

AVRDC ASIAN VEGETABLE RESEARCH
AND DEVELOPMENT CENTER

1981 Highlights



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April 1982

AVRDC is the only international agricultural research center with the mandate for improving vegetable production and quality in the tropics. The Center, founded in 1971, is principally supported by the Republic of China, Japan, the Republic of Korea, the Republic of the Philippines, the Kingdom of Thailand, the United States of America and the Federal Republic of Germany. All responsibilities for this publication rest with the Asian Vegetable Research and Development Center.

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Director's Foreword

This publication is designed to provide a brief review of AVRDC's research program during 1981. Selected experiments are presented in condensed form and are intended only to highlight the Center's general research program. More extensive information will be forthcoming in our annual progress report scheduled for publication later this year.

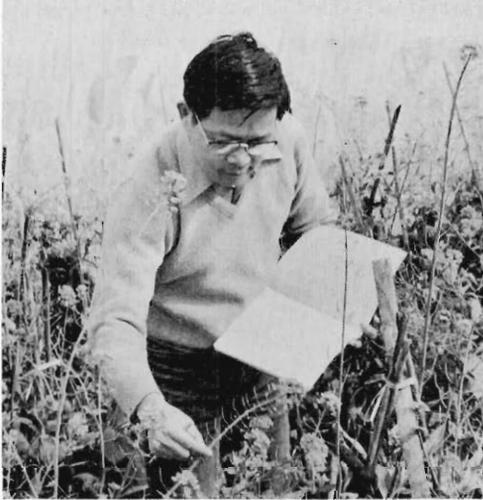
In either case, it is difficult to present a complete picture of an international research institute based solely on scientific reports. While primarily a research organization, AVRDC is a diverse institution and many of its most important activities do not necessarily lend themselves to a scientific format. One example is training. This year, 66 trainees from nine countries attended training programs at AVRDC—more than twice the number in 1977. Numbers only tell part of the story, however. The real test of a training program comes when the participants return home to implement what they have learned. A letter from former trainee Isaac Odei illustrates the point.

An agricultural officer with the Veia Irrigation Project in Ghana, Mr Odei spent five months at AVRDC studying tomato cultural practices in 1980-81. In his letter he told us that when he returned home, he conducted trials to assess the performance of various tomato lines. What he found was that AVRDC heat tolerant line CL 1591 outyielded and outperformed the farmers' traditional cultivar. Local farmers liked the fact that CL 1591 was early maturing and had a survival rate far better than their own cultivar. So great was the demand for CL 1591 that this year Mr Odei and his colleagues will be multiplying a full two hectares.

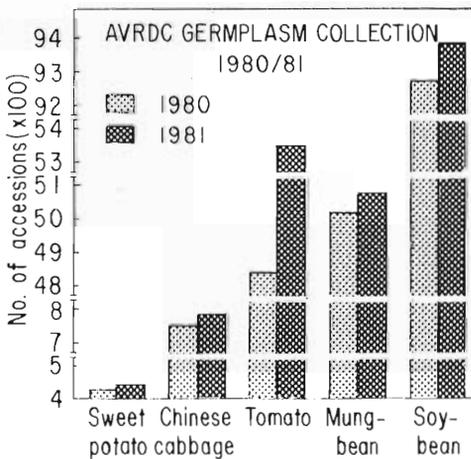


An AVRDC scientist (right) discusses mung-bean breeding with research intern Rungsarid Kaveeta. When he completes his training program, Mr. Kaveeta will take up duties with AVRDC's Thailand Outreach Program.

Germplasm Conservation



AVRDC's Seed Laboratory is responsible for the multiplication, preservation and distribution of more than 21,000 accessions. This year new responsibilities were added with the expansion of the Chinese Cabbage Germplasm Preservation Project. The Project is sponsored by the International Board for Plant Genetic Resources and is being conducted in collaboration with Britain's National Vegetable Research Station at Wellesbourne. Pictured above is Seed Lab Chief Leonard Ho, rating various accessions.



In a country where nutritious food is often in short supply there is no telling what dividends Mr Odei's efforts may ultimately pay. It seems to us, however, that the investment made in Mr Odei's training is already paying off.

This is just one example of the kind of information that a scientific report cannot communicate. Similar stories can also be told of AVRDC's collaborative projects with national programs. In 1981, the Center's seed laboratory distributed nearly 13,000 seed packets for testing in more than 75 countries. The expertise of research scientists in these countries is used to routinely evaluate AVRDC-developed cultivars over a wide range of environments. At the same time, this process provides national programs with an opportunity to test our materials firsthand. On the basis of their own trials, for example, national programs in Guatemala, Sri Lanka and Taiwan are now preparing the release of a number of AVRDC soybean lines. Similarly, this past year AVRDC mungbean VC 1628 A was released in Taiwan, and VC 1973 A will be recommended for release in Korea by the end of 1982.

