time of drought) until about 30 September when the first two pods were noticed. Irrigation was provided thereafter.

Abnormalities in newly formed leaves became apparent after 2 or 3 cold fronts (not frosts) passed through the area. There were various degrees of curling along the edges, leaflets were more elongated (less lobes) and interveinal areas were raised and "wrinkled."

Harvesting of pods and roots began on 3 December, when the plants were 186 days old, 78 days after the first flower bloomed. The pods were not yet mature. Pod yields were poor, being 263.3 and 279.9 g/plant respectively from two sample plants. Excellent yields of edible roots were obtained. They were found to be simply fleshy, not tuberous. The largest single root weighed 118.9 g and was 10 cm long and 17.2 cm in circumference. Edible root yield averaged 80.3 g per harvested plant. Harvested seeds,

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though pods were not mature at harvest, have successfully germinated at a rate of 21% after soaking for 24 hours in water and planting under greenhouse conditions.

3. Csizinsky, A.A. (1980). Methods of increasing seed germination of winged bean *Psophocarpus tetragonolobus* (L.) DC. *HortScience* 15(3):252.

Accessions Tpt-1 and Chimbu, treated in dilute H_2SO_4 (8:1 by volume in water) for 5 minutes at 62°C followed by a 5 minute rise under running tap water gave 96 - 100% germination in 7 days with no apparent injury to the emerging seedlings. A cold (22°C) sulphuric acid treatment for 5 minutes without rinsing gave 82 - 85% germination. In contrast, control seeds gave 34 - 58% germination over a similar period. Soaking in water at 22°C gave variable results of 32 - 58% germination.

4. Csizinsky, A.A. (1981). Performance of two winged bean accessions in Florida. *HortScience* 16(1):62-3.

Winged bean accessions 'Chimbu' and 'Tpt-1' grown with seepage irrigation on raised, plastic mulched beds, yielded 10.76 and 6.81 mt/ha green pods. 'Chimbu' had a higher dry seed yield and tannin concentration, 1.49 mt/ha and 1.50 respectively, than 'Tpt-1', 1.08 mt/ha and 0.72%. Both winged bean accessions had a long harvest season for green and ripe pods and were considered suitable only for home gardens.

5. Data, E.S. (1980). Patterns of pod growth, development and respiration in the winged bean. *Tropical Agr.* 57(4):309-17.

Characteristics of developing flowers and fruits of winged bean cultivar 'Tpt-2' at various ages after anthesis and various aspects of growth were studied. For use as fresh beans, this cultivar should be harvested between 15 and 20 days after anthesis; after 20 days they are too tough. A 'seed index', proposed for judgement of snap bean maturity, did not give useful results with winged beans.

6. Karikari, S.K. The potential of the winged bean (*Psophocarpus tetragonolobus* (L). DC.) as a root crop. Presented at the 5th International Symposium on Tropical Root Crops, Manila, Philippines. 17-21 September, 1979.

Root crops feeding over half the world s population are cassava, yams, cocoyam and potatoes. These are however regarded as inferior to

cereals because of their low protein contents. The winged bean plant contains high protein in all parts including the roots; therefore efforts should be concentrated to improve its root production. The potential yields of the winged bean as a root crop in comparison with other root crops are discussed. Breeding for development of male sterile types will create self-pruned plants and offer high sink-strength for desirable tuber formation.

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

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

8. Stephenson, R.A.; Kesavan, V.; Claydon, A.; Bala, A.A. and Kaiulo, J.V. Preliminary studies on tuber production in winged bean (*Psophocarpus tetragonolobus* (L.) DC.). Presented at the 5th Symposium on Tropical Root Crops, Manila, Philippines, 17-21 September, 1979.

Preliminary work including a dietary survey, regional variety tuber trials, and the effects of pruning, mulching and temperature on, and the genetic control of, tuber production has indicated the potential which exists for the development of winged bean as a valuable, high protein tuber-producing crop for the tropics. Yields of 11 tonnes of fresh tubers per hectare with protein contents of up to 10.9 percent of fresh weight have been obtained. Evidence suggests that there is considerable scope for increasing winged bean tuber yields beyond this level.

B. GENETICS AND PLANT BREEDING

9. Eagleton, G.E.; Halim, A.H. and Chai, N.F. Towards the effective utilisation of winged bean germplasm. Proceedings of the International Symposium on Legumes in the Tropics, U.P.M., Serdang, Malaysia, 1980.

In this review of literature and ongoing research, a framework is drawn up for evaluating the commercial potential of the winged bean. Four production possibilities are considered, deficiencies in existing genotypes are identified and germplasm is described whereby the deficiencies might be overcome.

For commercial vegetable purposes, existing Malaysian varieties mature too slowly (68 days to first flower), have low harvest index (34% pods as percentage of plant tops), and produce pods with poor storage qualities. There is germplasm available, particularly from Papua New Guinea, to upgrade these characteristics.

As a grain legume the winged bean is a distant prospect, pod-shattering, low shelling percentage (40 to 60%), unsuitable plant architecture and deficiencies in processing characters require long-term research programmes.

The tuber potential of the winged bean is greater than previously believed. Experimental yields in the order of 1500 g/m^2 have been obtained from lines of Northern Thai and Burmese origin.

For forage purposes, Indonesian varieties with perenniality, vegetative vigour and resistance of *Synchytrium psophocarpi* (Rac.) Gaumann warrant investigation. The tuberous roots serve as regenerative bases allowing recovery after defoliation.

10. Hildebrand, D.F.; Hymowitz, T.; Newell, C.A. and Bryan, H.H. Variation in growth habit, determinancy and shattering of the winged bean - *Psophocarpus tetragonolobus* (L.) DC.

One hundred and eighty-nine accessions of winged beans and three accessions of *P. scandens* (Endl.) Verdc. obtained from cooperators in 16 countries were planted at Homestead, Florida (25.5 N latitude) in May, 1978. Observations were made on determinancy and growth habit from May 1978 to July, 1979. Shattering was determined by leaving pods on the plants of each accession at least one month after harvest maturity.

Growth habits varied from genotypes with many months of prostrate growth before climbing up the supporting stakes (IL 4, IL 23) to genotypes

which soon after germination climbed up the supporting stakes (IL 61-A, IL 23). The accessions evaluated displayed four determinancy classes: 1) plants with one reproductive period during their life cycle (IL 11-B, IL 87); 2) plants with regrowth from the roots after producing a seed crop (IL 13, IL 117); 3) plants with regrowth from the stems after producing a seed crop (IL 79, IL 147); and 4) plants with continuous growth during the entire study (IL 80, IL 112). One accession (IL 226) showed no shattering in the field.

The variation seen in the three characteristics indicates that winged bean lines could probably be developed compatible with a diversity of cropping systems. However, an upright bush genotype amenable to combine harvesting was not found in the accessions evaluated.

11. Pickersgill, B. (1980). Cytology of two species of winged bean, *Psophocarpus tetragonolobus* (L.) DC. and *P. scandens* (Endl.) Verdc. (Leguminosae). *Botanical Journal of the Linnean Society* 80:279-91.

Karyotype morphology of *Psophocarpus tetragonolobus* and *P. scandens* is described and the behaviour of chromosomes at meiosis discussed. Both species have a chromosome number of 2n = 18 and similar karyotypes of a sort unusual within the Phaseolinae. Differences between the species in detailed morphology of the chromosomes agree with data from external morphology, palynology and crossability in indicating that *P. scandens* cannot be the immediate wild ancestor of domesticated *P. tetragonolobus*. Study of meiotic chromosomes and analysis of qualitative and quantitative variation in Papua New Guinean *P. tetragonolobus* suggest that there are few restrictions to recombination other than those imposed by predominant self-pollination. The bearing of these data on the taxonomic relationships of *Psophocarpus* and on chromosomal evolution within the Phaseolinae is discussed.

C. PHYSIOLOGY

12. BaSamba, S. and Rüegg, J. The performance of winged bean in the field and in controlled environment - a comparative study. A monograph from Nestle Foundation, Kpouebo, Ivory Coast and Department of Crop Science, Swiss Federal Institute of Technology (ETH), Zürich.

Winged beans, accessions Kade 1-26, UPS-32, UPS-122 and TPT-8 were sown on the 21st of May 1980 (main rainy season March to June) in the rain forest zone of the Ivory Coast some 200 km northeast of Abidjan

(7°N latitude) where the annual rainfall is 1778 mm. Each accession was represented by 60 plants (3 replicates with 20 plants). Plants were spaced by one metre between and within the lines and staked individually to two metres. On the 16th of December (209 days after sowing) seed harvest was completed and on the 27th of January 1981 (294 days after sowing) plants were dug up for the tuber harvest.

The same accessions, represented by 10 plants each (5 replicates with 2 plants) were grown in 6-litre pots to a height of one metre in growth chambers set to a 12 hour photoperiod and day/night air temperatures of 27/23°C. Kade 1-26 and UPS-32 were harvested after 140 days, UPS-122 and TPT-8 after 172 days.

The *seed yields* (g/plant) of the field grown plants were 119, 133, 141 and 217 for Kade 1-26, UPS-32, UPS-122 and TPT-8 respectively. Clearly, TPT-8 was the top yielder and there was no significant difference between the three other accessions. The number of pods/plants were 40, 47, 41 and 68 (order as above). The seed yield of the plants grown in the growth chambers were eightfold lower than in the field but the ranking of the accessions was the same. The results confirmed TPT-8 as top seed yielder and underlined that the number of pods/plant was by far the single most important component of seed yield. Other yield components such as pod length, number of seeds/pod and single seed weight were very similar in absolute terms for field and growth chamber grown plants.

