

PN-AAU-398

43587

The Third External Review of the Asian Vegetable Research and Development Center

A Response From the AVRDC Board of Directors

September 1984



The Asian Vegetable Research and Development Center

**The Third External Review
of the Asian Vegetable Research
and Development Center**

**A Response From
the AVRDC Board of Directors**

September 1984



Contents

Executive Summary	1
Foreword	2
Quotations From the Report	3
General	3
Mandate Crops	4
Nutrition, Environment and Management	6
Farm Management	6
Training	6
Library, Information	7
Cooperative Programs	7
The Future	7
Committee Recommendations and Responses by the AVRDC Board of Directors	9
Soybean	9
Mungbean	11
Chinese Cabbage	13
Tomato	14
Sweet Potato	15
Nutrition, Environment and Management	16
Disciplines	18
Germplasm Conservation	20
Statistics	20
Information	21
Training	21
Cooperative Programs	22
Organization and Management	24
Miscellaneous	26
Appendices	
I Membership of the Review Panel	28
II Members and Observers AVRDC Board of Directors	29
III AVRDC Achievements	31

The Third External Review of the Asian Vegetable Research and Development Center (AVRDC) was conducted by an eight member committee comprised of Guy Vallaeys, Chairman, H. Dion, Secretary, and members Robert Dumsday, Ricardo Lantican, S. H. Ou, Akira Tanaka, T. Ajibola Taylor, and Paul H. Williams (Appendix I).

Executive Summary

An External Review of AVRDC was conducted from April 21 to May 12, 1984. Chaired by Dr. Guy Vallaeys, the Panel consisted of eight scientists from as many countries. The team reviewed AVRDC activities, including administration, scientific and management programs, and out-reach projects.

It was stated that during the past ten years AVRDC has made exceptional progress toward achieving many of the goals in its original mandate. The Panel was extremely positive about the Center, particularly its potential for making major contributions in the years ahead. The Panel was also impressed by the unusually high productivity and efficiency of the Center's research, the high quality of its senior and local scientists, and the esprit de corps of its staff. The Center's high level of productivity was attributed to dedication, ingenuity, and good management.

The training programs were judged to be well integrated with research. Many former trainees have accepted posts in their home countries where they utilize the skills acquired in their training at AVRDC. The Panel assessed the training component as one of the Center's greatest strengths.

The Panel concluded that by status, scope, modalities of action, and tradition, AVRDC is an international center. International vegetable research, as well as the Center itself, would benefit by AVRDC being a full member in the international system of Centers.

The Panel displayed considerable insight in its ability to probe the methodologies utilized by research and management and suggested means for improvement. In so doing, it listed sixty-seven recommendations for consideration. The Board of Directors and staff of AVRDC are most appreciative of these recommendations and have responded positively to them as evidenced on the following pages.

Foreword

"The Review Panel assembled at AVRDC during the weekend of April 21-22, 1984 and began its activities the following Monday morning. On Sunday, April 29, the Panel members divided themselves into three teams to visit and review AVRDC's outreach projects in Thailand, the Philippines, and Taiwan. The panel re-assembled at AVRDC on the evening of Thursday, May 3. After reporting briefly to AVRDC's senior management on the three outreach reviews, the team continued its discussions with the staff and its examination of AVRDC's programs and practices. The preparation of this review document began on the weekend of May 5-6.

The Panel reported its findings to the AVRDC staff and to several members of the Board of Directors at a meeting on Saturday, May 12, after which some members of the Panel left AVRDC because of prior commitments.

The remaining members, including the Chairman and the Secretary, reported to the full membership of the AVRDC Board (Appendix II) on Monday, May 14, and the duties of the team were considered to have been completed at that time. The remaining members of the panel left AVRDC on Tuesday, May 15."

The following pages include quotations from the report, the Board of Director's response to the committee's recommendations, and a few noteworthy accomplishments of the center (Appendix III).

Quotations From the Report

The Board of Directors was pleased that the External Review Panel judged AVRDC as having a high level of productivity and efficiency in its research operations, both technically and administratively. The following are quotations from the report.

General

"By status, scope, modalities of action, and tradition AVRDC is an international center . . . the dissemination of its results, and the development of its cooperative projects go beyond the geographical boundaries of tropical and subtropical Asia." (p.154)

" . . . the wide acceptance of AVRDC as a productive research organization, and the interest evident in its advanced breeding materials, must be regarded as significant". (p.154)

"Clearly AVRDC is endowed with a staff of highly qualified, high quality senior and junior scientists together with senior managers that are both skilfull and effective. The versatility of AVRDC's senior staff is matched only by the diligence and skills of the junior scientists and support personnel. Nowhere has the Panel seen such uniformly well-trained supporting scientists. Likewise, the supporting farm work force of managers and field personnel has the dedication and skill levels that have ensured a high standard of operation." (p.151)

"The Directors General, scientists, and staff of AVRDC have good reason to be proud of their significant accomplishments achieved in such a relatively short period of time. Such high productivity is remarkable when one considers the relatively small numbers of senior and supporting scientists engaged in the enterprise. Indeed, it is a tribute to the overall management of AVRDC that such productivity has been achieved." (p.153)

"Though it is obvious that the operational budget is severely restricted and that physical research resources are frequently limited, it is also clear that an unusually high level of productivity has been sustained in spite of these constraints. Such output can only be attributed to dedication, ingenuity, and good management. Among the scientific staff we have noted an esprit de corps and a sense of devotion to maintaining the high quality of work that exists at the Center . . ." (p.151)

"The Panel has been very impressed by the productivity and efficiency of the research operations conducted by the Center, in spite of the financial constraints that the Center has lived with almost since its establishment." (pp.i,ii)

"The Review Panel commends the Directors General and their collaborators for having managed to maintain a proper balance between

supporting management and the main thrusts of the Center in order to preserve the research functions of the crop programs." (p.140)

"During the past ten years AVRDC has made exceptional progress toward achieving many of the goals in its original mandate. Among its five mandate crops, Chinese cabbage has been successfully adapted to tropical cultivation; tomato has been significantly improved in its ability to grow and set fruit under high temperatures and high disease pressures; the architecture of the mungbean has been restructured and the genetic components for yield potential increased markedly; the soybean has been tropicalized to yield well under short day lengths in the presence of a number of biotic and abiotic stresses; and the sweet potato has been improved to produce high yields of nutritious roots for both food and animal feed." (p.153)

"As AVRDC reviews its accomplishment over the past ten years, we feel it has reason to be proud of its programs and research." (p.154)

"Advanced lines of all crops are being effectively tested in national programs throughout Southeast Asia and there is strong and growing interest in the output of the AVRDC crops in many tropical countries in Oceania and the Western Hemisphere." (p.153)

"An excellent reputation and image has been built under the current name and we have found no reason to encourage a change in the name of the center." (pp.154, 155)

"The panel is satisfied that AVRDC has proved its ability to organize and execute research on an international scale and has credibility." (p.155)

"The AVRDC Genetic Resources Unit represents a unique and invaluable regional and world resource of germplasm. The philosophical position taken by the GRU in maintaining a wide diversity of germplasm of each AVRDC crop as individually distinct accessions is entirely in keeping with its recognized position as a world germplasm resource." (p.101)

Mandate Crops

"Management has provided a good balance in the distribution of personnel and funds to support research in the development of the five mandate crops." (p.153)

"The Panel acknowledges the dedication and outstanding work of the soybean improvement team in making its contribution felt world-wide in a relatively short period of time." (pp.16-17)

". . . the initial success of the mungbean program is commendable. Yield potential has been increased to about 2.7 t/ha from 0.3 to 1 t/ha. Plant architecture has been changed; resistance to CLS and PM has been developed and incorporated into advanced lines; pod maturity has reached 80% at first harvest; and plants are less photosensitive than before. (p.29)

". . . the general acceptance of several of these lines (Chinese cabbage) and their licensing and release as named cultivars in various tropical countries is a significant achievement. The development of suitable cultural practices to support the production of the tropical types of cabbage is an important contribution, complementing the production of the new plant types." (pp.37-38)