Encouraging reports have also been received on the performance of the Center's horticultural crops. This year, AVRDC tomatoes were released or distributed to farmers in Fiji, India and the Seychelles, and others are being prepared for release to commercial canners in Korea and Taiwan. AVRDC Chinese cabbage lines also entered the final stages of evaluation in Indonesia, the Philippines and Taiwan, and showed outstanding performance as far away as Saudi Arabia and the United States.

These collaborative efforts with national research programs are a source of pride for AVRDC, and in the past have led not only to the release of the Center's cultivars, but to the establishment of formal outreach programs designed to accelerate cooperative projects. Such programs now operate in Korea, the Philippines and Taiwan, and are playing a major role in promoting closer cooperation between AVRDC and the national programs of these countries. This year the Center was particularly pleased to announce

the establishment of a new outreach program in Thailand. Funded by the Asian Development Bank and the Kingdom of Thailand, the program will serve both as a conduit for research activities and as a training program for areas not formerly served by AVRDC.

Complementing these efforts is the Center's Nutrition Program. With the posting of a full-time nutritionist to AVRDC, the Center has in the past two years significantly expanded the link between its own crop improvement programs and nutrition intervention programs in selected developing countries.

Preliminary studies in 1981 demonstrated that simple home and school gardens, with a minimum of inputs, can produce enough nutritious vegetables to provide high levels of a child's daily vitamin and mineral requirements. These studies are now in an intermediate stage of development, but are already attracting the attention of several Southeast Asia nations.

These are just a few of AVRDC's activities that do not necessarily lend themselves to reporting in a scientific format. Nevertheless, they are an important complement to the Center's research programs, helping to mobilize and coordinate national and international resources crucial to agricultural development in the tropics. Through its training programs, collaborative trials, outreach programs and nutrition studies, AVRDC is working to expand information exchanges and the flow of technology. This, we believe, is basic to an effective and responsive program of international agricultural research.

New Crops for AVRDC



This year AVRDC added cauliflower, mustard green, radish, snap bean and pepper to its research program. Choosing these vegetables for their nutritive value and potential as cash earners, the Center will limit its research on the crops to performance evaluation trials.

Earlier in the year, an appeal was made to seed companies throughout the world for samples of their best materials. The seeds supplied will be tested in 1982 and 1983 and the results made available to national research programs.

G. W. Selleck

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Director

SOYBEAN

Soybean has bright prospects as a food crop in the tropics. It is in tropical environments, however, where the constraints facing soybean farmers are the most daunting. Tropical heat, humidity, diseases and pests keep soybean yields low. At AVRDC, research has concentrated on resolving these constraints. In 1981, priority projects included multi-seasonal adaptability, rust and mosaic resistance, beanfly and podborer tolerance and mycorrhizae yield enhancement.

New selections with two and three-season adaptability

Four AVRDC soybean selections (AGS 129, AGS 146, AGS 154 and AGS 162) demonstrated stable adaptability across all three cropping seasons in advanced yield trials. Five selections had good yields across two cropping seasons. AGS 154 and AGS 162 rated tolerant to downey mildew.

Vegetable soybean selection

In evaluations of seven vegetable soybean types, AGS 164 produced the highest green bean yield (90% moisture basis) of 10.7 t/ha in the spring cropping season. In the fall cropping season, G 8285 yielded 17 t/ha (90% moisture basis). In a three-season trial, AVRDC soybean selections AGS 164, AGS 167 and AGS 165 significantly outyielded check Zen Wu No. 2 in all three seasons.

Trifoliolate leaves and reproductive potential

Further insights were made into the relationship between the number of trifoliolate leaves and reproductive potential of soybean in an evaluation of three photoperiod insensitive accessions and



Despite low yields, soybean promises to become an important grain legume in the tropics as the demand for edible oils and protein-rich foods for humans and livestock increases.

one sensitive accession. In a series of treatments, plants were stripped of all but one to four trifoliolates, or completely stripped of trifoliolates. Days-to-flowering was the same for the day-neutral accessions regardless of treatment. Less than four trifoliolate leaves for sensitive G 2120 significantly increased the time required for flowering. Day-neutral genotypes G 257, G 2502 and G 215 were more efficient than sensitive G 2120 in seed production per unit leaf area.

Physiologic age of soybean and soybean rust development

Physiologic age of a soybean plant, as expressed by days to full maturity (DFM), plays an important role in the rate of soybean rust development. Two soybean cultivars were grown under natural photoperiods (avg 11.2 hr) and 14 hr photoperiods. Both cultivars matured later under the 14 hr photoperiods. When rust development was analyzed using days after planting (DAP) as a parameter, both cultivars showed higher disease development rates under the shorter photoperiods. However, when adjustments were made for the different maturities under the different photoperiod regimes, there were no significant differences between photoperiod treatments in disease development rates for either cultivar.