Days to the first open flower were 42, 48, 59 and 51 in the field and 42, 45, 54 and 46 in the growth chambers for Kade 1-26, UPS-32 UPS-122 and TPT-8, respectively. In the field TPT-8 produced an average of 3320 flowers/plant of which 88% were shed. In the growth chambers the respective values were 51 and 87%.

Leaf size was estimated after two months of growth by measuring the maximal length of the centre leaflet of fully expanded trifoliate leaves. Values (in cm) were in the field: 9.7, 8.7, 13.3, and 10.3 and in the growth chambers 9.5, 9.0, 12.3 and 10.9 for Kade 1-26, UPS-32, UPS-122 and TPT-8 respectively.

Both Kade 1-26 and UPS-32 failed to produce any significant tuber yields in the field as well as in the growth chambers. However, modest tuber growth was observed in the field on 33% and 43% of the plants of UPS-122 and TPT-8 respectively. Average tuber yields (g/plant, fresh weight basis) were 131 (Range 70-210) for UPS-122 and 147 (70-265) for TPT-8. In the growth chambers the respective values were 57 (32-81) and 52 (0-115).

An additional treatment in the growth chamber experiment revealed that when the average temperature was lowered to 22/18°C, as it is similarly encountered in the highlands of PNG (Wau Ecology Institute), the

tuber yield of UPS-122 and TPT-8 was about doubled while the seed yield was about halved. These results suggest that the prevalent temperatures near Kpouebo, which are approximately comparable to 27/23°C, may be an important factor preventing satisfactory tuber production, at least with the genotypes tested so far. Reproductive pruning (picking all flowers daily or all young pods weekly) in the field had a stimulative effect on tuber growth which was also confirmed by similar results in the growth chambers.

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

Rhizobia isolated from fourteen different genera of legumes were tested for their N-fixing effectiveness with *Psophocarpus tetragonolobus* in standard Leonard jar trials. Isolates from all plants except *Pithecellobium jiringa* were able to form nodules with *P. tetragonolobus* although a wide range of effectiveness amongst the different rhizobia was demonstrated. Thus *P. tetragonolobus* may be considered promiscuous with respect to its rhizobial requirements. Based on this experiment, a group of rhizobia comprising three elite strains (RRIM 56 from *P. tetragonolobus*, UMKL 36 from *Lablab purpureus* and CB 756 from *Macrotyloma africanum*, a moderately effective strain (NGR 258 from *P. tetragonolobus*), and two strains of low effectivity (RRIM 968 from *Centrosema pubescens* and UMKL 12 from *Phaseolus angularis*) were selected for further study. When these were used to inoculate *P. tetragonolobus* growing in soil taken from virgin jungle (less than 1.54 rhizobia g^{-1} soil); RRIM 56 and UMKL 36 again performed well, but NGR 258 outperformed CB 756.

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

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

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

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

16. Faizah, A.W.; Broughton, W.J. and John, C.K. (1980). Rhizobia in tropical legumes - XI. Survival in the seed environment. *Soil Biol. Biochem.* 12:219-27.

Factors affecting rhizobia in the seed environment of the legumes *Cajanus cajan*, *Centrosema pubescens*, *Glycine max*, and *Psophocarpus tetragonolobus* were investigated. These included the effects of fungicides, insecticides, and herbicides on the survival and growth of rhizobia on agar and in liquid cultures. The pesticides used varied in their toxicity towards rhizobia but many fungicides and insecticides could be used in the vicinity of inoculated seeds. Certain fungicides and insecticides were shown to have little or no effect on the Rhizobium-legume symbiosis of *C. cajan*, *C. pubescens*, *G. max*, and *P. tetragonolobus* when added directly to inoculated seed. Various protective pelleting procedures were investigated including preparation of coating materials containing rock phosphates from different localities, talc, and bonemeal. These were applied to the seed in mixtures suspended in aqueous solutions of substituted celluloses, or gum arabic. Talc and Christmas Island rock phosphate both proved satisfactory, while "Cellofas" is recommended as the adhesive in this formulation. Soaking seeds before pelleting in an effort to remove anti-rhizobial substances from *G. max* seeds was beneficial in the case of soyabean cultivar KS 437, but harmful when applied to Palmetto seeds.

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17. Rüegg, J. Flowering of winged bean under long day conditions. Monograph.

Thirteen accessions of winged bean from Papua New Guinea, Ghana and the Ivory Coast (supplied seed was called P-0 seed) were grown in 6 - litre pots to 1.6 m height in a glasshouse near Zürich where daylength was extended to 16 hours throughout the year by artificial lighting. Day/night growth temperatures were:

27.7 ± 2.7/22.5 ± 1.0°C (warm) and

23.4 ± 2.5/18.0 ± 1.0°C (cool).

In the warm environment reproductive growth was absent, but in the cool environment 6 plants, representing the accessions UPS-62, UPS-99 and TPT-8, out of a total of 210 plants, flowered and set seeds (called P-1 seed). P-1 seed was resown in both temperatures. All plants of UPS-62, UPS-99 and TPT-8 cultivated from P-1 seed flowered and set seeds (P-2 seed) in the cool environment. In the warm environment, 80% of the plants of TPT-8 flowered and set seeds (P-2 seed), all other plants remained vegetative. P-2 seeds of UPS-62, UPS-99 and TPT-8 were then resown in both temperatures and compared with P-1 seed of TPT-8 and P-0 seed of the accessions TPT-8, Kade 1-26, UPS-32 and UPS-122.

The cool environment combined with the 16-hour photoperiod was more inducive to flowering than the warm. Out of 8 tested winged bean types (4 unselected and 4 selected), 2 flowered in the warm and 7 in the cool environment. Potential for pod and seed production was determined on P-0 of Kade 1-26, P-2 of UPS-99 and P-2 of TPT-8 in the cool environment, and on P-2 of TPT-8 in the warm environment. In the cool, P-0 of Kade 1-26 and P-2 of UPS-99 began flowering 101 days after sowing.

The population P-2 selected within accession TPT-8 was particularly interesting since it showed potential for pod and seed production in both temperatures. In the warm and in the cool environment, respectively, flowering of this selected type began 58 days (range 55-67) and 71 days (63-85) after sowing. Seeds were harvested 169 days and 190 days after sowing and seed yields per pot were 27.4 (17.4-35.4) grams and 19.2 g (17.4-37.2), respectively, in the warm and cool temperature. These results may indicate potential for the selection of day-neutral winged bean types.

18. Ruegg, J. Potential for a day-neutral winged bean types.

Seeds of population P-2 (see previous abstract) were resown in the 16-hour photoperiod and the warm temperature. Out of 24 plants 20 flowered within 55 to 97 days after sowing. All plants which had begun

flowering within 70 days after sowing were selected arbitrarily and referred to as ETH-selection I. All other plants were discarded.

In a comparative test including both plants grown from seeds of the original accession TPT-8 and from seeds of ETH-selection I, we recorded the days to first flowers as follows:

Photoperiod	8 hours[1]	12 hours[1]	16 hours[2]
Accession TPT-8	56 (54-60)	57 (49-68)	--[3]
ETH-selection I	62 (59-65)	58 (54-62)	61 (55-69)

Day/night temperature was approximately 28/23°C for all photoperiods. 1: in growth chambers, 2: in glasshouse, 3: an average of only 6% of all plants flowered and there were very few flowers per plant.

In addition, ETH-selection I was being tested in the 16 hour photoperiod and the cool temperature. Compared to the warm temperature the low temperature delayed the beginning of flowering by two weeks which confirmed our earlier results.

Although for technical reasons the tests could not include all combinations of three photoperiods and two temperatures, and growing conditions in the glasshouse and in the growth chambers were not strictly comparable, the results suggest that ETH-selection I is very likely to represent a day-neutral type within a temperature range of about 20 - 30°C.

In the glasshouse (16 hours, 28/23°C) seeds of ETH-selection I were propagated by means of a miniature plantation which covered 4 m^2. Sixty plants staked to 1.3 m were grown for seven months. The final seed yield was 128 g/m^2 or 8.5 g/plant. Immature green pods were harvested as well, the average fresh weight per plant was 16.5 g. Tuber production was insignificant.

In a qualitative test winged beans (accessions UPS-99, Kade 1-26, TPT-8 and ETH-selection I) were sown in the field in southern Switzerland (46° 10'N latitude) on the 20th of May 1981. The mean temperature between sowing and 90 days after sowing was 17.5°C with a mean maximum of 23.0°C and a mean minimum of 11.6°C. The average daylength was approximately 15 hours. Clearly the temperatures were too low for optimal growth, however it was interesting to note that about half of the plants grew to 1.5 m (staking height supplied) and between 85 and 100 days after sowing flowers opened on some plants of ETH-selection I and on fewer plants of accession TPT-8. The first young pods were observed by the end of August. Kade 1-26 and UPS-99 produced only small flower buds.

The results suggest that winged bean types exist which can flower under fairly high latitudes with prevailing long-day conditions during summer. The cultivation of winged bean under truly subtropical conditions, e.g. in the central and southern mediterranean area, may become feasible.

19. Wong, K.C. and Schwabe, W.W. (1980). Effects of daylength and day/night temperature on the growth, flowering and tuber formation of winged bean (*Psophocarpus tetragonolobus*) (L.) DC.) Proceedings of the International Symposium on Legumes in the Tropics, Serdang, Malaysia, 1980.