"The Panel has been impressed with the effectiveness of the Chinese cabbage research in developing a number of F₁ hybrids and open pollinated lines widely adapted to production under high temperature conditions in the humid tropics. The rapid acceptance of AVRDC lines and their release in Taiwan, the Philippines, Korea, and Japan has confirmed the value of these materials. Furthermore, the breeding approaches, as currently underway, together with those planned for the future, will ensure that over the next few years a supply of improved lines will continue to become available to national programs." (p.40)

"The AVRDC Chinese cabbage germplasm collection has become recognized as an important world resource. The financial support . . . from the IBPGR . . . indicates the value placed on this important working collection by the international germplasm community." (pp.40, 41)

"The Panel recognizes the achievements of the tomato group and its impact on tomato production in the tropics through the development of heat tolerant, bacterial wilt resistant materials and their transfer to national programs for use by farmers." (p.49)

" (Sweet potato breeding) Objectives have been largely achieved through the development of orange-fleshed elite lines which are rich in vitamin A (4-12 mg/100 g of fresh wt. of β -carotene) and are early maturing (100-120 days)." (p.58)

"The characteristics of early maturity and low input requirement (for sweet potato) . . . could bring into production part of the 39 million ha of idle rain-fed rice fields in Asia alone." (p.58)

"The sweet potato program has been operating . . . in its present modest state since 1973, yet it has made substantial progress in developing high yielding, nutritious selections adapted to the low input cropping systems of tropical Asia." (p.62)

". . . the physiology group has made a considerable contribution in describing various phenomena related to the improvement of all AVRDC mandate crops . . ." (pp.88-89)

"The Panel feels that considerable progress has been made in Pathology toward the resolution of specific disease problems. Many sources of resistance have been identified. Some of those which have been put into practical use by breeders include resistance to powdery mildew and Cercospora leaf spot of mungbean, and bacterial wilt of tomato." (p.92)

"On the whole, entomology as a discipline has made important contributions to the legume and horticultural programs at AVRDC in the

definition of pest problems, the identification of host plant resistance, and the investigation of some essential components for the development of implementable pest management programs." (p.98)

Nutrition, Environment, and Management

"The Panel was favorably impressed with the contributions of the NEM staff." "The title of the program adequately describes its activities, and there is good cooperation between its staff and the staff of other programs . . ." (p.66)

" . . . the Panel was satisfied that a major contribution to soil management on the experimental plots at AVRDC had been made . . ." (by the Soil Science Unit). (p.69)

"The agricultural economics group has made a valuable contribution to the AVRDC program within the limits set by its budget." (p.72)

"The activities of the chemistry group consist of identifying nutritionally beneficial vegetable traits for which screening is justified, and in the development of assay and screening methods. In each of these areas, the group has made considerable progress." (pp.75-76)

"The Panel was impressed with the concepts and achievements of the Nutrition Garden Program . . . The Panel believes that the garden program successfully complements and enriches the research and development program of AVRDC . . ." (pp.80-81)

Farm Management

"The Panel, in its visit to the experimental plots, was impressed with the level of care and maintenance that was evident, in spite of an environment that encourages weed growth. The plots were well cared for, and experimental error should be relatively low." (p.109)

Training

"The review team was impressed with the importance attached to training at AVRDC and with the quality of the Center's programs, which compare more than favorably with those of other centers." "The training programs are well integrated with research . . . It was evident . . . that many former AVRDC trainees had accepted posts in their home countries where they fully utilized the skills acquired in their training." (p.113)

". . .the influence of AVRDC's training program has already provided important improvements in strengthening the vegetable production resources of many nations by supplying well trained personnel. The 'multiplier effect' at the national level is now becoming apparent as persons trained at AVRDC go on to receive higher advanced training or train others in their own national programs. Clearly, the training component of AVRDC is one of its great strengths." (p.154)

Library, Information

"Despite severe constraints in terms of staff and equipment, the OIS (Office of Information Services) has been able to disseminate widely an impressive array of publications and meet the requirements of the scientific and administrative units in terms of communication services." (p.106)

"Like many other AVRDC units, the OIS has managed to produce large quantities of high quality work using small numbers of talented staff and minimal equipment." (p.107)

"The library has been able to manage a substantial collection with a smaller staff than some of the other IARCs. . . and compares favorably with other IARC libraries." (p.108)

Cooperative Programs

". . . the AVRDC outreach objectives (in Taiwan) . . . are being clearly achieved through a wide range of largely informal but effective collaborative activities and relationships . . ." (p.116)

"AVRDC's role in tropicalizing its mandate vegetables has been very successful as far as the Philippines are concerned; in 1983 three AVRDC Chinese cabbage lines and one sweet potato accession were approved for release, and lines of tomato, mungbean, and soybean have been identified as superior in regional trials. (p.121)

"The Philippines program has demonstrated the efficacy with which new technology can be transferred through training specialists and exchanging germplasm, so that the outreach partner becomes an independent equal in the network." (p.121)

"The Korean Outreach program is similarly mature . . . has been very successful, and has released several AVRDC-based varieties, including two mungbean varieties, three Chinese cabbage hybrid varieties (which permit production in lowland areas in summer), one variety of tomato for processing and four soybean varieties." (p.121)

"The Thailand Outreach Program (TOP), which was finalized in 1975 but not activated until 1981 due to 'political constraints,' is flourishing, and is in its second phase . . ." (p.122)

"The program (TOP) goes well, with involvement not only from Kasetsart, but also from the Universities at Chiang Mai, Khon Kaen, and Songkhla where horticulturists are selecting varieties from AVRDC nurseries." (p.122)

The Future

". . . we are very positive about the Center and its programs, particularly its potential for making major contributions in the years to come with its present and future mandate crops." (introductory letter).

"The Panel reaffirms its view that it would be in the interest of the Center, and that of international vegetable research, for AVRDC to be a full member in the international system of Centers." (p.155)

"The Panel commends the results of the Center's study which has produced the proposal for the adaptability study for new crops as a preliminary step before adding additional mandate crops to the Center's research activities." (pp.78-79)

The Panel considers the candidate crops eminently suitable for future adoption as mandate crops." (p.79)

Committee Recommendations and Responses by the AVRDC Board of Directors

The AVRDC Board appreciates the recommendations made by the Review Panel, has considered them carefully, and has decided upon several courses of action to be taken based on financial, personnel, social, and political considerations. The recommendations of the Panel are listed below and are followed by an "action priority" assigned by the Board, i.e.: 1 - immediate action sanctioned; 2 - items which will be acted upon when necessary preparations and organization are completed; and, 3 - items which will be acted upon when conditions permit (i.e. funding or personnel).

Soybean

1. In the final stages of varietal evaluation, conditions simulating intercropping and paddy cultivation should be superimposed. (p.17)

Action priority: 2-3

Such an experiment will be initiated in the fall of 1984. However, the testing of soybean materials takes place at AVRDC following paddy rice cultivation. Intercropping studies are underway in certain cooperating countries, e.g. Nepal. AVRDC is participating in the lowland cropping system program conducted by IRRi and certain national programs. AVRDC will extend this program as funding permits. AVRDC is following a multi-stage breeding and evaluation program which will be strengthened. However, studies by Francis et al. (1978 a, b; 1979) indicated that cultivars tested in monoculture and mixed-cropping systems have a consistency relative to yield and ranking. Experiments at the University of the Philippines at Los Banos in 1978 and 1979 showed that dry upland crops provide satisfactory yields when grown under paddy conditions. Hence, breeding and selection exclusively for paddy adaptation loses its validity (Lantican, 1982) and may not be desirable. In the case of multiple cropping, a different evaluation system is used involving national programs for assessment of suitable varieties.

2. The Panel recommends that 'selection indices' be established for critical traits that make for broad adaptation and stability in yield and tolerance to soil stresses in tropical and subtropical climates. (p.17)

Action priority: 1-2

A few key characters, such as sensitivity to photoperiod and temperature have been identified and are being used as 'selection indices' to provide broad adaptation. Other characters presently utilized are maximum plant height at flowering (more than 40 cm) and minimum increase in height after flowering (less than 10 cm). Maturity criteria differ according to cropping system, and criteria

for branch numbers, nodes (10 or more) and pod numbers per plant vary with plant population density. Selection indices are underway for acid soils in cooperation with the AVRDC soil scientist, and for drought and flooding with plant physiologists. Further refinement of 'selection indices' will be attempted from 'AVRDC Soybean Evaluation Trials' instead of mono-locational data developed at the AVRDC site. This is of necessity a long term program for successful incorporation of desirable agronomic characteristics into cultivars adapted to specific environments.