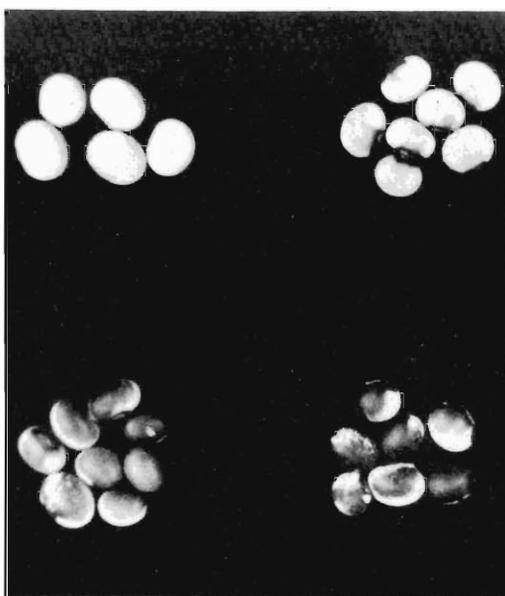
If the rate of rust development decreases with increasing days to maturity, late-maturing cultivars would appear to have higher levels of resistance even though their actual levels are similar. Future rust resistance screening efforts should therefore test lines that have been selected first by maturity group. A similar procedure should also be used to select appropriate check cultivars.

Intensity of seed discoloration and seed transmission of SMV

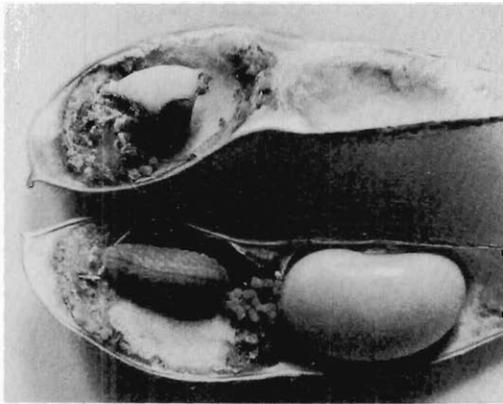
The intensity of seed discoloration was found to be related to seed transmission of soybean mosaic virus (SMV). Seed harvested from SMV-1 infected soybean plants were grouped into six classes by size and color and immediately sown. The emerging seedlings were observed for SMV symptoms. Seeds with the most intense discoloration (dark black and dark brown)



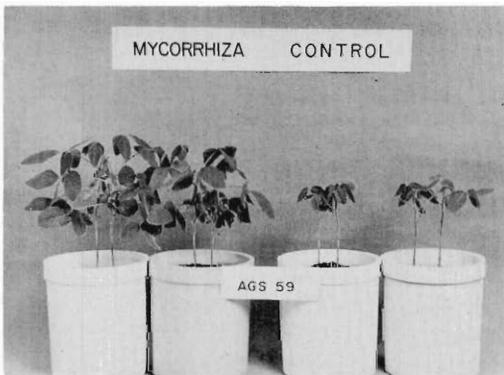
Studies demonstrated that photoperiod insensitive soybeans can flower even when stripped of trifoliolate leaves (right). This technique is now being used to identify photoperiod insensitive lines in greenhouse experiments.



Seed discoloration was found to have a direct link to the transmission of soybean mosaic virus. Seeds with the most discoloration had transmission rates of 10% to 18%, whereas seeds with less discoloration had significantly lower rates.



Podborer is a serious threat to soybean farmers in the tropics. A number of AVRDC lines showed moderate to high levels of resistance this year and will be retested in 1982.



Mycorrhizae inoculations have been shown to promote soybean growth in pot experiments. AVRDC scientists are now evaluating the applicability of mycorrhizae inoculations to soybeans grown in the field.

extending beyond the seed shoulder had high SMV transmission rates (18% and 10% respectively), whereas seeds with light grey or light brown discoloration had transmission rates of 1.8% and 1.7% respectively. No transmission was recorded for seeds without discoloration.

Beanfly tolerance screenings

Six soybean accessions showed tolerance to beanfly infestation in a fall screening. Each entry was planted in two plots, one of which was kept beanfly-free with monocrotophos applications and one which was allowed to become infested with beanflies. Mean yield reduction for 200 entries was 16.2%. For accessions G 64, G 123, G 135, G 212, G 222 and G 252, beanfly infestations reduced grain yields by less than 1% of those from the beanfly-free treatments. These six accessions will be reevaluated in 1982.

Screening for resistance to podborer

Accession G 8506, which showed moderate to high levels of resistance to podborer in tests at AVRDC, was the least affected entry (33.52% mean damage) under high podborer pressure at three locations in Indonesia. This accession and accession G 8448 with 41.6% mean damage are now being used for breeding purposes.