The growth, flowering and tuberization responses of winged bean to daylength and day/night temperature regimes were studied in controlled-environment cabinets using a Malaysian selection M 14/4. Plants grown under 16-h daylength failed to flower altogether and produced no tuber. Less chlorophyll was produced by the leaves of the long-day-grown plants. Flowering in plants given 8-h daylength was markedly affected by day/night temperatures, whereas, tuberization occurred irrespective of temperature. Under this short daylength, flowering was inhibited when day temperatures were extreme at a high 32°C and a low 18°C. In a day temperature of 26°C, flowering occurred readily at a high night temperature (26°C) but was inhibited when this was low (14°C). There was no evidence from the present study of a thermoperiodic response.

D. DISEASES

20. Abdullah, H. (1980). A disease of winged bean caused by *Pseudomonas solanacearum* in Malaysia. *Plant Disease*. 64(8):798-9.

P. tetragonolobus was infected with *Pseudomonas solanacearum* in Malaysia. Although the pathogen occurs world wide, this is the first report of this pathogen on this host in Malaysia or elsewhere.

21. Khan, A.Z.M. Nowsher A. and Rahman, M.M. (1980). A study on some *Colletotrichum* species from three leguminous crop plants. In Abstract of Section II (Supplementary issue), Fourth and Fifth Annual Science Conference of Bangladesh Association for the Advancement of Science. pp. 3-4.

The present account includes the results of a study on five isolates of *Colletotrichum* species, found on three leguminous crop plants, with special reference to their cultural growth characters and conidiospore morphology. The hose plants were grown either in the Botanical garden of

the University of Dacca, or in vegetable gardens in certain localities of Dacca City. Those dealt with in the straight-spore group are *C. lindemuthianum* (Sacc. & Magn.) Bri. & Cav. on hyacinth bean (*Lablab niger* Medik) and *C. gloeosporioides* (Penz.) Sacc. (perfect state - *Glomerella cingulata* (Stonem) Spauld & Schr.) on soya bean (*Glycine max* (L.) Merr.) and winged bean (*Psophocarpus tetragonolobus*) (L.) DC.) and in the curved-spore group *C. truncatum* (Schw.) Andrus & Moore on soya bean and winged bean.

The isolates of the straight-spore group of *Colletotrichum* spp. produced oblong, 1-celled hyaline conidiospores with rounded ends. The conidiospore of the hyacinth bean isolate of *C. lindemuthianum* measured 12-19.2 x 3.65-5 µm while the range of conidiospore measurement for the soya bean and winged bean isolates of *C. gloeosporioides* was 11.6-18 x 3.2-5.6 µm. The lone isolate of *C. lindemuthianum* showed a slower growth on potato dextrose agar (pH 6) at 25°C than the isolates of *C. gloeosporioides*. Both the isolates of *C. gloesoporioides* unlike the isolate of *C. lindemuthianum*, produced ascigerous state on several occasions, at room temperatures (21.5-24.5°C) which resembled *Glomerella cingulata*.

As for the curved-spore group, soya bean and winged bean isolates of *C. truncatum* produced falcate, 1-celled, hyaline conidiospore with rounded ends but tapered towards the apex. The conidiospore measurement of the soya bean isolate was 13.2-24.4 x 2.4-3.6 µm while that of the winged bean isolate was 24-26 x 2.8-4. um. The soya bean isolate of *C. truncatum* showed comparatively a slower growth on potato dextrose agar (pH 6) at 25°C than the winged bean isolate of the same species.

The effect of the above discussed isolates of *Colletotrichum* spp. were tested on the detached leaves of the host plants by cross inoculation. The hyacinth bean isolate of *C. lindemuthianum* and the winged bean isolate of *C. gloesporioides* infected the detached leaves of hyacinth bean, soya bean and winged bean. The soya bean isolate of *C. gloeosporioides* readily infected the detached leaves of hyacinth bean and soya bean but failed to establish on the detached leaves of the winged bean. As regards the soya bean and winged bean isolates of *C. truncatum* cross inoculations were successful on the detached leaves of soya bean and winged bean

22. Khan, A.Z.M. Nowsher A. and Nahar, K. (1978). *Cercospora canescens*, associated with a leaf spot disease of the winged bean plants (*Psophocarpus tetragonolobus*) in Bangladesh. *Bangladesh J. Bot.* 7(2):10-2.

In the months of August and October, 1976, several varieties of winged bean were planted in the Botanical garden of the University of Dacca, Bangladesh. A large number of these plants were found to suffer from a leaf spot disease in winter, 1977. The spots were circular to

sub-circular, up to 0.5 mm in extent, whitish-grey, surrounded by a reddish brown border.

The fungus associated with these disease leaf spots was *Cercospora canescens* Ellis & Martin, which is most frequently encountered in tropics and sub-tropics on a wide range of the Leguminosae, but has not been reported earlier on winged bean. Other species of *Cercospora*, so far reported on the winged bean are *C. aranetae* Borlaza & Roldan, *C. psophocarpi* Yen, and *C. psophocarpicola* Yen, *C. psophocarpi* has been recently transferred to *Pseudocercospora* Speg. by Deighton (1976).

The specimen cited is deposited at C.M.I., Kew, England, U.K.

23. Khan, A.Z.M. Nowsher A.; Rahman, M. Mizanur and Banu, Lulu Bilquis. (1980). Fungi causing anthracnose of soya bean in Dacca City, Bangladesh. *Bangladesh J. Bot.* 9(2):157-63.

Soya bean plants (*Glycine max* (L.) Merr.) grown at the Botanical Garden of the University of Dacca, Bangladesh, during 1976-1978, suffered from anthracnose disease caused by either *Colletotrichum truncatum* (Schw.) Andrus & Moore or *Glomerella cingulata* (Stonem) Spauid. & V. Schr. (imperfect state: *C. glocosporioides* (Penz.) Sacc.). The pathogens were isolated on potato dextrose agar, described and illustrated. Parasitic effects of these species were tested by artificial inoculation of their original host plant, i.e. soya bean and two other leguminous crop plants, winged bean (*Psophocarpus tetragonolobus* (L.) DC.) and hyacinth bean (*Lablab niger* Medik). *C. truncatum* produced grayish to brownish necrotic lesions on the artificially inoculated plants of soya bean, winged bean and hyacinth bean. *G. cingulata* when inoculated on soya bean and hyacinth bean plants induced yellowing and premature withering of the leaves followed by the drying up of the plants. As for winged bean, *G. cingulata* did not produce any visible sign of infection on the inoculated plants but the pathogen was found successful in establishing itself as an endophyte in the symptom-less plant parts like green leaves.

24. Krishnappa, K.; Gururaja Rao, M.R. and Shirashankar, G. Screening of winged bean cultivars against root-knot nematode. Monograph.

Preliminary field investigations carried out during 1980-81 at the University of Agricultural Sciences, Bangalore, India, indicated that out of 25 lines of winged bean 23 showed varying degrees of host reaction against root-knot nematode (*Meloidogyne incognita*) (Kofoid and White) Chitwood) at a soil population of 22 larvae/100 g of soil. Varieties IC 17005-A and LB NC3 were completely free from nematode infection (immune). Trivandrum local showed fairly resistant type of reaction, whereas varieties LB NC1 and IC 27884 were highly susceptible. Further work

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regarding screening of these varieties in nematode sick plots, identifying the resistant material and incorporation of the resistance into popular local varieties is in progress.

25. Lordello, Rubens R.A. and de Almeida, Luiz D'Artagnan. (1979). *Meloidogyne javanica*. *Revista de Agricultura*, Piracicaba 54(3):136 (São Paulo, Brazil).

Winged bean, a legume introduced into Brazil in 1976, was very heavily injured by a Javanese root-knot nematode, *Meloidogyne javanica* (Treub. 1885) Chitwood, 1949. Symptoms shown by plants are described.

26. Parman and Thompson, A.E. (1981). Resistance to false rust in winged beans. *Hort Science*. 16(1):63-5.

An inoculation technique was developed to test seedling plants of winged beans for resistance to false rust disease incited by the fungus *Synchytrium psophocarpi* (Rac.) Gaumann. Sporangia were collected in distilled water by washing or scrapping from infected, sporulating winged bean leaves. Inoculum was applied by brushing the sporangial suspension onto the 1st or 2nd true leaves of seedling plants, and holding the inoculated plants under high humidity conditions for 24 hours. Intensity of infection can be scored 10 days after inoculation. Resistance appears to result from a hypersensitive reaction.

E. CHEMICAL COMPOSITION AND NUTRITION

27. Garcia, V.V. (1980). Carbohydrates of winged beans. *Journal of Food Technology*. 15(5):477-84.

Five varieties of winged beans were analyzed and found to contain 9.8 to 13.8% soluble sugars. Verbascose was present at a level of 0.2 to 0.9%; stachyose 2.2 to 3.6%, raffinose 1.1 to 2.0%, and sucrose 5.6 to 8.2%. Starch could not be detected in the mature beans of the five varieties analyzed.

28. Garcia, V.V. (1980). Proximate analysis of five varieties of winged beans. *Journal of Food Technology*. 15(5):469-76.

Varieties TPT-2, HIMBO, WB-19, Selections 10 and 12 were investigated. The results showed that the varieties analyzed had a high protein and fat content; which was similar to soybeans.