3. The Panel recommends that joint planning workshops and international monitoring tours of screening trials among Asian scientists be provided as funds allow. (p.18)

Action priority: 1-3

AVRDC has organized soybean rust workshops and symposia in cooperation with INTSOY, the Philippines, Thailand, and the Tropical Agricultural Research Center in Japan. The Center is also cooperating with IRRI in organizing monitoring tours. A joint planning workshop with IRRI and INTSOY was held in Indonesia in July 1984 in which an Asian Soybean Improvement Network was proposed to strengthen these activities.

4. The Panel . . . recommends that joint efforts be mounted to study and establish resistance against yellow mosaic virus disease, a pathogen which poses a threat to the developing soybean industries on the Indian sub-continent. (p.18)

Action priority: 1-3

This virus, which also infects mungbean, does not occur in Taiwan, hence no active screening can be done at AVRDC. Indian scientists have already incorporated resistance into improved soybean cultivars and various levels of resistance have been found in AVRDC cultivars. The proposed Asian Soybean Improvement network will strive for joint efforts to maintain and improve resistance. Because of a shortage of specialists, cooperation with several virus institutes is underway. These activities will be intensified where appropriate.

5. The Panel . . . recommends that efforts be strengthened to develop low and high input (crop management) technologies as options for the varied clientele of the farming communities of Asia. (p.19)

Action priority: 1-3

Experiments for low and high input technologies are underway at AVRDC and at selected locations in Taiwan and Thailand. Suitable varieties for high and low input technologies are being identified. Methodologies will also be developed in consultation with national programs and will be transferred for testing through the proposed AVRDC Soybean Improvement Network (ASIN) when funds are available. However, low input technology is a temporary measure, and we recognize that improved practices must be adopted

by farmers in the tropics if they are to succeed in feeding rapidly increasing populations.

6. The Panel . . . recommends that germplasm materials that have been identified as possessing outstanding attributes be constituted to a 'working collection' that is properly characterized and catalogued. Printed information should be sent to national programs. (p.17)

Action priority: 1

The compilation of germplasm with outstanding characteristics is underway. Once completed this information will be published and distributed to national programs. Periodic additions and revisions of the list will be made through AVRDC's Tropical Vegetable Information Service.

7. AVRDC, IITA, and INTSOY recently joined in discussions on a proposal for coordinating soybean research on the basis of geographical responsibilities (Africa, IITA; the Americas, INTSOY; Asia, AVRDC). Considering the specific differences in the problems encountered in growing soybean on these three continents, the Panel strongly recommends that negotiations on this matter be pursued to a successful conclusion. (p.149)

Action priority: 1

A meeting between members of the above institutions, plus IRR1, was held in June 1984 at which time the proposed reorganization was discussed. Further discussion took place at the World Soybean Conference in Illinois. Plans are presently being executed to establish a world-wide soybean network with specific responsibilities for the above institutions, as well as for national programs.

Mungbean

8. The team strongly urges that additional (mungbean) accessions be acquired from China, Vietnam, Burma, and other countries. (p. 29)

Action priority: 1-3

Through the help of IBPGR, arrangements were made to collect mungbean germplasm from Laos. Efforts will be expanded, through the assistance of the IBPGR and others to mount plant collection expeditions to relevant regions of Asia, providing that funds are available.

9. The Panel encourages AVRDC in its program to supply a wide range of breeding lines to national programs at various stages of selection. (p.29)

Action priority: 1

Segregated populations have been sent to cooperators committed to evaluating and making improved selections from AVRDC germplasm.

10. The Panel recommends that a distribution and damage survey of mungbean viral diseases be conducted in major growing areas. (p.30)

Action priority: 2-3

We do not consider a damage survey of mungbean to be feasible at this time. So many viruses cause similar symptoms that it is impossible to attribute damage to any one virus. To study yield impact by artificial inoculation would be time consuming and expensive.

In the past, most research on mungbean viruses has been done by Indian scientists. Many viruses have been described, but most of the available information is on symptoms, host range and insect transmission. Electron microscopic studies of these viruses are scanty and exact identification by serological methods is often lacking. Only two viruses, mungbean yellow mosaic virus and mungbean leaf crinkle virus, have been studied in detail. Mungbean viruses identified from other countries include bean common mosaic virus (BCMV), a strain of cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV), tobacco ringspot virus (TRSV), tobacco streak virus (TSV), bean yellow mosaic virus (BYMV), broadbean wilt virus, adzuki bean mosaic virus (AZMV), blackgram mottle virus, and blackgram sterility virus. Their occurrence and importance on mungbean in Asia is not known. No information is available on viruses occurring on mungbean in Taiwan. During the past two years, several viruses have been isolated from mungbean in Taiwan. Work on their exact identification (host range, particle morphology, and serological relationships) is presently under way at AVRDC in cooperation with scientists from the USA, Germany, and Japan. Screening for resistance to several of the viruses that have been isolated is underway at AVRDC, and resistance has already been found in mungbean germplasm and breeding lines.

11. The Panel agrees that interspecific hybridization programs should be continued until their potential is established or it is abandoned . . . the international program would need to be expanded to transfer the new mungbean technology to client countries. (p.30)

Action priority: 1-3

We are currently investigating the interspecific hybridization program to assess the likelihood of its ultimate success. The international program will be expanded through the Center's International Mungbean Nursery and the Tropical Vegetable Information Service, as funds allow.

12. The Panel recommends that any additional work of major significance on legumes be undertaken after a detailed consideration of the criteria for the selection of additional crops.

Action priority: 1-3

In the event that funding permits expanded research, careful consideration will be given to adding a mandate crop before expanding the legume crop programs.

Chinese Cabbage

13. With the perspective in mind of continuing the creation of improved lines over the next few years, the Panel recommends that the direction of the Chinese cabbage program be carefully evaluated in the next year to examine the possibility of reducing the activities to a level that would still ensure that the progress made over the past is maintained for the future. (p.40)

Action priority: 1

An examination of the Chinese cabbage program has been initiated. Present projects include using cultivar 'Hakuran' as a source of disease resistance, particularly to downy mildew and soft rot. The project looks promising, and if progress continues we expect to complete the transfer of resistance genes into Chinese cabbage. Some open pollinated lines also carry resistance to downy mildew. Considering the present success of the Center's Chinese cabbage lines, it seems appropriate to discontinue the research following either the success or failure of the Hakuran backcross program. However, the entire Chinese cabbage program will be carefully examined during the next year before a decision is made.

14. If and when the activities in the Chinese cabbage program are being reduced, the Panel would recommend that activities on another crop, preferably with similar breeding characteristics and possibly related to Chinese cabbage, be considered for inclusion as a new mandate crop. (p.40)

Action priority: 1-3

Careful and critical inventory studies will begin this year for the assessment of a new mandate crop. Once selected, germplasm collection will begin.

15. Regardless of whether an active Chinese cabbage program exists at AVRDC, the germplasm collection should be maintained as an active working collection in which characterization and new accessioning are adequately supported. (p.41)

Action priority: 1

The germplasm collection will be expanded as an active working collection, including characterization of new accessions. If the Chinese cabbage program continues to be active, new lines developed with desirable characteristics will be distributed to national programs, particularly when new gene sources are available in the active working collection. Chinese cabbage is a very important crop in Asia and is developing in many countries outside Asia. If the breeding program is terminated, existing lines and germplasm will be classified into cultivars for registration and possible patent, and will be maintained and distributed upon request.

16. Based on the Panel's suggestion to reduce inputs in the total Chinese cabbage program to a 'maintenance level', the Panel recommends that concentrated short-term efforts be made to produce more time-

and space-efficient disease screens so that these could later be used in maintaining improved stocks already in the program. (p.41)

Action priority: 1

This type of screening has already been successfully established for turnip mosaic virus. The concept will be extended to the other major diseases, i.e. downy mildew and soft rot. This will require a certain level of varietal improvement activity.