VA mycorrhizae and no-tillage, rice-stubble soybean

Inoculations of vesicular-arbuscular (VA) mycorrhizae showed field potential for fall plantings of no-tillage, rice-stubble soybean. Fields were inoculated with *Glomus fasciculatus* at 15 g/rice stubble after the rice harvest. Selection AGS 2 was planted using all standard cultural practices except the application of phosphorus. VA mycorrhizae inoculations resulted in a yield enhancement of 11% over that of the control.

MUNG BEAN

Mungbean is a well-known legume that has never received the research attention directed to other major food crops. AVRDC chose to work on this crop because of its potential as a source of easily digestible protein that can complement the protein deficiencies of cereal diets. In 1981, the research program's efforts included identifying high yielding lines, screening for resistance to *Cercospora* leafspot and powdery mildew and the identification of beanfly tolerant cultivars.

Yield trials

The average spring yield for 30 AVRDC elite mungbean breeding lines was 2.0 t/ha compared with 1.7 t/ha from check cultivar V 3476. Breeding line VC 2764 A yielded highest at 2.6 t/ha. Summer trials were adversely affected by late, heavy rain, but AVRDC lines still yielded an average 1.7 t/ha compared with 1.5 t/ha from check V 3476. Line VC 1482 D was the highest yielding at 2.1 t/ha.

In advanced yield trials, 1.9 t/ha was produced by two breeding lines in the spring and four lines in the summer. The check cultivar yielded 1.6 t/ha in the spring and 1.4 t/ha in the summer.

Screening for resistance to *Cercospora* leafspot and powdery mildew

Mungbean breeding lines VC 1560 D and VC 2719 A rated highly resistant to both *Cercospora* leafspot (CLS) and powdery mildew in a screening of AVRDC advanced breeding lines and accessions. Both lines showed higher levels of resistance, higher yields and better agronomic characters compared with the resistant check (V 2773) and other resistant accessions. Eleven additional lines demonstrated moderate to high levels of resistance to both diseases.

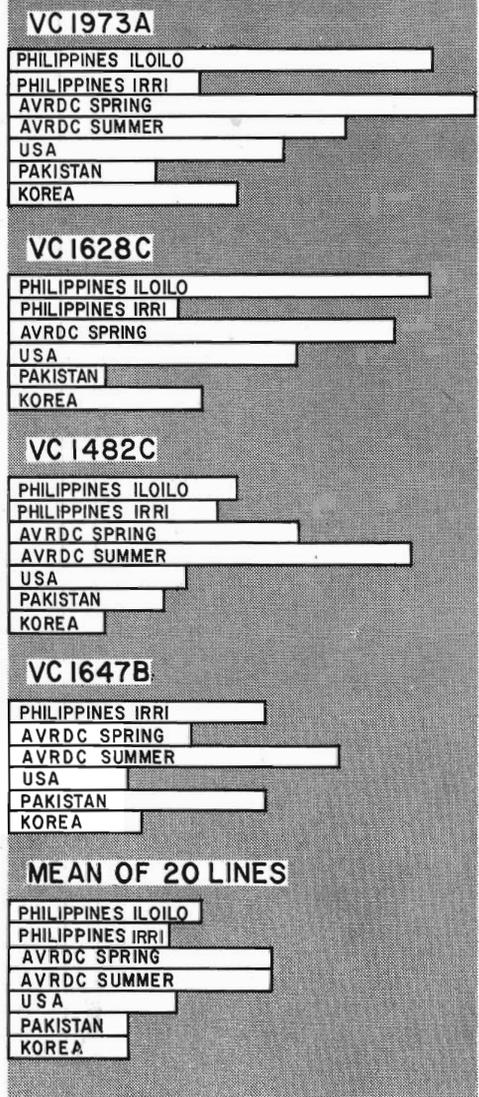


With its short growth period, wide adaptability and soil enrichment properties, mungbean is especially well suited to mixed cropping systems.

NINTH INT'L MUNGBEAN NURSERY . . .

Yield (100 kg/ha)

0 5 10 15 20 24



AVRDC mungbean breeding lines were the highest yielders at six locations. VC 1973 A had the highest average yield of 1.5 t/ha at all locations.

Sets of 40 AVRDC mungbean breeding lines and 22 accessions were sent to Indonesia, Korea, Philippines, Taiwan and Thailand for disease resistance screening. VC 1560-2-B-4-1-B-2-2B, V 4679 and V 4717 rated highly resistant to both *Cercospora* leafspot and powdery mildew at all locations.