29. Hettiarachchy, N.S. (1980). Folic acid conjugase from leafy vegetables. Proc. 36th. Ann. Sessions Sri Lanka Assoc. Advmt. Sci. 36(1):3.

Naturally occurring folates in foods are mainly in the form of polyglutamates. These polyglutamates are cleaved in the intestine by conjugase to monoglutamate, prior to absorption. The present communication deals with a study of conjugase from leafy vegetables and the finding is that winged bean and sweet potato leaves released food folates from conjugated forms at pH 4.5 (0.1 M, acetate buffer). The food folate values obtained by using rat liver and chicken pancreas conjugase was in close agreement with the values obtained by using winged bean leaves conjugase. The folic acid released after the action of conjugase was determined by the radio-isotopic protein binding assay method. Folic acid conjugase from winged bean and sweet potato leaves can therefore be used for the estimation of total folates in foods.

The prevalence of folic acid deficiency among pregnant mothers and among women using oral contraceptives in Sri Lanka may be due to the low folic acid content in their food and the losses incurred due to over-cooking. Conjugase from winged bean or sweet potato leaves can be used to determine the exact amount of folate available in food before and after cooking.

30. Hettiarachchy, N.S. and Sri Kantha, S. (1980). Nutritive value of winged bean, *Psophocarpus tetragonolobus*. Presented at 8th International Congress of Dietetics and 6th Latin American Congress of Nutritionists, São Paulo, Brazil, Aug. 25-31, 1980.

Edible portions of 20 cultivars of winged bean grown in Sri Lanka have been analysed for the proximate composition (AOAC method), and their anti-nutritional factor, trypsin-inhibitor (Kakade *et al* method). The protein content in seeds was 29.8 - 42.5% (36.0 ± 0.97, means + S.E.) and trypsin inhibitor present was 4.89×10^4 - 2.35×10^5 TUI/g of protein. The oil content was 11.0 - 23.0% (17.8 ± 0.98). The protein content in tubers was 2.27 - 8.05% (5.56 ± 0.43) on wet weight basis. The trypsin inhibitor present in the edible portions could be inactivated or destroyed by boiling. Analysis of fatty acid composition of six cultivars showed a high percentage of unsaturated fatty acids (75-80%). Winged bean thus appears to be a promising source to alleviate protein deficiency seen mainly in the Tropics.

31. Hildebrand, D.F.; Hymowitz, T.; Chaven, C.; Bryan, H.H. and Duncan, A.A. Yield, protein and oil data from the 1978-1979 International Winged Bean Trials, Homestead, Florida.

A replicated performance trial for seed yield in winged bean strains was conducted at Homestead, Florida (25.5 N latitude) in 1978-1979. This trial was part of the international winged bean cooperative test which was conducted in many locations throughout the world.

Oolite limestone deposits were mechanically pulverized and tilled to form the "soil" upon which the winged beans were grown. These deposits have low levels of clay and organic matter. The pH of the soil was about 7.8.

The field received a basal application of 448 kg/ha of 7-6-12-2 (N-P-K-Mg) fertilizer prior to planting. The winged bean seeds were planted directly in the field through holes in white on black plastic mulch strips with a trickle irrigation line under each strip. The seeds were inoculated with inoculum provided for the international trials. The strains were planted in a randomized complete block with 4 replications. The plots consisted of 2 rows of 9 plants planted 30 cm apart on either side of the plastic covered beds with 60 cm between each plot. There was 30 cm between twin rows. Both rows of the double row plots were provided with a 2 m trellis with the poles for the two rows joined at the top.

Several harvests were made for each entry by hand. The harvested pods were thrashed mechanically. The cumulative harvests were pooled for each strain. Duplicate random seed samples were taken from the cumulative harvest of each strain and the protein and oil was determined by an infrared grain analyzer (Hildebrand *et al* (1981)).

There was a significant effect of strain on yield (5% level), a highly significant effect of strain on % protein level (1% level), and no significant effect of strain on % oil. The variation for both protein and oil is not large, but these strains were selected because of their yielding ability and most of the strains originated in Papua New Guinea.

In this experiment the coefficient of variation was 26.2% for yield, 2.7% for % protein and 5.5% for % oil. The correlation between protein and oil was 0.04; oil and yield 0.08, protein and yield 0.16; and protein plus oil and yield of 0.21.

32. Hildebrand, D.F.; Chaven, C. and Hymowitz, T. Winged bean seed protein and oil.

In a recent study we reported on the range of protein and oil in mature bean seeds from a large, heterogeneous germplasm collection grown in a single environment using infrared light reflectance analysis (Hildebrand *et al*, 1981). In this note we report on the frequency distribution of protein and oil of the accessions evaluated.

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The frequency distribution for protein shows a near normal distribution with the mode being between 37 to 38% protein (Figure 1) The frequency distribution for oil is roughly bell shaped but skewed to the left in the low oil range (Figure 2). The mode is between 19 to 20% oil. The correlation between protein and oil content was 0.075 (n = 227).

Reference

HILDEBRAND, D.F.; CHAVEN, D.; HYMOWITZ, T.; BRYAN, H.H. and DUNCAN, A.A. 1981. Variation in protein and oil content of winged bean seeds as measured by near infrared light reflectance. *Agronomy J.* 73: (In press)

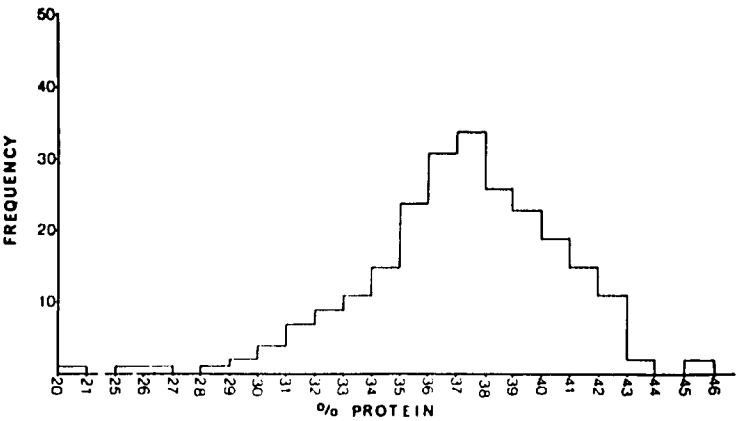

Figure 1. Frequency distribution for protein content in winged bean seeds.

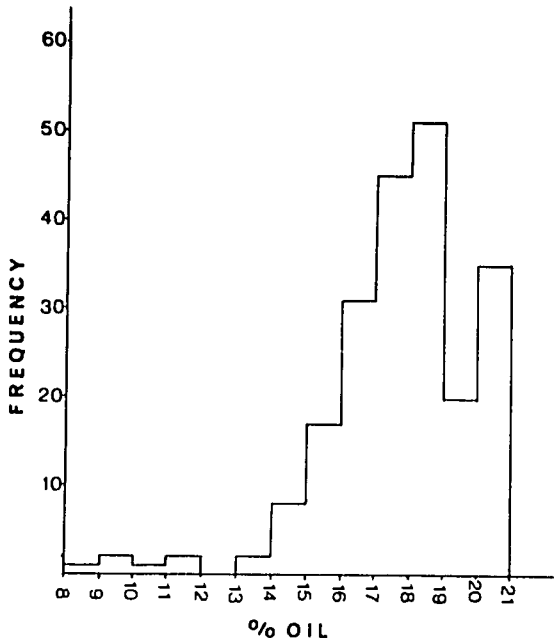

Figure 2. Frequency distribution for oil content in winged bean seeds.

33. Khor, H.T.; Tan, N.H. and Wong, K.C. (1980). Winged bean seed: a potential food source of the tropics. Proceedings of the 6th Annual Conference of the Malaysian Biochemistry Society, Kuala Lumpur, Malaysia.

Protein, trypsin inhibitor and oil contents of several varieties of winged bean seeds were investigated. The seed protein content varied from 32 to 42.4% of the wet weight of the seeds and trypsin inhibitor content varied from 2.77 to 6.29 million inhibitor units per 100 g of seeds. The winged bean seed oil content varied from 16.5 to 24.8% of the wet weight of the seeds. Analysis of the fatty acid composition by gas chromatograph shows that most of the fatty acids are unsaturated in nature. There appears to be no major qualitative difference in fatty acid components among the varieties but quantitative differences are fairly obvious. The potential of winged bean seeds as a source of plant protein and edible oil is discussed.

34. Kortt, A.A. (1979). Isolation and characterization of the trypsin inhibitors from winged bean seed (*Psophocarpus tetragonolobus* (L.) DC. *Biochimica et Biophysica Acta*, 577:371-382.

The trypsin inhibitors from winged bean seed were isolated by affinity chromatography on trypsin-Sepharose 4B and the components fractionated by chromatography on SP-Sephadex C-25 and Sephadex G-100. The major components, inhibitors 2 and 3 were found to be homogeneous proteins with molecular weight of about 20 000. The inhibitors stoichiometrically inhibited bovine trypsin in the molar ratio of 1:1 whereas the inhibition of bovine α-chymotrypsin was weak and non-stoichiometric. Amino acid analysis indicated that both the inhibitors contain four cysteine residues and are rich in aspartic acid, glutamic acid, glycine, valine and leucine; however, inhibitor 3 lacks histidine and methionine while inhibitor 2 contains one histidine and three methionines. A minor trypsin inhibitor fraction was also isolated which contained at least three proteins with a molecular weight of about 10 000 and a high content of half-cystine.