Tomato

17. While there are many tomato diseases, exact information on their occurrence and their relative importance in various locations in different seasons is still required. The Panel recommends that such a survey be undertaken in the near future. Until the survey is completed, priorities for resistance breeding of less important diseases cannot be established. (p.50)

Action priority: 1

A questionnaire survey for virus diseases has been conducted in Korea, Thailand, Malaysia, the Philippines, and Indonesia. According to this survey the following virus diseases are most important and widespread: Tomato - tomato mosaic virus (ToMV, cucumber mosaic virus (CMV), leafcurl virus; Chinese cabbage - turnip mosaic virus (TuMV); Soybean and Mungbean - viruses not specified, but considered important; sweet potato - viruses not important.

Based on a review of the literature and on-site surveys conducted in 1983, we believe that priority should be given to the following viruses for tomato: ToMV, CMV, leafcurl virus, and potato virus Y. Although these viruses cause considerable yield loss, there are no screening programs for resistance presently underway in national programs. The status of these and other viruses will be checked periodically.

18. Based on the progress made by the physiologist concerning the effect of high temperatures on fruit setting, the Panel recommends continuation of the study to improve the heat tolerance of existing cultivars. (p.50)

Action priority: 1

This program is given a high priority rating. New sources of heat tolerance have been identified in the germplasm and an intensive breeding program to strengthen heat tolerance is underway. The physiology of heat tolerance continues to have a high priority rating for research.

19. To accelerate the program, the Panel supports the proposal to obtain access to an experimental site in the highlands to permit experimentation during the hot, monsoon season. (p.50)

Action priority: 1

A highland experimental site for accelerating the breeding program during hot, monsoon seasons has been identified in the Puli area of the Taichung mountains. It will be utilized in the summer of 1985.

Sweet Potato

20. The Panel recommends that priority attention be given to the application of techniques for meristem culturing and virus indexing and to the early movement of both cultivars and lines to variety improvement programs. (p.62)

Action priority: 1-3

Although we are already engaged in these activities, there is a strong need to expand the facilities of both the tissue culture and virology laboratories. This will entail the hiring of additional personnel and the purchasing of supplies and equipment. Since the new Seed Laboratory will include a tissue culture room and screen-house facility, the present tissue culture lab in the Plant Physiology Department will be moved to the new Seed Lab to centralize both propagation and virus-indexing activities.

21. The Panel recommends that AVRDC Management undertake a review of stated program objectives with a view to applying more rigorous priorities in determining what can be done with the present resources if additional resources cannot be made available. In any case, the Panel recommends that an overall review of sweet potato research be undertaken within the next four years to determine appropriate levels of research inputs for this crop. Such a review should take account of any changes in the status of the crop and how successful AVRDC has been in overcoming problems of distribution of its improved materials. (p.60)

Action priority: 1-3

A review of the sweet potato program will be conducted to assess short term priorities, and will be extended to adjust long term research levels with the crop potential, problems, and research activities by other national and international institutions.

22. In order to assist with the distribution problem, the Panel recommends that AVRDC collaborate with other international agencies and research centers such as the IBPGR, the South Pacific Commission, the Glasshouse Crops Research Institute (UK), and IITA in establishing an internationally acceptable virus indexing system and in training national program personnel in participating countries with a view to creating an international testing network for sweet potato.

Action priority: 2-3

Contacts have been made with IITA for cooperation and coordination. Efforts will be made to extend this relationship and include those listed by the Panel. U.S. institutions that work with sweet potato will also be contacted.

23. The Panel recommends a review of the overall needs of the (sweet potato) program so that the desired impact of bridging the gap between AVRDC's achievements and national programs' production performance can be achieved within the available resources. (p.63)

Action priority: 1-3

Ten years of research at AVRDC has produced marked improvements in sweet potato, which in turn has resulted in a significant gap between AVRDC achievements and those of national programs. Present activities emphasize transfer of the necessary technology to national programs in order to bridge the production gap.

An important and urgent need is to establish an international testing network to ensure the smooth distribution and efficient testing of improved AVRDC materials, as well as breeding materials from other research institutions. Such a network will require funding and cooperation from other international organizations such as the IBPGR, IITA, the South Pacific Commission, and possibly CIP. Preliminary discussions between the Directors General of the above IARC's have taken place.

Nutrition, Environment and Management

24. The Panel agreed that the NEM program was being asked to cover too many activities over a wide range of specialities which gave the impression that the program lacked cohesion and direction with respect to its general objectives and activities. The Panel recommends that AVRDC consider the establishment of a unit with the suggested title of 'Central Resources and Services Unit' and that the existing program be re-named the 'Production Systems Program.' (p.67)

Action priority: 1-2

NEM will be reorganized along the lines of the committee's recommendation. Before doing so, however, a careful study will be made to ensure maximum efficiency regarding discipline relationships with ongoing programs. When established, the roles of each group will be defined with clearly stated objectives.

25. The Panel recommends that on-station activities be seen as a major responsibility of the Production Systems Program, and that off-station, on-farm activities be carried out through the Outreach Program, and usually in the first instance, through the Taiwan Cooperative Program. The word "development" would then be removed from the "Training and Development" part of AVRDC's organizational chart. (p.67)

Action priority: 2

At the time of the reorganization of NEM, on-station activities associated with all national programs will be assigned to the Production Systems Program, thereby freeing the training component for other responsibilities.

26. It would appear that in the future, soil science at AVRDC would steadily move toward basic soil science studies which are not aimed directly at solving vegetable production problems. It is suggested that a study group composed of representatives of disciplines associated with soil science look at the appropriate role of soil science at AVRDC. (p.65)

Action priority: 1-3

A study group of various disciplines to reassess the functions and objectives of soil science will be established. Our present philosophy is for soil science to solve soils-related problems at AVRDC and to generate technology applicable to cooperating national programs. Example: A simple method to determine appropriate fertilizer recommendation for local conditions. The balance between soil science, crop management, and microbiology will be carefully considered.

27. The Panel considers that the initiation of an improved support program for crop management in the development of appropriate packages of cultural practices for outreach programs is a very important part of the technology transfer process, and should be accorded some priority when additional resources are available. (p.70)

Action priority: 1-3

A program of crop management packages for national programs has been underway for some time. The technology is developed during seasons represented at AVRDC in which the conditions are carefully specified. National Programs are cautioned that modification may be necessary for different environments. Increased emphasis will be placed on this activity.

28. The Panel recommends that high priority be given to making a senior appointment in the economic sub-disciplines most directly concerned with identifying and dealing with constraints to producer and consumer acceptance of new technologies and their products, namely production economics and marketing. (p.73)

Action priority: 1-3

Despite financial constraints, we have been active for two years in trying to attract a senior specialist in micro-economics. The position is expected to be filled by the end of 1984. Methodologies will be developed that are suitable for use by national programs.

29. The Panel recommends careful consideration of the extent to which the (Chemistry) group should be involved in the development of processing technologies within the context of AVRDC's mandate. Since a group from the University of Idaho will come to AVRDC to examine research areas concerned with post harvest technology for vegetables, discussions with that mission will be very helpful. (p.76)

Action priority: 1

We do not emphasize process development. Most of our research is concentrated on raw material evaluation for processing. We are interested in maintaining crop quality from field to market and from market to kitchen. Process development research is expected to be closely associated with postharvest which will be decided after the survey by the postharvest team as indicated by the review panel.

30. . . . the Panel recommends that the scientists in the garden project evaluate the relative benefits of each garden type with a view to concentrating research and development on one or two categories. (p.81)

Action priority: 1

Pursuant to this change in concentration, we have started two home garden activities: 1) dryland home gardens, 2) AVRDC mandate crop home garden.

31. The Panel recommends that AVRDC continue the funding of the Garden Program, preferably from special project funds. (p.81)

Action priority: 1

AVRDC will continue to support the on-station research of garden projects, as funding permits, and to seek outside support for technology transfer and outreach activities.

32. The role of mycorrhizae and other "yield promoting rhizosphere micro-organisms" in promoting crop yields has yet to be substantiated. Before such expectations can be realized, significant "basic" research will be needed. The Panel questions whether such research should become an integral part of the crop research program at AVRDC.