Cercospora leafspot studies

The number and size of *Cercospora* leafspot lesions could be useful in identifying resistant cultivars. Two cultivars, VC 1560 D (resistant) and V 2010 (susceptible), were planted in the field and exposed to naturally occurring CLS pressure. Lesion number increased with time in both cultivars, but the rate of increase for VC 1560 D was less than half that of V 2010. Average lesion size increased with time in the susceptible cultivar and decreased in the resistant cultivar. The results indicate that VC 1560 D is not only resistant to infection, as evidenced by reduced lesion number, but also to lesion development. Lesion number and size should prove useful in identifying other cultivars with rate-reducing resistance to CLS.

In epidemiology studies of *Cercospora* leafspot, the rates of disease development of all three mungbean breeding lines tested were equal to or less than those of their resistant parents. This indicates that higher levels of disease rate-reducing resistance are obtainable.

Beanfly resistance

A total of 25 F₃ mungbean selections, out of a population of 295, showed an average of 0.15 insects per plant. Plants were infested by the prevailing beanfly population. Each selection was sampled for beanfly damage four weeks after planting. The F₄ lines will be tested in 1982 at AVRDC and under heavier population pressure in selected beanfly-infested areas in Thailand and Indonesia.

TOMATO

Perhaps more than any other crop, tomatoes hold the promise of increasing farmer incomes and improving the diets of both rural and urban populations. After only eight years of research, AVRDC tomato materials are having considerable success around the world. This past year, the research program undertook a more intensive study of the nature of bacterial wilt resistance and heat tolerance, as well as focusing more attention on tomato virus diseases.

Yield trials

In winter yield trials of AVRDC processing tomatoes, eight lines outyielded check TK 70, the most commonly grown processing tomato cultivar in Taiwan. Two lines, CL 1104-0-0-29-3 and CL 197-0-2-3-2-2, had fruit sizes comparable to that of TK 70. All eight lines will be entered in advanced yield trials in 1982 and evaluated against TK 70 for processing quality.

In late summer yield trials of single seed descent (SSD) lines, AVRDC tomato selection CL 1104-0-0-50-1-1 yielded 62 t/ha compared with 2 t/ha from heat sensitive check L 387 and a mean yield of 13 t/ha from 30 entries. In an early summer planting, the same line yielded 22 t/ha compared with 3 t/ha from L 387.

Possible presence of tobacco leaf curl virus (TLCV) in Taiwan

Symptoms similar to those caused by tobacco leaf curl virus (TLCV) or tomato yellow leaf curl virus (TYLCV) were observed on tomato in Taiwan. Pathologists have been able to transmit the disease agent by white flies but not by mechanical means from tomato to tomato and from tomato to *Datura stramonium*. In immuno-



A Taiwanese farmer displays his crop of AVRDC processing tomatoes.

diffusion tests, a single precipitation line was formed with TLCV antiserum. These results indicate that a white fly-transmitted agent such as TLCV might be responsible for the symptoms observed in the field.

Tomato mosaic virus (TMV) strain detection

The major tomato production areas in Taiwan were surveyed for naturally occurring strains of tomato mosaic virus. Of 345 samples, 158 contained the virus as indicated by local lesion formation on *Nicotiana sylvestris*. Strain typing of these isolates indicated that only TMV strain 0 and TMV strain 1 are present in Taiwan.

Cultural control of the aphid and fruitworm

Nylon net covers provided the lowest aphid infestation, least fruitworm damage and greatest tomato yield in an experiment evaluating different cultural practices for aphid and fruitworm control. Aluminum foil, as well as clear and black plastic mulches, also gave satisfactory insect control and yields significantly greater than that of the untreated control. Intercropping (58 combinations) did not control aphids and resulted in reduced fruit yields.

Screening for specific physiological factors involved in heat tolerance

Physiological studies were conducted to evaluate individual physiological and morphological aspects involved in the complex tomato fruiting process under high temperature stress. Fifty-four tomato accessions and breeding lines previously identified as heat tolerant were screened for fruit setting ability and stigma exertion under high temperatures. Forty of these entries were further screened for pollen production, pollen viability and anther cone splitting under high temperatures. All entries showed reduced pollen production, pollen viability and fruiting ability, as well as greater stigma exertion and anther cone splitting under high temperatures. However, some of the entries showed only slight differences between high and normal tem-



Leaf curl symptoms induced by white fly transmission.



The fruitworm burrows inside the tomato to feed, and is thus able to escape insecticide sprays. Cultivar resistance offers the best hope of finding a solution and AVRDC entomologists are incorporating several resistant lines into breeding stocks.

perature treatments. Under high temperatures, five entries showed high fruit setting ability, 11 showed low anther cone splitting, six showed low stigma exsertion, three had high pollen production and four showed high pollen viability. These genotypes are now being combined in the heat-tolerant tomato breeding program.