35. Kortt, A.A. (1980). Isolation and properties of a chymotrypsin inhibitor from winged bean seed (*Psophocarpus tetragonolobus* (L.) DC.) *Biochimica et Biophysica Acta*, 624:237-48.

A new inhibitor of bovine α-chymotrypsin has been isolated from winged bean seed. The inhibitor was purified to homogeneity by affinity chromatography on chymotrypsin-Sepharose, following the removal of the trypsin inhibitors on trypsin-Sepharose. The inhibitor has a molecular weight of approx. 21 000 and amino acid analysis showed that it contains four half-cystine residues, lacks methionine, and is rich in aspartic acid, glutamic acid, valine and leucine. The inhibitor does not inhibit bovine trypsin in the standard inhibitor assay and does not bind to trypsin-Sepharose at pH 8.0. Inhibition data show that 1 mol of inhibitor inhibits 2 mil of α-chymotrypsin to form a 1:2 complex. The inhibition, however, is characterized by substrate induced dissociation of the complex

and complete inhibition, even at high inhibitor concentration, is not attained. The inhibitor-chymotrypsin complex is stable at pH 8.0 and was isolated by gel-filtration on Sephadex G-100. An apparent molecular weight of approx. 70 000 was obtained for the complex, measured by gel filtration and ultracentrifugal analysis, consistent with a 1:2 molar stoichiometry.

36. de Lumen, B.O. and Gerpacio, A.L. Report on the use of winged beans as a chicken feed component.

The potential of winged bean as a substitute for soybean oil meal in chicken feed was evaluated. Soybean oil meal is expensive and often not always available in developing countries, making it imperative to utilize other locally available plant protein sources, among them the winged bean.

Winged beans are high in protein and fats, but not much is known on their overall nutritive value as chicken feed. Some toxic effects resulting in depressed growth have been observed when fed to chickens over a period of time. It was concluded that whole winged bean properly heat treated can be used to replace soybean meal up to about 50%. There were adverse effects on broiler performance at higher levels of replacement. The latter may have been caused by the seed coat, suggesting that dehulled winged bean seeds may be superior. The economics of this will have to be studied.

The possible use of red flower beetle larvae (*Trifolium castaneum*) to evaluate the selective nutritional values of several varieties of winged bean has been assessed. The method may be useful in screening the good from the poorer quality winged bean varieties.

This work was designed to determine the *in-vitro* digestibilities, crude protein, cellulose, hemicellulose, lignin, cutin and ash content of various parts of the winged bean plant and its possible nutritive value as a ruminant feed.

37. N'Zi, G.; Sylla, B.S. and Ravelli, G.P. Introduction of the winged bean (*Psophocarpus tetragonolobus*) into traditional dishes of a rural population in the Ivory Coast. *Cahiers de nutrition et de diététique.*

The winged bean is a legume indigenous to the humid tropics (Papua New Guinea). The plant has a great potential for improving the human diet that has as yet been underexploited. All parts of the plant are edible and rich in proteins and vitamins: the leaves, the green pods, the seeds and the tuberous roots. The seeds have a composition very

similar to that of soya seeds (37% protein and 17% oil). This article presents a project undertaken by the Nestle Foundation in the forest zone of the Ivory Coast with the aim of increasing the nutritional value of the local diet through the introduction of the winged bean culture in family gardens and the consumption of its products by the villagers. Results of composition analysis of the various parts of the plant are given. Traditional recipes used by the housewife in the village are presented. Examples are given of how the introduction of the winged bean in local recipes improves the nutritional value of traditional dishes. The villagers' reactions to the new plant and to its consumption are discussed.

38. Sri Kantha, S.S. and Hettiarachchy, N.S. (1980). Phytohaemagglutinins in the winged bean. Proc. 36th Ann. Sessions Sri Lanka Assoc. Advmt. Sci. 36(1):11-12.

Though the presence of phytohaemagglutinin in the winged bean has been recorded by some workers, the varying levels in the different cultivars have yet to be reported.

This study reports the phytohaemagglutinin levels in some different edible portions of the winged bean - namely the seeds, tubers and leaves Phytohaemagglutinin activity was studied in the winged bean extracts, with washed human erythrocytes, by a modification of the serial dilution technique of Liner & Hill (1953). Phytohaemagglutinin activity in the raw mature seeds ranged from 3,200 - 25,600 haemagglutination units/g sample, in the eleven cultivars tested. On the contrary, the dried leaves (at 60°C) and fresh tubers showed comparatively low values of 800 HU/g and 100 HU/g respectively. These phytohaemagglutinins were found to be thermo-labile, and were inactivated considerably by the normal moist-heat cooking methods.

39. Yap, T.N. (1979). Composition and *in-vitro* digestibility of the winged bean and possible utilization of the whole plant in ruminant feed. *Malaysian Applied Biology*, 8(2):119-23.

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

The neutral detergent soluble 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.

VII. THESES ABSTRACTS

1. Sri Kantha, S.S. Nutritive value of winged bean, *Psophocarpus tetragonolobus* (L.) DC. Unpublished thesis for the Degree of Master of Science in Biochemistry, University of Peradeniya, Sri Lanka, August, 1980.

Thirty two cultivars of the winged bean grown in Sri Lanka have been analysed. Weight of a seed ranged from 0.18 - 0.42 g with a mean value of 0.28 g while the weight of a full mature tuber ranged from 7.1 - 53.3 g with a mean value of 34.7 g. The average weight of edible portion in tuber ranged from 4.6 - 42.3 g/tuber with a mean value of 25.4 g. Around 65 percent of the weight of the tuber forms the edible portion.

Proximate chemical analysis shows that the protein content of seeds ranged from 29.8 - 42.9 g/100 g fresh weight with a mean of 36.7 g/100 g. The protein content of fresh tubers ranged from 2.3 to 8.1 g/100 g, with a mean of 5.5 g/100 g. The range of protein values exhibited by fresh leaves falls between 4.6 and 11.8 g/100 g with a mean of 7.4 g/100 g. The protein contents of fresh immature pods and flowers range from 1.3 - 2.7 percent (mean 2.1 percent), and 1.3 - 2.7 percent (mean 2.1 percent) respectively. The oil content of the seeds ranged from 11.0 - 24.0 g/100 g with a mean of 17.8 g/100 g.

Detailed chemical analysis shows that the winged bean seed protein is rich in lysine which is the limiting amino acid in the Sri Lankan staple diet of rice. Sulphur containing amino acids and tryptophan seem to be the first and second limiting amino acids in this protein. The fatty acid profile of the seed oil shows that oleic and linoleic acid fractions formed the major fatty acid components with mean values of 40.2 and 31.6 percent respectively.

The levels of two anti-nutritional factors, trypsin inhibitors and phytohaemagglutinins were determined in the seeds, tubers and leaves. The range of trypsin inhibitor content in the raw mature seed, tuber and leaf were 10.6-49.5, 0.2-33.1 and 0.2-1.9 mg TI/g sample respectively. Phytohaemagglutinin content in the raw mature seeds ranged from 3,200 - 25,600 haemagglutinin units/g sample.

Soaking the seeds for 10 hours at room temperature (28 ± 2°C) resulted in hydration of the seed and is recommended as an initial processing step. Maximum tenderisation and complete inactivation of the two anti-nutritional factors, trypsin inhibitor and phytohaemagglutinin, resulted when the seeds soaked in tap water or in $NaHCO_3$ (0.5 percent) solution, and boiled in $NaHCO_3$ (0.5 percent) or NaCl (0.5 percent) solutions. Tenderisation of the seeds occurred in soaking as well as boiling steps, but to a greater extent during boiling. Inactivation of trypsin inhibitors and phytohaemagglutinins resulted only during boiling. Depending on the individual preferences, either $NaHCO_3$ or NaCl may be used for tenderisation of the seed during cooking while this study prefers the usage of NaCl since it is easily accessible at village consumer level in comparison to sodium bicarbonate.

Winged bean food preparations (winged bean "rotti", winged bean "thosai", winged bean-butter cake, winged bean bread and winged bean milk) were made from the processed winged bean flour. Supplementation of winged bean flour at 10 percent levels to wheat flour resulted in acceptable food items. Of the preparations, all except the winged bean bread were found to be acceptable to the taste panel. Winged bean milk is suggested as a substitute for coconut "milk", in traditional food preparations. Initial processing of winged bean flour and winged bean tuber for food items with longer shelf-life is suggested.

2. Truong, Van den. Lipoxygenase isoenzymes of winged bean, *Psophocarpus tetragonolobus* (L.) DC. Unpublished Ph.D. thesis, University of the Philippines at Los Baños, Philippines, 1980.

Lipoxygenase (Linoleate: oxygen oxidoreductase EC 1.13.11.12) in winged bean and cowpea seeds were studied using various spectrophotometric assay, isolation and purification procedures. Winged bean lipoxygenase specific activity (14-30 units/mg protein) was comparable

to that of soybeans (11-48 units/mg protein) while cowpea had the highest specific activity (205-316 units/mg protein).

Winged bean has high protein and fat content which are similar to that of soybeans, ranging from 30 to 38.5% and 16.9 to 20.5%, respectively. Lipoxygenase activity and fat content decreased during seed germination. The fatty acid composition of five native winged bean lines determined by gas liquid chromatography (GLC) was similar to peanut oil. Parinaric acid was not present in the samples analyzed. Lignocenic acid and behenic acid had the range of 1.02-2.05% and 5.04-11.62%, respectively. The major unsaturated fatty acids were oleic and linoleic acid. Linoleic acid values ranged from 21 to 36% of the oil by both GLC and enzymatic methods. At least with the lines studied, there was no correlation between the lipoxygenase activity and the polyunsaturated fatty acid content of winged bean seeds.