Action priority: 1

Despite the fact that AVRDC has taken certain initiatives in the field of mycorrhizae research, we do not intend that it become an integral part of our core program. Instead, we expect to pursue basic research which we feel has specific potential for AVRDC's mandate crops and for economic utilization of soil fertility.

Disciplines

33. The Panel feels that the physiology group should provide breeders with convenient and quick methods to screen germplasm and breeding lines for useful characteristics. Under the present situation at AVRDC, it would be difficult to achieve such a goal without adding at least a small number of junior members to the group. (p.88)

Action priority: 1-3

An assessment will be made of the active projects and objectives in plant physiology to place emphasis on fewer, high priority projects. The emphasis on quick methods for screening germplasm

in cooperation with plant breeding and other appropriate disciplines is well underway as exemplified by the test for tomato fruit set, criteria for good head production of Chinese cabbage, and chlorophyll content and specific leaf weight as an indicator of high yield potential in mungbean. Additional junior staff will be hired as funding permits.

34. Pathology faces a large number of disease problems in five different crops. The Panel recognizes the need for additional manpower and recommends that the administration consider hiring an additional senior staff member and a number of junior researchers. (p.92)

Action priority: 1-3

The staffing pattern of Pathology will be studied to determine the specializations (e.g. virology, nematology, bacteriology, mycology) that need strengthening. Additional staff will be hired as funds become available.

35. The panel feels that it might be possible to concentrate on fewer important diseases. However, more attention should be paid to the virus diseases. (p.92)

Action priority: 1

AVRDC is concentrating on TMV, CMV and leafcurl virus of tomato and TuMV of Chinese cabbage, diseases considered to be most important in Southeast Asia. At the end of 1984, work on TMV and TuMV will be concluded, permitting us to concentrate on other virus diseases.

36. To facilitate the study of the effects of environment on disease development, the Panel recommends the provision of some greenhouse and controlled environmental facilities. However, elaborate phytotrons are beyond the financial capability of the Center. (p.92)

Action priority: 1-3

Construction of a screenhouse will begin within the next 12 months. Greenhouse facilities will be improved and extended as funding permits.

37. It is recommended that a limited number of large incubators with temperature and humidity controls be purchased for the species of insects in which mass rearing will be required. (p.97)

Action priority: 3

Additional incubator boxes will be purchased when the program is underway and as funds become available.

38. The Panel recommends that as a matter of priority, a second entomologist be recruited in the area of integrated pest management. (p.96) . . . The Panel recommends that when a second entomologist is appointed, a review of the entomological research work at AVRDC be conducted with a view to establishing a careful balance between

host plant resistance work and the development of pest management systems for the legume and horticultural crops. (p.98)

Action priority: 1-3

A second entomologist specializing in IPM will be hired as funding permits. Activities have been directed towards pest management in recent years, and emphasis will be increased in this area with the goal of maintaining a careful balance between host plant resistance and pest management systems.

39. The Panel expresses reservations about requests for controlled environment rooms for work in some of the scientific disciplines. The Panel recommends the Center not involve itself in serious capital expenditure and high running costs for such facilities at this time. (p.146)

Action priority: 3

The management feels that such facilities can be used at other institutions when needed.

Germplasm Conservation

40. The Panel recommends that careful consideration and attention be given to all pre- and post-importation precautions, including host specificity and hyperparasite studies and also to effective planning with the involvement of national programs. (p.96)

Action priority: 1-3

AVRDC routinely cooperates with local quarantine authorities in the importation of biological materials. In the case of parasites, if allowed entry, government regulations require parasite confinement for three generations and subjects them to periodic quarantine inspection. Studies will include parasite biology, host range, and efficacy prior to any mass release. All such activities will be done in full cooperation with local authorities.

41. The Panel recommends support for the activities of the Germplasm Resource Unit, and that the leadership within the unit work actively to generate additional funds for special research activities from interested agencies. (p.101)

Action priority: 1

Emphasis has been placed on generating funding support for a new germplasm resource unit for several years. Construction of the new AVRDC Germplasm unit commenced in 1984. Efforts have been made since the review to identify new sources of funding for necessary equipment. This activity will have a high priority.

Statistics

42. The Panel . . . recommends that if Japanese support for the (statis-

tical services) position is terminated at some time in the future, efforts be made to fund the position from the core budget. (p.104)

Action priority: 1-3

Efforts will be made to maintain a statistical services position on the senior staff. The Japanese Government will be petitioned to continue support. Failing that, efforts will be made to identify alternative funding for the position.

43. The Panel . . . recommends that the statistician should have greater involvement in experimental design than appears to have occurred in the past, and that he should assist researchers in performing their own analyses in order to maintain statistical standards. (p.104)

Action priority: 1

The statistician has been involved in experimental designs with senior scientists in the past. A program has just been initiated to extend this activity to a one-on-one consulting service with senior researchers. Courses are envisaged by the statistician for senior and local staff.

Information

44. The Panel . . . suggests that some material from the Progress Report Summaries be incorporated into the Progress Report to avoid confusion, and to make the Progress Report more useful as an annual report. (p.107)

Action priority: 1

The material to be inserted into the Progress Report has been identified and will be included in the 1983 Progress Report.

Training

45. The Panel supports the proposal for the expansion of the present training facilities, while noting that the new capacity will meet only 40 percent of potential annual demand for training at AVRDC. The Panel recommends that the Board attach high priority to this project. (p.113)

Action priority: 1-3

We have been seeking funding for two years to expand our present training facilities. Efforts to identify sources of support will be intensified.

46. The Panel observed that there was room for expanding the training program in Thailand. The Panel recommends that AVRDC evaluate the potential for increasing the number of training programs conducted outside of Taiwan. (p.113)

Action priority: 1-3

Efforts are underway to expand the Thailand training program with improvement expected in 1984. The principle of establishing periodic training courses in cooperating countries is accepted and will be evaluated. The interest by national programs will be surveyed and support funding will be solicited. However, the major training activity will continue at AVRDC headquarters.

Cooperative Programs

47. . . . the Panel recommends that the Taiwan Development Program be re-named The Taiwan Cooperative Program, largely to avoid confusion in terminology in the use of the word 'development.'

Action priority: 1-2

The term 'Taiwan Cooperative Program' has been ratified by the AVRDC Board. In the past, AVRDC has adopted the terminology preferred by the cooperating country resulting in some confusion of terms, i.e. 'development' in Taiwan, 'outreach' in Korea, Thailand, and the Philippines and 'bilateral' in Indonesia and Malaysia. There is justification for uniformity and this will be done as appropriate. For example, Thai representatives have indicated that the term 'outreach' is presently understood and an introduction of a different term at this time may cause internal confusion. At present, the term 'cooperative program' is used to describe the various kinds of involvements between AVRDC and the 100 or more participating national programs.

48. The Panel observed that although no formal agreement or memorandum of Understanding has been made or signed with the Taiwan authorities . . . objectives . . . are being clearly achieved through a wide range of largely informal but effective collaborative activities and relationships. We found that these informal mechanisms are working well and recommend that they continue and be strengthened. (p.116)

Action priority: 1

The local department of agriculture has been in a state of flux in anticipation of its re-organization. The signing of an agreement for cooperation has therefore been postponed until the new organization is in place. Although the present arrangement works well, it is likely that a document of cooperation will be negotiated within the next twelve months.

49. The Panel endorses the efforts that are being made to strengthen the outreach programs of AVRDC and recommends that the proposed expansion be undertaken as soon as additional resources can be procured. (p.145)

Action priority: 1-3

The strengthening of AVRDC's outreach programs will continue to have high priority, but care will be taken to avoid expansion at the expense of central research.

50. The Panel recommends to the Board that the Memorandum of Understanding for all future outreach programs financed by third party donors should include not only funds to cover all expenses, but in addition, an allowance for overhead and headquarters services which is fixed at the same percentage as similar allowances agreed to by the CGIAR for outreach programs managed by other IARC's. (p.147)

Action priority: 2

These points have been discussed and negotiated in the past. A firmer bargaining stance will be taken in future.

51. The Panel recommends that AVRDC research and development continue to service the needs of vegetable farmers employing relatively highly developed technologies. (p.118)

Action priority: 1

This will continue in Taiwan, Korea, and Japan. Technologies, especially those related to crop management, will be transferred to less developed areas when considered appropriate.