Flood tolerance studies

Six tomato accessions were rated flood tolerant on the basis of two screenings that involved oxygen restriction in the root system. The six accessions were selected from 25 that were grown in an aerated water culture with 2mM dinitrophenol added to block oxidative phosphorylation in the root system. Tolerance ratings were made on the basis of shoot growth, chlorophyll content, leaf curvature and proline content. Previous experiments had indicated that flooding damage is caused by the primary effect of oxygen restriction rather than the secondary effect of elevated ethylene levels in the tomato plant.



AVRDC scientists are studying the physiological mechanisms of the tomato fruiting process to pinpoint additional areas for cultivar improvement.

SWEET POTATO



AVRDC's sweet potato breeding program concentrates on developing high yielding cultivars that are high in vitamins and protein, have good eating quality, and are adapted to cultivation with a minimum of inputs.

Sweet potato is an undervalued crop that has the potential to produce more food per hectare than rice, and with fewer inputs. This potential, however, has remained unexploited in the drive to develop the better known staple crops. At AVRDC a joint effort by the sweet potato crop improvement program and the Nutrition, Environment and Management Program is directed at improving not only the agronomic characteristics of the crop, but also developing it as a food source. In 1981, crop improvement research emphasized the development of sweet potatoes that perform well under wet and dry season conditions and the identification of weevil resistant cultivars.

Yield trials

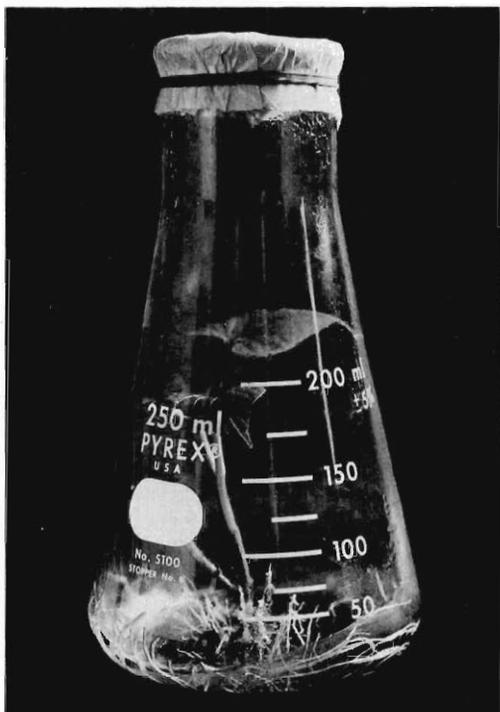
Breeders continued to identify sweet potato lines with good performance under wet (spring-summer) and dry (fall) seasons. In spring preliminary trials, AVRDC selections yielded up to 12.7 t/ha against 1.7 t/ha for the local check. In advanced trials over two summer seasons, selection CI 942-26 produced an average marketable yield of 21.8 t/ha and had 25% dry matter content. In summer preliminary trials, selection CI 995-23 showed promise as a dessert type sweet potato with a yield of 19 t/ha, 9.7 mg β -carotene/100g fresh weight and 7% protein on a dry weight basis. A total of 287 lines yielded more than 25 t/ha in fall cropping observational trials. Eight lines with yields of more than 20 t/ha were selected for further evaluation in advanced trials.

Screening for resistance to sweet potato weevil

Nine sweet potato entries showed high levels of resistance to sweet potato weevil (*Cylas formicarius*) and yielded more than 15 t/ha in single screenings at AVRDC and on Penghu Island in the Taiwan Strait. At AVRDC, test materials were planted between heavily infested source rows of a susceptible cultivar. At Penghu Island, weevils were released in the experimental field two months after planting. Evaluation of resistance was based on the number of insects per unit weight of root. These materials



In March 1981, AVRDC was co-host of the First International Symposium on Sweet Potato. Attracting more than 100 scientists from 24 countries, the symposium called attention to the lack of research on this underrated crop.



Tissue culturing of vegetatively propagated crops such as sweet potato can be used to supply national programs with disease-free planting materials.

will be screened further in 1982 to assess resistance stability.

Sweet potato weevil cultural control

Effective control of sweet potato weevil was obtained in a three-season experiment involving rice rotation. Two fields were selected, one located near weevil-infested fields and the other away from any weevil source. Sweet potato cultivar AIS 35-2 was planted in both fields in October 1979 and weevils were released when plants were six to eight weeks old. After harvest, both fields were planted to paddy rice. After the rice harvest, sweet potato was planted again with four treatments: dipping the cuttings in a carbofuran solution before planting, carbofuran 3G soil applications at 2kg ai/ha every two weeks, carbofuran 3G soil applications at 2kg ai/ha every four weeks, and an untreated control. Dipping the cuttings in carbofuran prior to planting controlled the weevil effectively if the crop was planted away from a weevil source. Both carbofuran soil application treatments controlled the weevil effectively regardless of the proximity of the weevil source.