Winged bean and cowpea lipoxygenase activities were located in 30-50% and 40-60% $(NH_4)_2SO_4$ precipitates, respectively. Disc gel electrophoresis followed by specific enzyme staining revealed at least 2 and 4 isoenzymes for winged bean and cowpea lipoxygenase with a major isoenzyme at Rf = 0.21-0.27.

Purification of winged bean lipoxygenase on CM-Sephadex column had a poorer performance compared to DEAE-Sephadex column. A purification procedure of winged bean lipoxygenase using $(NH_4)_2SO_4$ fractionation and sequential Sephadex G-150, DEAE-Sephadex and hydroxyapatite chromatography revealed two major isoenzymes, F1 and F11, with 104- and 171-fold purification respectively compared to the crude extract. Both isoenzymes possess carbonyl-producing activity. They had similar electrophoretic mobility (Rf = 0.25) on polyacrylamide gel and molecular weights of 78,000 and 82,000 by gel filtration and SDS-PAGE, respectively. Optimum pH of 6.0 and 5.3, Km values of 0.44×10^{-3}M and 0.37×10^{-3}M for linoleic acid, the best substrate of winged bean lipoxygenase, were obtained for F1 and F11, respectively. Ca^{++}, CN^{-}, Fe^{+++}, Mg^{++}, Mn^{++} and ethanol inhibited the enzyme but Fe^{++}, Zn^{++}, Co^{++} at 1 mM concentration enhanced the activity. Among the antioxidants tested, butylated hydroxyanisol and butylated hydroxytoluene were the most effective inhibitors of winged bean lipoxygenase. Sulfhydryl reagents such as idoacetamide and dithiothreitol has little effect on the lipoxygenase isoenzyme activity.

In solution, winged bean lipoxygenase was stable up to 60°C. Increasing the temperature to 70°C rapidly denatured the enzyme. In whole seed, the enzyme was more resistant to heat than soybean lipoxygenase. The heat inactivation followed first order reaction. Winged bean lipoxygenase had optimal activity at 30°C and an activation energy of 4.5 Kcal/mole.

The chromatogram of volatiles produced by purified winged bean lipoxygenase using linoleic acid indicated that the system produced some components which are present in the flavour profile of raw winged bean homogenate. This study showed that lipoxygenase is responsible for the formation of flavor components in winged bean seeds.

VIII. COUNTRY REPORTS

AUSTRALIA

Khan, T.N. Winged bean (*Psophocarpus tetragonolobus*): a report and hints for growing in the South West of Western Australia. Monograph produced by the Western Australian Department of Agriculture: 3 September, 1980.

Over 900 seeds packets were distributed to people in Perth and in country areas. In most cases, results were disappointing indicating that plants failed to establish, and although some grew well, flowering did not take place.

The winged bean is essentially a plant suited to the hot and humid regions of the equatorial region. The Mediterranean climate of Perth and the surrounding countryside presents many problems in trying to grow this plant in the summer months. These problems are:

1. Equatorial regions are hot but the temperature seldom exceeds 32°C and humidity is always high. Temperatures above 35°C with dry conditions, as are experienced in Perth during summer, are not suitable to its growth.

2. Winged bean requires short day conditions for flowering. Long day conditions delay flowering.

3. As flowering does not take place until summer/early autumn, the period in which pod setting takes place is considerably reduced, giving low pod yield. This is due to the fact that temperatures in late autumn and winter are too low to allow pod setting.

Work has shown that different varieties vary in their flowering habit and in their ability to thrive in hot and dry summers. Through cross breeding it should be possible to develop a more suitable variety.

BELIZE

Benya, E.G. The winged bean (*Psophocarpus tetragonolobus*) in Belize, Central America: Three case studies (St. Paul's Bank, Belize; Santa Elena, Cayo; and San Antonio, Toledo). A report to the International Council for the Development of Underutilized Plants, 197

At St. Paul's Bank, a region less than 150 m above sea level, winged bean was grown in a mixed cropping, shifting agriculture, (slash and burn) situation on a heavy clay loam soil. Germination was slow but once growth began, it was prolific. Some support stakes were easily broken by the weight of the vines. No pests were noted. Yields were reported to occur in waves, although exact figures were not available. Pod production continued from a high level in October/November 1978 to lower levels in April 1979. The edible roots were not used for food since new sprouting started from these. The flavour and general palatability of the bean was considered very good but the hardness of the seed had an effect on the uses. Before eating, seed was boiled, ground into a flour and strained. The beans were extensively used in soup.

The Benedictine Monastery near Santa Elena was also used for trials (60-90 m above sea level). Tpt-1 was grown on a silt loam soil high in iron and provided with irrigation and fertilizer. There was no problem with seed hardness or germination. Beans were used in the green pod stage at the monastery. Harvesting began about 7 weeks after the February planting.

Mixed winged bean seed of the Tpt-1 and Chimbu varieties was planted in the shallow sandy loam soils of San Antonio (88.5 m above sea level) in September, 1978. No fertilizer or pesticide was provided. Pods were produced over a 2-month period although yields were unsatisfactory. Adverse effects of the dry season resulting in high moisture loss from the shallow soil probably contributed to this. Parasol ants (*Atta* spp) were a major pest which attacked the plants when they were at the peak of growth and stripped them of green tissue. Pods were used for food in the green pod stage only. They were boiled and found to be very palatable. No attempt was made to eat the fleshy roots.

BRAZIL

Lam-Sánchez, A. Introduction and cultivation of winged bean in the region of Jaboticabal, São Paulo, Brazil. (A monograph with 3 tables).

Two varieties of winged bean, UPS-31 and UPS-122 were introduced from Papua New Guinea and submitted to a date of planting experiment in Jabotica al (21°15'18" S Latitude 48°15'18" W; 610 m altitude). Dates of planting were spaced by 15 days, starting in 10/16/78 and ending 12/15/78. Plants were planted in rows 1.5 m apart and 0.6 m between plants, they were tutored by bamboo poles 1.7 m high. Observations on the general biology of the plant were made in the rows, and specifically for flowering and fructification observations were made on individual flowers. Plant characteristics and yield components were obtained from 8 competitive plants and submitted to statistical analysis.

By the results obtained it can be concluded that this crop can be cultivated in the region, and date of planting had some effects where the earlier ones promoted a higher plant development and also as a consequence higher values for the studied characteristics. Variety UPS-122 showed a greater plant development and consequently a higher yield.

GUATEMALA

Tiberghien, J.; Bahlinger, D.G. and Benya, E.G. Some production and palatability factors concerning the winged bean (*Psophocarpus tetragonolobus*) in San Jacinto, Chiquimula, Guatemala. A report to the International Council for the Development of Underutilized Plants, 20 January 1981.

Seeds of both Chimbu and Tpt-1 were sown on 9 July, 1979 and germinated in 12 days. Vegetative growth was profuse and the first green pods were harvested in early October. Irrigation was provided from November when the dry season set in. Where plants were not staked, growth was poor. The yield of green pods began declining in February. Chimbu plants produced an average of 7 pods each. Production from Tpt-1 was less.

Generally, insects were not a serious problem but, in some cases, plants were defoliated.

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 Bean Flyer/ICDUP.

Please send your completed subscription notice and your cheque to:

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Project Manager
Agricultural Information Bank
for Asia
c/o SEARCA
College, Laguna 3720
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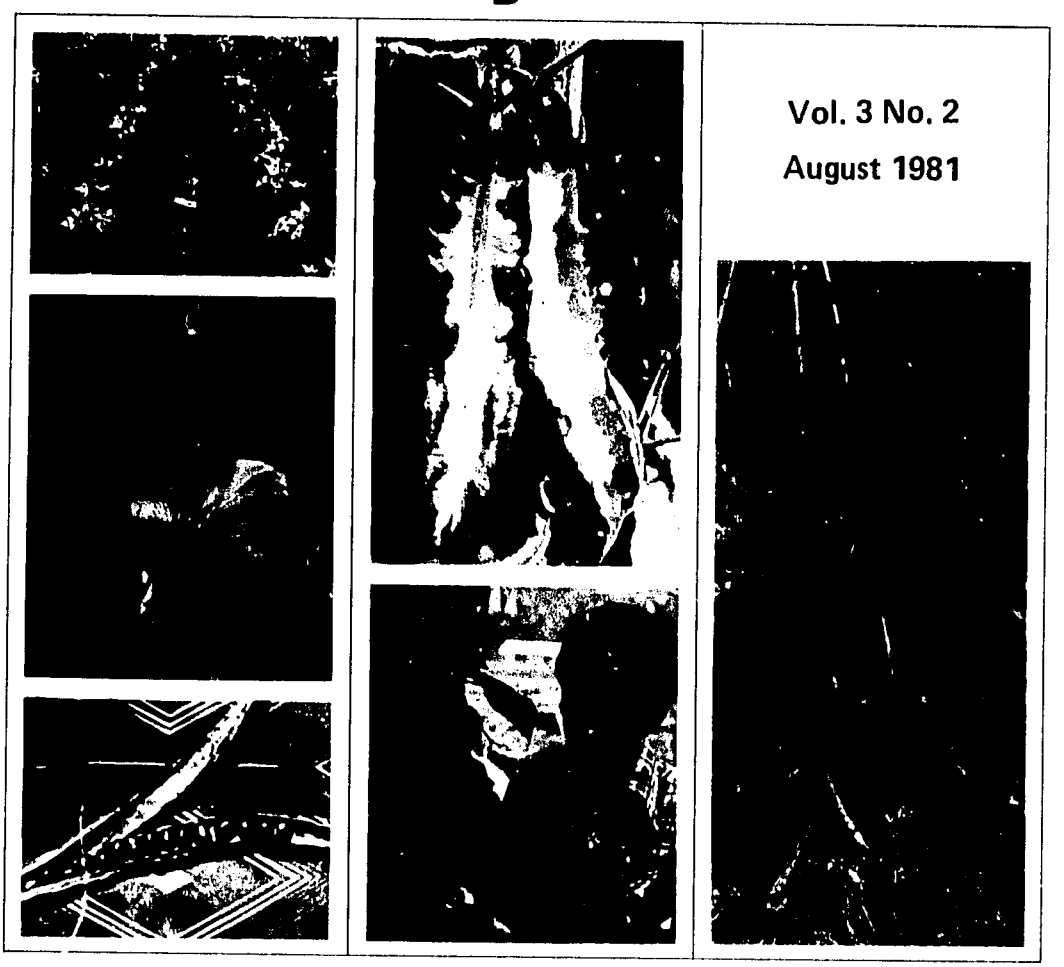