52. The Panel recommends that AVRDC pay increased attention to the proper balance between the level of local testing versus the testing done in cooperation with other client countries.

Action priority: 1

This is accepted as a very important principle at AVRDC. AVRDC germplasm is being evaluated in more than 100 countries. New technologies cannot be introduced into national programs without local evaluation. Cooperative programs in crop management, plant pathology, and crop breeding are underway in several countries, often at a comparatively early stage of development, particularly if the problem is more severe than in Taiwan. This principle will receive increased emphasis.

53. . . . the Panel recommends that heavy emphasis be given to successfully disseminating AVRDC improved germplasm and technology to countries where basic nutritional and economic needs are not being met for low income farmers and urban people. (p.119)

Action priority: 1

Most of the countries where AVRDC is involved fit into this category. The nature of AVRDC crops fits the farms in the Asian region where farm holdings are traditionally small and frequently outside of the active economic system. The Board and staff recognize the need and have endeavored to meet it. Attempts have been made to strengthen relationships by promoting bilateral programs with countries in West Asia and Latin America.

54. Observations and comments made by the Panel indicate the need for more support and visits from headquarters scientists when travel funds are available. (p. xviii)

Action priority: 1-3

AVRDC places priority on senior staff visits to cooperating countries within the constraints of the budget, and normally authorizes two major trips per scientist annually.

Organization and Management

55. The Panel considers it as being in AVRDC's interest to adopt and apply as closely as possible the Board procedures followed by other IARC's. (p.131)

Action priority: 1

The Board agrees in principle and already adheres to many of the Board procedures followed by other IARC's. Further conformity will be instituted as appropriate. The Board notes, however, that each system should be constituted in conformity with its own background and composition.

56. The Panel suggests that an Executive Committee, composed of the Chairman, or in his absence, the Vice Chairman, the Director General, and two other members of the Board, be given power to act on behalf of the Board whenever decisions must be taken prior to the next Board meeting, the quorum for the Executive Committee being three. (p.113)

Action priority: 1

This system is already in operation. These are also periodic meetings of the Executive committee throughout the year. In addition, there are several exchanges of information between the Chairman of the Board and the Director General on an ad hoc basis.

57. The Panel suggests that Program Leaders and their staff report on past progress and proposed programs to the (Program) Committee immediately before (i.e. two days) the annual board meeting so that the Program Committee can report to the Board, and if necessary, have the benefit of the reaction of the Director General and his staff. (p.133)

Action priority: 1

This activity will take place at the January 1985 committee meetings for report to the full Board in April 1985.

58. The Panel suggests that the Board consider the advisability of establishing a two-man Finance and Audit Committee which would report to the Board on financial matters, including expected income

and budget proposals. This committee would also report to the Board with respect to the external auditor's report after interviewing the auditor. (p.134)

Action priority: 1

The Board authorized an audit Committee of two that reports to the Board on financial matters to interview the auditors on their report. It was noted that auditing personnel rotate so that each audit is done by different individuals.

59. The Review Panel recommends that the Board examine the merits of limiting the period of service of the Chairman to perhaps four or six years (i.e. re-elected once or twice). (p.132)

Action priority: 3

Initially stipulating that the Board Chairman and Vice Chairman positions be rotated among Board members, the charter was amended to make the rotation optional. This developed during times when the host country was pressed for higher levels of funding and it was felt that a chairman from the host country would be more effective in this endeavor. In the meantime, the vice-chairmanship has rotated periodically. When the financial situation of the Center improves, it will be easier for the Board to reach a consensus to rotate the chairmanship and to observe the tenure limitations. At present, the Board feels the need for flexibility in its chairmanship.

60. The Panel recommends that initiatives be taken at the professional staff level in order to develop better intellectual involvement and participation with the local staff in the planning and implementation of research work. The Panel recommends that existing communication mechanisms be reviewed and that a process be institutionalized for a regular dialogue between management and local staff.

Action priority: 1

This is an activity that AVRDC senior staff and management believe is already done well. We consider it very important and will continue to emphasize this principle. Recognizing the importance of the participation of local staff in the planning and decision making responsibilities of research, a new program has been initiated to ensure local staff participation as well as to improve communication between local and international staff at all levels (management, research, and the trades). A regular dialogue schedule already followed between management and various staff will be increased in frequency.

61. The Panel thinks it necessary to encourage the adoption and implementation of measures that will allow post-doctorate appointments, preferably focused on specific core program interests, or aimed at filling recognized program deficiencies or areas of study that can be dealt with through relatively short appointments.

Action priority: 1

Post-doctorate fellows have traditionally been an important part of the AVRDC program. We will continue to emphasize this activity, and more effectively, if possible. We are also active in pre-doctorate programs where graduate students who are under contract with various universities may conduct research towards either M.Sc. or Ph.D. degrees.

62. The Panel . . . recommends that AVRDC be encouraged to carry out some internal reorganization within its budgetary constraints and to provide for some additional staff and facilities. The Panel supports the steps that AVRDC has taken and the modest plans that have been prepared to strengthen program staffing and develop facilities and recommends these for the consideration of the Board. The Panel notes that the following senior staff positions will be needed in the next five years: Director of Research, Director of Development (outreach-cooperative programs), Plant Breeder, Economist, Farming System Specialist, Plant Pathologist, Entomologist, and Science Editor. (p.145)

Action priority: 3

An internal reorganization will be carried out after careful reassessment. Priorities will be established for additional senior staff and the programs executed when funds become available. The fulfillment of these priorities will need to be concurrent with the physical development of the campus.

63. The Panel recognizes the need for some urgent physical development to support the programs for research and development. The Panel supports the requests for additional housing for senior staff, accomodation for postdoctoral research associates, a training center, and additional dormitory facilities. The Panel also supports the proposed improved facilities for the Genetic Resources Unit. (p.146)

Action priority: 1-3

A new Genetic Resources Unit is presently under construction. A single apartment unit is being built and will be completed in 1984. Other projects will be initiated as funding permits.

Miscellaneous

64. The Panel feels that comparison of various physiological traits between crops, in addition to within crop germplasm, may be useful. . . . In relation to this proposal, the Panel recommends the compilation of all of the available data on environmental conditions (including climate, topography, soils, etc.) in the target areas to identify suitable sites and seasons that could be exploited by various crops. This should be carried out in cooperation with the NEM program. (p.88)

Action priority: 1-3

Preliminary work has been done in this area. Work will continue as funding permits.

65. (The Panel) . . . recommend(s) that there be consultation between AVRDC, the CAPD (Council for Agricultural Planning and Development), and other Taiwan national institutions involved in postharvest technology, and that AVRDC attach priority to postharvest research and development from biological and economic viewpoints. (p.118)

Action priority: 1-3

Discussions have been initiated between CAPD (now Council of Agriculture, COA), certain other Taiwan institutions, the Post-harvest Institute for Perishables (USA) and Cornell University regarding AVRDC's role in postharvest technology.

66. There is a long-term need to answer questions such as who is benefiting from AVRDC research and where - 'small' farmers, 'large' farmers or both? . . . The Panel . . . recommends that AVRDC attempt to develop the research capabilities of the social science group within the scope of its available funding. (p.73)

Action priority: 3

Our target is small farmers. However, vegetable varieties do not benefit exclusively either large or small farmers. Economists and anthropologists have been represented periodically on the AVRDC senior staff. Anthropology is presently represented and a micro-economist is scheduled to join the senior staff in 1984.

67. The panel recommends finally that the future plans of AVRDC should place greater emphasis on the humid tropics, vegetable crops of the traditional type consumed by the poorer people, and on production systems. (p.155)

Action priority: 1-3

The initial selection of crops such as sweet potato and mung-bean for research by AVRDC scientists is an example of this principle in operation. Greater emphasis will be placed on traditional crops in the future, with special regard to production systems.