Effect of flooding on growth and yield of sweet potato

Preliminary experiments indicated that low sweet potato yields in the hot-wet season may be due more to excessive moisture rather than to high temperature. Two sweet potato cultivars were planted during the cool dry season and subjected to five days of artificial flooding 46 days after planting. At 73 days after planting, the flooded cultivars showed reduced storage root number and storage root weight. At harvest, the flooded treatments produced lower yields of tips and storage roots than the non-flooded control.

CHINESE CABBAGE



An improved AVRDC Chinese cabbage line

Chinese cabbage is one of the most popular and widely grown crops in Asia's temperate regions. Cultivation in tropical Asia, however, is restricted to highland areas, away from tropical heat and humidity. Since 1973, scientists at AVRDC have been working to develop cultivars specifically adapted to tropical conditions. In 1981, emphasis was given to assessing the stability and disease resistance of these adapted cultivars, as well as gaining a more thorough understanding of the factors limiting production.

Yield trials

Four AVRDC Chinese cabbage hybrid selections (80-32, 80-33, 80-37 and 80-38) showed high, stable yields in three successive advanced yield trials. All four entries had mean yields between 25 t/ha and 26 t/ha against 19 t/ha and 21 t/ha from local checks. AVRDC check hybrid 62 yielded 25 t/ha. The advanced trials continue to show that performance stability during the summer season can be attributed primarily to levels of heat tolerance (measured by heading rate) and harvest rate. Stable entries had heading rates of nearly 100% and harvest rates of 95% to 99%. Harvest rates of less than 87% were attributed to softrot.

Screening for resistance to turnip mosaic virus

In turnip mosaic virus (TuMV) resistance screenings of Chinese cabbage, an apparent 'loss' of resistance was noted in cultivars previously rated as resistant. In recent tests, materials that had been used as resistant checks rated only moderately resistant (21%-40% disease incidence) or even susceptible (>75% disease incidence). A new strain of TuMV in the field is suspected.

Screening for resistance to softrot

A total of 22 Chinese cabbage accessions, three breeding lines and hybrids 58 and 59 rated resistant (1%-20% disease incidence) to softrot (*Erwinia carotovora*) in the spring cropping season. AVRDC hybrid 59 appears particularly promising, having also rated twice resistant and once moderately resistant to TuMV in three successive screenings.

Heat tolerance

Twenty Chinese cabbage progenies selected for heat tolerance showed significantly higher electrical conductivity, chlorophyll content and leaf thickness than 230 heat sensitive progenies of the same crosses. The F₂ progenies were the result of 37 crosses between one heat tolerant and one heat sensitive accession.

Flood tolerance studies

Nine Chinese cabbage accessions and three F₁ hybrids (58, 59 and 62) rated flood tolerant when screened in an aerated water culture. Two mM dinitrophenol (DNP) was added to the solution to mimic soil flooding by blocking oxidative phosphorylation. Tolerance ratings were made on the basis of shoot growth and proline accumulation.

In field screenings for flood tolerance, hybrids 58, 59 and 62 yielded 16-17 t/ha after being subjected to 431 mm rainfall (75% of which occurred over a five-day period) during the summer cropping season. Seven accessions, previously rated as flood tolerant, produced yields ranging from 9.8 t/ha to 12.9 t/ha. Flood/heat sensitive accessions B 6 and B 14 yielded 0 t/ha and 4.3 t/ha respectively.

All flood tolerant cultivars showed high electrical conductivity in an evaluation of morphological and physiological characteristics. Except for the three hybrids, all entries also had thick leaves. Together with data from heat tolerance studies, the results suggest that flood tolerance and heat tolerance are closely linked.



When AVRDC heat tolerant Chinese cabbage lines are not available, farmers have an alternative. AVRDC crop management scientists have developed a method of tying Chinese cabbage so that the outer leaves form a protective canopy. Studies conducted in 1981 indicate that by leaf-tying heat susceptible cultivars, yields can be increased by more than 100%.



For the Chinese cabbage farmer in the tropics, raised beds are a potential solution to the problem of flooding. AVRDC management specialists have found that 30cm bed heights can minimize flood damage as evidenced by the vigorous plants on the right.

Nutrition, Environment and Management



Protein digestibility testing is an integral part of AVRDC's mungbean improvement program.

The Nutrition, Environment and Management Program comprises an interdisciplinary approach to expanding the potential and utilization of AVRDC crops. The program involves research on nutrition, nutrition chemistry, soil science, crop management, agricultural economics, social anthropology and other disciplines. Some of the more notable activities of the program in 1981 are briefly described.

In vitro test for mungbean protein digestibility

An *in vitro* mungbean protein digestibility test has been developed to replace the traditional *in vivo* test which is unsuitable for mass screening work. The test involves monitoring the growth of *Streptococcus zymogenes* bacteria in an amino acid-limited medium. The growth of these bacteria is directly proportional to the availability of specific amino acids. Ten available amino acids were examined and availability indexes prepared. Valine and leucine were found suitable for mungbean and blackgram protein digestibility determinations. The correlation coefficients between *in vivo* (apparent and true digestibility) and *in vitro* (available valine and leucine indices) tests were highly significant.