Vol. 3 No. 2
August 1981

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:

Dr. Narong Chomchalow, Deputy Governor, TISTR, Thailand
Dr. Setijati Sastrapradja, Director, LBN, Indonesia
Dr. V. Kesavan, University of Papua New Guinea
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the winged bean flyer

Edited by
RUSS A. STEPHENSON

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

The *Flyer* is being produced with the welcome and able cooperation of the Agricultural Information Bank for Asia (AIBA) which is headquartered in the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in the Philippines. The Editor of the *Flyer* is Dr. R.A. Stephenson. All communications should be sent to him at the following address:

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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.)

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.

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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.I.; 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 temperatureson 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/l kinetin and 1.0 or 5.0 mg/l 2,4-dichlorophenoxyacetic acid (2,4-D). In certain cases, 1.0 or 5.0 mg/l 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/l kinetin and 0.1 mg/l 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 required 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.

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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_2PO (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 10.6 - 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.1.13.1' 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

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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.

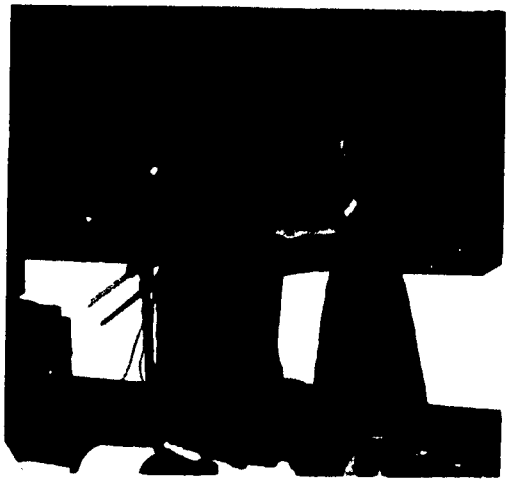
(7) – Session on Food, Nutrition and Processing (2nd Session).
L to R – Dr. Ted Hymowitz (Univ. of Illinois, USA); Dr. Carl Hittle (Sri Lanka Soybean Development Program).

(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 Hawai'i, 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

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS
STATEMENT OF REVENUES RECEIVED
AND EXPENSES PAID
INCEPTION TO DECEMBER 31, 1981
(With Accountants Report Thereon)

PARODI & CROPPER
CERTIFIED PUBLIC ACCOUNTANTS
505 SANSOME STREET, SUITE #1901
SAN FRANCISCO, CALIFORNIA 94111
(415) 421-7721

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

We have examined the statement of revenues received and expenses paid for the year 1981 and the period from inception (December 1978) to December 31, 1980. Our examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As described in Note 1, the Council's policy is to prepare its Financial Statements on the basis of cash receipts and disbursements; consequently, certain revenue and the related assets are recognized when received rather than when committed, and expenses are recognized when paid rather than when the obligation is incurred. Accordingly, the accompanying statement of revenues received and expenses paid is on the cash basis of accounting and is not intended to present the results of operations on the accrual basis which is in conformity with generally accepted accounting principles.

In our opinion, the financial statement referred to above presents fairly the revenues received and expenses paid for 1981 and the period from inception (December 1978) to December 31, 1980 on the cash basis of accounting described in Note 1, which basis has been consistently applied.

Parodi & Cropper

PARODI AND CROPPER

April 19, 1982

PARODI & CROPPER
CERTIFIED PUBLIC ACCOUNTANTS
505 SANSOME STREET, SUITE #1901
SAN FRANCISCO, CALIFORNIA 94111
(415) 421-7721

May 4, 1982

Mr. Louis Lazaroff
International Council for Development of
Underutilized Plants
18 Meadow Park Court
Orinda, CA 94563

Dear Mr. Lazaroff:

Pursuant to our conversation today, please be advised that it is our opinion that the cash basis of accounting is the appropriate method to use in presenting the financial statements of the Council and in maintaining the fund accounting records thereof.

The cash basis follows precisely the flow through the fund accounts which are maintained on the cash basis. A substantial portion of the funding is provided by an A.I.D. grant, wherein support revenue is made available as expenditures are ready for disbursement. A proper matching of expense and revenue results from the method used.

The middle paragraph of the accountants report is required terminology wherein the accountant is required to indicate the difference between the comprehensive method employed (in this case the cash basis) and the accrual basis which by definition is the generally accepted accounting method.

The statement of Position and Reporting Practices for certain nonprofit organizations issued by the American Institute of CPA's on December 31, 1978 indicates:

> "For numerous nonprofit organizations, complex accounting procedures may be neither practical nor economical, and reporting based essentially on cash receipts and disbursements may be adequately informative."

Again, in my opinion the cash basis does yield "adequately informative" results and is appropriate in the circumstances.

Very truly yours,
PARODI & CROPPER

ABC Cropper

A. B. Cropper

ABC/mlt

INTERNATIONAL COUNCIL FOR DEVELOPMENT OF UNDERUTILIZED PLANTS
STATEMENT OF REVENUES RECEIVED AND EXPENSES PAID
FOR THE YEAR 1981 AND THE PERIOD FROM INCEPTION (DECEMBER 1978) TO DECEMBER 31, 1980

	YEAR 1981			INCEPTION TO DECEMBER 31, 1980		
	UNRESTRICTED	RESTRICTED	TOTAL	UNRESTRICTED	RESTRICTED	TOTAL
REVENUES						
U. S. Agency for International Development	$ -	$ 98,600	$ 98,600	$ -	$ 40,000	$40,000
National Science Foundation	-	30,000	30,000	-	2,149	2,149
Australian Development Assistance Bureau	-	11,670	11,670	-	-	-
Food and Agricultural Organization of the United Nations	-	10,000	10,000	-	10,004	10,004
BankAmerica Foundation	5,000	-	5,000	10,000	-	10,000
Bank of America, Colombo Sri Lanka	-	-	-	-	1,500	1,500
W.S. Atkins Group	-	1,500	1,500	-	-	-
The Asia Foundation	-	527	527	-	-	-
University of Illinois	-	535	535	-	-	-
The Coca-Cola Company	-	-	-	-	10,000	10,000
National Academy of Sciences	-	-	-	-	7,910	7,910
Philippine Council for Agriculture & Resources Research	-	-	-	1,000	3,850	4,850
A. T. International	-	-	-	-	3,537	3,537
Southeast Asia Regional Center for Graduate Study and Research in Agriculture	-	-	-	-	-	-
Batelle Pacific Northwest Laboratories	-	-	-	2,400	-	2,400
Board for International Food & Agriculture Development	-	-	-	-	326	326
Other	-	-	-	-	562	562
	802	-	802	641	7	648
TOTAL REVENUES RECEIVED	5,802	152,832	158,634	14,041	79,845	93,886
EXPENSES						
Varietal Trials	-	3,000	3,000	-	-	-
Documentation and Information Services	-	5,000	5,000	-	-	-
Winged Bean Flyer	-	9,030	9,030	154	117	271
International Seminar	-	55,264	55,264	-	49,083	49,083
Studies and experiments	-	20,767	20,767	-	-	-
Growth Center, Malaysia	-	15,000	15,000	-	-	-
Growth Center, Sri Lanka	2,387	3,510	5,897	-	-	-
Staff	2,596	27,990	30,586	5,779	14,640	20,419
Supplies	60	1,449	1,509	211	192	403
Communications	-	4,772	4,772	3,113	804	3,917
Travel	-	11,168	11,168	3,271	8,574	11,845
Equipment	-	399	399	249	-	249
Other	164	89	253	1,085	-	1,085
TOTAL EXPENSES	5,207	157,438	162,645	13,862	73,410	87,272
Excess (deficiency of revenues over expenses	595	(4,606)	(4,011)	179	6,435	6,614
Cash balance at beginning of period	179	6,435	6,614	-	-	-
Cash balance at end of period	$ 774	$ 1,829	$ 2,603	$ 179	$ 6,435	$ 6,614

See accompanying accountants report and notes to financial statements.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

NOTES TO FINANCIAL STATEMENT

DECEMBER 31, 1981

1. Summary of Significant Accounting Policies

The Council's policy is to prepare its financial statements on the basis of cash receipts and disbursements. Consequently, support revenues are recognized when received rather than when committed, and expenses are recognized when paid rather than when the obligation is incurred.