Appendix I

Membership of the Review Panel

Dr. Guy Vallaëys Chairman	Scientific Advisor, GERDAT-IRAT Chairman, Committee for International Agricultural Research, Ministry of Research c/o IRAT 45 bis, Avenue de la Belle Gabrielle 94130 Nogent sur Marne, France
Dr. George Dion Secretary	195 A, Promenade du Portage Hull, Quebec J8X 2K6, Canada
Dr. Robert Dumsday Member	Senior Lecturer/Agricultural Economics School of Agriculture La Trobe University Bundoora, Victoria, 3083, Australia
Dr. Ricardo Lantican Member	Director Institute of Plant Breeding University of the Philippines at Los Banos College, Laguna, Philippines
Dr. S. H. Ou	Special Chair Professor National Science Council Taiwan Forestry Research Institute 53 Nanhay Road, Taipei 107 Taiwan, Republic of China
Dr. Akira Tanaka Member	Professor of Plant Nutrition Faculty of Agriculture Hokkaido University North 9 - West 9, Kita Ku Sapporo 060, Japan
Dr. T. Ajibola Taylor Member	Senior Research Officer ISNAR Oranje Buitensingel 6 2511 VE, The Hague Netherlands
Dr. Paul H. Williams Member	Professor of Plant Pathology 1630 Linden Drive University of Wisconsin Madison, Wisconsin 53706 USA

Appendix II

AVRDC Board of Directors

Dr. Paul C. Ma (Chairman)
Director, Food Industry Research and Development
Institute
Hsin-chu, Taiwan, ROC

Dr. Yoshiaki Ishizuka (Vice Chairman)
Professor Emeritus, Hokkaido University
Sapporo, Japan

Dr. T. C. Tso
Collaborator, National Program Staff
Agricultural Research Service/USDA
Beltsville, Maryland, USA

Hon. Arturo R. Tanco, Jr.
Minister of Agriculture
Quezon City, Republic of the Philippines
Represented by Deputy Minister Domingo F. Panganiban

Dr. J. H. Kim, Director General
Horticultural Experiment Station/ORD
Suweon, Korea

Dr. Klaus J. Lampe
Deutsche Gesellschaft für Technische Zusammenarbeit
(GTZ)
Eschborn, Federal Republic of Germany

Dr. Chongrak Prichananda
Rector, Kasetsart University
Bangkok, Thailand

Dr. Norio Kondo
Professor, Director, Institute for Breeding Research
Tokyo University of Agriculture
Setagaya, Japan

Dr. R. V. Valmayor
Director General, Philippine Council for Agriculture and
Resources Research
Los Banos, Philippines

Mr. C. H. Huang
Director
Department of Agricultural Production
CAPD/ROC

Dr. T. M. Koyama
Director of Asiatic Programs and Senior Curator
New York Botanical Garden
Professor, City University of New York, USA

Dr. G. W. Selleck
Director General,
Asian Vegetable Research and Development Center
Shanhua, Taiwan, ROC

Observers:

Mr. Clarke Ellis, AIT/Taipei
Mr. T. Yamaguchi, Japan Interchange Association/Taipei
Dr. B. Pollack, USAID, Washington D.C., USA
Mr. J. Hallett, American Institute in Taiwan
Dr. M. A. Stevens, Scientific Liason Officer/USAID
Mr. S. L. Huh/Embassy of the Republic of Korea/Taipei
Mr. F. T. Chang/CAPD, Taipei, Taiwan, ROC

Appendix III

AVRDC Achievements

A. Germplasm Enhancement

From 1972 to 1983, 121,427 samples were tested by AVRDC scientists, and 170,077 seed samples were dispatched to researchers in 148 countries. The present collection exceeds 23,000 accessions.

B. Soybean

1. High yields: Two high-yielding accessions G 2120 (small seeded) and G 2261 (early maturing) are used extensively in the breeding program. A total of 35 breeding lines have been derived from G 2120 alone.
2. Wide adaptability to photoperiod and temperature insensitivity: A significant contribution to soybean variety improvement has been the development of cultivars that are insensitive to day length and temperature. From screening studies, 1,486 varieties proved insensitive to photoperiod and 75 were insensitive to temperature.
3. Resistance to soybean rust: Eleven breeding lines have been derived from two resistant sources, and six additional sources of resistance have been identified in the germplasm.
4. General disease resistance: Resistance to soybean mosaic virus (one of seven strains) has been identified in five lines, and two breeding lines have inherited this trait. The majority of AVRDC's high yielding selections are also resistant to bacterial pustule or downy mildew.
5. Resistance to insect pests: Resistance to two species of beanfly have been identified in four accessions, two of which are being tested by cooperators. Another accession appears resistant to stink bugs and other foliage feeders.
6. Seed quality: Six soybean lines were identified for good seed quality and resistance to weathering in cooperation with IITA.
7. Flooding and drought tolerance: Two lines have proven tolerant to soil flooding; two lines appear to withstand both flooding and drought; and four lines are capable of tolerating mild drought.
8. Vegetable soybean: Two large-seeded accessions have been distributed to cooperators for testing as a vegetable-type soybean.

C. Mungbean

1. High yield, earliness, and uniform maturity: Three high yielding and early, uniformly maturing accessions have been used to develop 57 breeding lines. Both the accessions and the breeding lines have been widely distributed to cooperators.

2. Insensitivity to day length and temperature: Four non-sensitive cultivars carry genes for good seed quality, high yield, and flooding tolerance.
3. Resistance to powdery mildew (PM) and Cercospora leaf spot (CLS): Several breeding lines carry resistance to both CLS and PM. Cultivar V 2773 has been used as a parent for 28 breeding lines.
4. Insect resistance: Three mungbean accessions are being used in the breeding program to improve resistance to beanfly, and several breeding lines are being used for their high levels of resistance to Callosobruchus chinensis, a serious seed storage pest.
5. Flooding tolerance: Five accessions were identified as moderately tolerant to flooding.
6. Breeding line combinations: Promising lines from 3,949 crosses have been developed with high levels of disease resistance, high yield, early and uniform maturity, resistance to insects and diseases, photoperiod insensitivity, lodging tolerance, and good seed quality.

D. Tomato

1. Heat tolerance and bacterial wilt resistance: A number of outstanding, tropically adapted breeding lines carrying heat tolerance and bacterial wilt resistance have been developed. Physiological studies on high temperature fruit set indicate that poor set results more from the impairment of reproductive growth than from the impairment of vegetative growth. High day and night temperatures are also detrimental, as is a lack of anthesis, low pollen production, poor pollen and ovule viability, style exertion, abnormal pollen tube growth, poor fertilization, poor fruit growth, and precocious pedicel abscission. No single factor could be singled out, however. Various heat tolerant cultivars have been developed that exhibit varying combinations of these traits.
2. Resistances to diseases: Development of screening techniques and the identification of resistance sources for TMV (tomato mosaic virus) were accomplished and successfully applied in the breeding program. The majority of new lines tested in 1983 carry TMV resistance as well as heat tolerance and bacterial wilt resistance. Some advanced breeding lines arising from crosses with cv. Anahu were highly resistant to root knot nematodes. Resistance to late blight was also identified in some breeding lines.
3. Two series of large and firm-fruited processing tomato lines, CL 1561 and CL 1591, were developed and are now being used by local and foreign processors. CL 1561-6-0-5-1-3 was released as 'Tainan No. 2' in Taiwan in 1982.

4. Other horticultural characteristics: Seven processing-type breeding lines exhibited characteristics such as high yield, acceptable solids content, good color, firmness, and, in certain lines, resistance to *Fusarium* wilt. Four hybrid processing lines have also been developed which combine high yield, heat tolerance, and resistance to bacterial wilt and TMV.
5. Fruitworm resistance: Two wild accessions of tomato that carry resistance to fruitworm are being utilized in the tomato breeding program.

E. Chinese cabbage

1. Heat tolerance: Heat tolerance was developed in a series of open-pollinated varieties and hybrids. A number of these breeding materials have been directly released to commercial growers or utilized in national breeding programs. Physiological studies on the nature of heat tolerance indicated that heat tolerant cultivars generally maintain high osmotic potential, relative water content, sap electrical conductivity, leaf thickness, chlorophyll content, and root growth, all of which appear to be essential in keeping the leaves turgid and facilitating head formation under high temperatures.
2. Disease resistance: Three of the hybrids and three open-pollinated lines (OP) mentioned above show high levels of resistance to downy mildew. Five lines and two hybrids are resistant to both downy mildew and turnip mosaic virus. Under artificially induced epiphytotic conditions, three OP's and three hybrids showed some resistance to soft rot. Higher levels of resistance to soft rot and downy mildew have been identified and are now being incorporated into advanced lines. Strain variation in turnip mosaic virus has been elucidated and sources of resistance to the strains have been identified from the germ-plasm collection.
3. Other horticultural traits: Apart from heat tolerance, AVRDC tropical hybrids are early maturing and yield two to three times more than older tropical cultivars. Their short cropping duration and uniform maturity make them well-suited for hot, humid environments where adverse conditions such as excessive rainfall, high temperature, and extensive damage from diseases amplify the risk of crop loss.
4. Pest resistance: Low levels of resistance to diamondback moth, cabbage webworm, and aphids have been identified among non-heading accessions.