Most support revenues are designated by contributors for specific program activities (one or several) indicated in the captions of expenses. When so designated, such revenues are accounted for in "restricted funds" to control the appropriate expenditures therefrom.

All support revenues received for which management has discretionary control are accounted for in "unrestricted funds".

2. Purpose of The Council

The International Council for Development of Underutilized Plants was established in 1978 by an international group of scientists in order to develop and encourage the use of neglected plants of potential benefit to man. Since then, it has been concentrating on the winged bean, Psophocarpus tetragonolobus, a hitherto neglected tropical legume which has outstanding potential for meeting increasing needs for plentiful and nutritious food. The Council is a private, nonprofit organization incorporated and headquartered in the United States.

The Council's winged bean program has two goals: the winged bean's early domestication and commercialization. To accomplish this, it has established a research system composed of scientists and research institutions already in place throughout the world. Scientists in this system conduct research in their home institutions and collaborate under an agreed-upon and coordinated set of investigative priorities.

3. Federal Income Taxes

The Council has been classified by the Internal Revenue Service as exempt from Federal income taxes under Internal Revenue Code Section 501(c) 3 under an advance ruling with period ending December 31, 1983.

Within 90 days after December 31, 1983, the Council is to submit certain information to determine whether it has met the requirements of public support during the advance ruling period. If not classified as a publicly supported organization, the Council could be classified as a private foundation. Management expects to meet the public support requirements.

Donors may deduct contributions to the Council as provided by Section 170 of the Code.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

NOTES TO FINANCIAL STATEMENT

DECEMBER 31, 1981

4. Grant From Agency For International Development

Pursuant to the authority contained in the Foreign Assistance Act of 1961, as amended, the U. S. Agency for International Development (AID) has granted to the Council the following amounts to provide partial support for a three year program in Asia:

GRANT AMOUNT	PERIOD	APPROVAL RECEIVED
$145,000	9/30/80-83	9/29/80
155,000	9/30/81-83	5/28/81
150,000	9/30/82-83	Pending

The $145,000 grant was effective September 29, 1980 and shall apply to commitments made by the Council pursuant to terms and conditions (restricted) as agreed upon in furtherance of program objectives during the period September 30, 1980 through September 30, 1983. An additional $155,000 was approved May 28, 1981 increasing the total approved to date to $300,000 of which $40,000 was expended for the period ending December 31, 1980 and $98,600 was expended for the year ended December 31, 1981. Funds are "drawn" as expenditures are made in compliance with the agreement.

INTERNATIONAL COUNCIL FOR DEVELOPMENT OF UNDERUTILIZED PLANTS

FINANCIAL STATEMENTS PREPARED ON A CASH BASIS

DECEMBER 31, 1982
(With Accountants' Report Thereon)

PARODI & CROPPER
CERTIFIED PUBLIC ACCOUNTANTS
100 CALIFORNIA STREET, SUITE #936
SAN FRANCISCO, CALIFORNIA 94111
(415) 421-7721

International Council for Development
of Underutilized Plants
18 Meadow Park Court
Orinda, CA 94563

We have examined the balance sheet of the International Council for Development of Underutilized Plants as of December 31, 1982 and the related statements of revenues received and expenses paid and changes in fund balances for the year then ended. Our examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As described in Note 1, the Council's policy is to prepare its Financial Statements on the basis of cash receipts and disbursements; consequently, certain revenue and the related assets are recognized when received rather than when committed, and expenses are recognized when paid rather than when the obligation is incurred. Accordingly, the accompanying financial statements are not intended to present the results of operations on the accrual basis which is in conformity with generally accepted accounting principles, however, such differences are not material.

In our opinion, the aforementioned financial statements present fairly the financial position of the International Council for Development of Undertutilized Plants as of December 31, 1982 and the results of its operations for the year then ended presented on the cash basis of accounting described in Note 1, which basis has been consistently applied.

Parodi & Cropper

PARODI & CROPPER

March 31, 1982

EXHIBIT A

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

BALANCE SHEET

DECEMBER 31, 1982

ASSETS

Petty cash	$ 25
Cash in bank	25,446
Furniture and equipment, less accumulated depreciation of $182	929
	$26,400

LIABILITIES AND FUND BALANCES

Liabilities	$ -
Fund balances:	
Restricted	22,177
Unrestricted	4,223
	$26,400

See accompanying accountants'report and notes to financial statements.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIXED PLANTS

EXHIBIT B

STATEMENT OF REVENUES RECEIVED AND EXPENSES PAID
YEAR ENDED DECEMBER 31, 1982

	UN-RESTRICTED	RESTRICTED	TOTAL
REVENUES			
U. S. Agency for International Development	$ -	$160,930	$160,930
Bank of America	5,000	13,180	18,180
University of Maryland	-	719	719
Other	548	-	548
TOTAL REVENUES RECEIVED	5,548	174,829	180,377
EXPENSES			
Winged Bean Flyer	-	908	908
Studies and Experiments	-	31,218	31,218
Growth Center, Malaysia	-	15,000	15,000
Growth Center, Sri Lanka	-	61,062	61,062
Council Board Meetings	-	7,382	7,382
Staff	1,129	27,221	28,350
Supplies	-	1,713	1,713
Communications	-	3,711	3,711
Travel	305	6,347	6,652
Equipment	-	848	848
Utilities	360	-	360
Other	305	-	305
TOTAL EXPENSES PAID	2,099	155,410	157,509
Excess of revenues over expenses	3,449	19,419	22,868
Cash balance, December 31, 1981	774	1,829	2,603
Cash balance, December 31, 1982	$4,223	$ 21,248	$ 25,471

See accompanying accountants' report and notes to financial statements.

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INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

EXHIBIT C

STATEMENT OF CHANGES IN FUND BALANCES
YEAR ENDED DECEMBER 31, 1982

	UN-RESTRICTED	RESTRICTED	TOTAL
Fund balances, December 31, 1981	$ 774	$ 1,591	$ 2,365
Results of 1982 operations:			
Excess of cash receipts over disbursements (Exhibit B)	3,449	19,419	22,868
Decrease in advances payable	-	440	440
Capitalization of equipment purchase included in cash disbursements	-	848	848
Provision for depreciation	-	(121)	(121)
	3,449	20,586	24,035
Fund balances, December 31, 1982	$4,223	$22,177	$26,400

See accompanying accountants' report and notes to financial statements.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

NOTES TO FINANCIAL STATEMENT

DECEMBER 31, 1982

1. Summary of Significant Accounting Policies

The Council's policy is to prepare its financial statements on the basis of cash receipts and disbursements. Consequently, support revenues are recognized when received rather than when committed, and expenses are recognized when paid rather than when the obligation is incurred.

Most support revenues are designated by contributors for specific program activities (one or several) indicated in the captions of expenses. When so designated, such revenues are accounted for in "restricted funds" to control the appropriate expenditures therefrom.

All support revenues received for which management has discretionary control are accounted for in "unrestricted funds".

2. Purpose of The Council

The International Council for Development of Underutilized Plants was established in 1978 by an international group of scientists in order to develop and encourage the use of neglected plants of potential benefit to humankind. Since then, it has been concentrating on the winged bean, Psophocarpus tetragonolobus, a hitherto neglected tropical legume which has outstanding potential for meeting increasing needs for plentiful and nutritious food. The Council is a private, nonprofit organization incorporated and headquartered in the United States.

The Council's winged bean program has two goals: the winged bean's early domestication and commercialization. To accomplish this, it has established a research system composed of scientists and research institutions already in place throughout the world. Scientists in this system conduct research in their home institutions and collaborate under an agreed-upon and coordinated set of investigative priorities.

3. Federal Income Taxes

The Council has been classified by the Internal Revenue Service as exempt from Federal income taxes under Internal Revenue Code Section 501(c) 3 under an advance ruling with period ending December 31, 1983.

Within 90 days after December 31, 1983, the Council is to submit certain information to determine whether it has met the requirements of public support during the advance ruling period. If not classified as a publicly supported organization, the Council could be classified as a private foundation. Management expects to meet the public support requirements.

Donors may deduct contributions to the Council as provided by Section 170 of the Code.

INTERNATIONAL COUNCIL FOR DEVELOPMENT
OF UNDERUTILIZED PLANTS

NOTES TO FINANCIAL STATEMENTS
DECEMBER 31, 1982

4. Grant From Agency For International Development

Pursuant to the authority contained in the Foreign Assistance Act of 1962, as amended, the U. S. Agency for International Development (AID) has granted to the Council the following amounts to provide partial support for a three year program in Asia:

GRANT AMOUNT	PERIOD	APPROVAL RECEIVED
$145,000	9/30/80-83	9/29/80
155,000	9/30/81-83	5/28/81
150,000	9/30/82-83	9/10/82
$450,000		

The grant was effective September 29, 1980 and shall apply to commitments made by the Council pursuant to terms and conditions (restricted) as agreed upon in furtherance of program objectives during the period September 30, 1980 through September 30, 1983. Funds are "drawn" as expenditures are made in compliance with the agreement. At December 31, 1982, $150,470 of the $450,000 grant had not yet been "drawn".