F. Sweet Potato

1. Early maturity, high root yield, and β -carotene content: Two high yielding dessert type sweet potatoes were developed with high vitamin A content. Several of these lines yield 20 t/ha or more, compared with an average of 8 t/ha for local cultivars. One line which is tolerant to witches broom has been distributed to cooperators for breeding purposes.

2. High dry matter content: A series of lines carry dry matter contents in excess of 28%. These materials also carry improved flood and drought tolerance, and have higher starch content and better eating quality than their predecessors.
3. Vegetable types: An improved vegetable type sweet potato was developed from a Filipino accession. It has an attractive yellow-green color and is rich in protein and vitamins A and B₂.
4. An inexpensive method of sweet potato weevil control was developed based on sanitation and control of alternate hosts.
5. Two accessions with moderate levels of vineborer resistance are being used for resistance breeding.

G. Cooperative Programs

1. Cooperative program in Korea resulted in the release of two mungbean cultivars, two Chinese cabbage hybrids, a tomato variety, and four soybean cultivars.
2. In the Philippines, a total of 6,500 accessions and breeding lines have been supplied for testing. To date, a sweet potato cultivar, three Chinese cabbage lines, and a processing tomato have been released for commercial use. Soybean and mungbean selections are being prepared for release.
3. Thailand: A training program was established in cooperation with Kasetsart University for international and local scholars. Representatives of AVRDC's five mandate crops show promise in trials with local cultivars. The technique of leaf-tying of Chinese cabbage shows promise for lowland production.
4. Taiwan: Crop releases in Taiwan include a Chinese cabbage hybrid, mungbean and soybean cultivars (one each) and two tomato cultivars. Relationships between AVRDC and Taiwan institutions are mutually beneficial. They include the exchange of technologies, information, and breeding materials; training of local scholars; close cooperation in research materials testing; and the exposure of AVRDC's international scholars to Taiwan's vegetable farming industry.

H. National Programs

AVRDC scientists collaborate with researchers in more than 100 national programs. As a result, AVRDC cultivars have been released in 22 countries (not including bilateral and development program countries).

I. Networks

1. International Mungbean Nursery: A world-wide International Mungbean Nursery (IMN) has distributed 253 trial sets to cooperators at 150 locations in 25 countries. Two compre-

hensive publications presenting the results of the network activities are in press.

2. Soybean evaluation trials: Since 1980, the soybean evaluation trial (ASET) has distributed 180 trial sets to 139 cooperators in 103 countries. Trial results will be highlighted in a forthcoming publication.
3. IRRI farming system network: AVRDC mungbean and soybean selections are included in IRRI's farming system network. From 1980 to 1983, mungbean lines were tested at 28 sites and soybean lines at 16.

J. Training

More than 500 individuals from 40 countries (87% from Asia) have completed training programs at AVRDC. Of these, 28% received training in vegetable research techniques, 31% in production and extension, 17% in programs designed to find solutions to location-specific problems, and 23% in undergraduate research and/or production techniques.

K. Formal Agreements

AVRDC has signed 35 agreements with 18 countries.

L. Crop Releases

Releases of AVRDC varieties at the farm level are recent. The impact is difficult to assess, but information has been received from some countries.

Cooperative national programs have released 70 improved cultivars or accessions of the Center's five mandate crops in 28 countries. These areas include Asia, Africa, Australia, Central America, North America, the West Indies, and the South Pacific.

1. Tomato: There have been 42 official releases of improved AVRDC tomatoes in 20 countries. In Taiwan, approximately 550 ha of AVRDC improved lines are grown annually at an estimated value of US\$2.2 millions. The Agricultural Extension Department in Thailand reports that 90% of 8,238 ha of tomatoes grown in that country are cultivar "SVRDC 4," a variety selected from an AVRDC line. AVRDC tomatoes represent 80% of the market share in Mauritius, an amount valued at US\$3.2 millions. The AVRDC tomatoes grown in the Seychelles are valued at US \$60,000. The annual value of AVRDC tomatoes in the Cook Islands was reported to be US\$10,000. Production in Papua New Guinea was estimated at 200 tons in 1982, valued at US \$234,000. In the Philippines, AVRDC processing tomatoes are grown on an estimated 600 ha with a new release expected in 1985. Center lines are also being commercially produced in Barbados and the Virgin Islands.
2. Chinese cabbage: Ten Chinese cabbage hybrids and open-pollinated cultivars have been released in four countries. An

additional four countries would release AVRDC hybrids if seeds were available. AVRDC is making arrangements to provide the required seed. Hybrid 62, which was recently released in the Philippines and Taiwan, is reported to yield three times more than local varieties. In 1983, AVRDC Chinese cabbage was grown on 25 ha in Taiwan and produced 316 tons valued at US\$69,000. Farmers' cooperatives in southern Japan are now using AVRDC OP lines for summer production.

3. Mungbean: Improved mungbean cultivars have been released in 10 countries. Some of these lines were developed in cooperation with national scientists using AVRDC materials and locally-adapted parents. This includes, for example, high yielding, yellow mosaic virus resistant varieties in India. In Australia, accession V 1388 was reported to yield 20% more than the most popular local varieties. In Taiwan, AVRDC mungbeans were reportedly grown on 150 ha in 1982. In Korea, AVRDC mungbeans were harvested from 1000 ha and were valued at US \$400,000 in 1983. Another AVRDC selection, which is said to be 27% higher yielding will be released in Korea in 1984.
4. Soybean: National programs have released seven improved soybean cultivars in six countries. The desirable characteristics of these lines, as listed by cooperators, include early maturity, high yield, resistance to leaf spot, adaptability to inter-cropping, and resistance to bacterial pustule. All of the approximately 1,000 ha of soybean grown in Honduras is comprised of an AVRDC cultivar known locally as DARCO-1. In Indonesia, AVRDC's G2120, an improved selection derived from an Indonesian accession, was reportedly planted on 300 ha in 1983.
5. Sweet Potato: One of the early contributions of AVRDC sweet potato research was the development of lines which are high in vitamin A and which are capable of producing yields even under low input conditions. One such cultivar has been released to growers in the Philippines. A second generation of sweet potatoes is now being developed. These materials are noted for their consumer acceptability (dry texture), high protein content, and high dry matter yields (approximately 25%). Fresh weight yields of up to 100 t/ha have been reported by collaborators in Tahiti, a major sweet potato consuming country.

M. Technology Development

1. An analysis of persistent pesticides in the soil has shown a much more rapid breakdown of these compounds in subtropical climates than in temperate climates. For example, DDT residues in southern Taiwan did not accumulate significantly when applied at rates of 5 kg/ha twice annually for five years.
2. An economic method for the cultural control of sweet potato weevil was developed through an integrated program involving Ipomea weed control and dipping planting material in a pesticide solution at planting.

3. An economical separation process has been devised which conserves what was previously a waste protein in the manufacture of mungbean noodles. The conserved protein can be used to enrich bread and partially replace wheat flour. Conservation and utilization of protein can now be practiced as a by-product of mungbean noodle production.
4. Leaf tying of Chinese cabbage 30 days after transplanting is a management technique which shows promise for economic production of moderately heat-tolerant varieties in the tropical lowlands.
5. The development of appropriate bed heights has permitted economic production of heat-tolerant, disease-resistant Chinese cabbage and tomato cultivars under lowland conditions in the monsoon season.
6. Heating tomato seed (5 to 8% moisture content) for two days at 78°C dry heat eliminates seed-borne tomato mosaic virus without affecting the germination rate up to 12 months after treatment.