Effect of tannin on blackgram protein digestibility

Tannin in the seed coat of blackgram was significantly negatively correlated with protein digestibility in both *in vivo* and *in vitro* tests. Blackgram has potential in interspecific hybridization efforts to improve the nutritional value of mungbean protein, but the low digestibility of blackgram protein is still a major constraint.

Sweet potato eating quality

Previous research indicated that the eating quality of sweet potato was closely related with the cultivar's content of alcohol insoluble solids. Correlations between alcohol insoluble solids and other chemical components (including dry matter, free sugars, water soluble and insoluble starches, cellulose, hemicellulose, pectic substances and lignin) were sought for possible use in the assessment of sweet potato eating quality. Both hemicellulose and water insoluble pectic substances were significantly positively correlated with alcohol insoluble solids. The correlation between alcohol insoluble solids of steamed and raw sweet potatoes can be used in *in vitro* evaluations to predict eating quality.

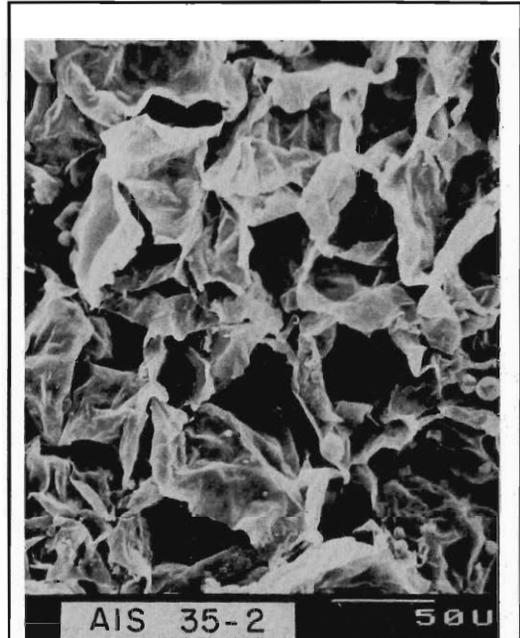
Effect of bed height and yield on summer tomato and Chinese cabbage

Bed heights of 30 cm and 45 cm resulted in marketable tomato yields of 8.2 t/ha and 9.1 t/ha respectively under heavy rainfall conditions. Yields from a 15 cm bed were 1.1 t/ha by comparison. The plant survival rate was 39% on the 15 cm bed, 96% on the 30 cm bed and 98% on the 45 cm bed.

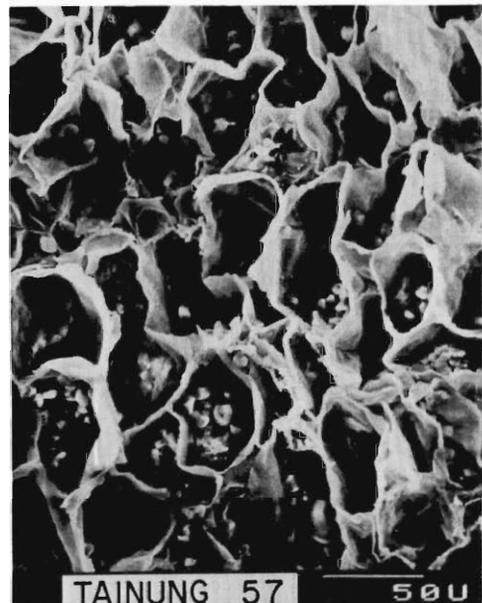
A similar experiment was conducted for Chinese cabbage. Marketable yields from the 30 cm and 45 cm beds were 12.1 t/ha and 14.3 t/ha respectively, compared with 6.3 t/ha from 15 cm beds. Results indicate that the head size, number of heads and number of surviving plants were affected by bed height. In both trials, bed width had no effect on yield or survival rates.

Improving nitrogen top dressing techniques for Chinese cabbage

In evaluations of different application techniques for the first nitrogen (^{15}N) top dressing on Chinese cabbage, double band applications resulted in the highest absorption rate of 70%, followed by single band applications resulting in a 58% absorption rate. Other treatments included nitrogen applied in one spot among four hills, in one spot between hills, in one spot per hill or broadcast over the bed.



Using scanning electron microscopy, AVRDC scientists can now rapidly identify dry and moist sweet potato cultivars. The photo above shows a moist cultivar whose cell walls have collapsed during specimen preparation. The photo below shows a dry cultivar whose cell walls have remained rigid. This technique should prove useful in future sweet potato eating quality tests.



Home and school gardens for the lowland humid tropics

Home and school gardens met initial objectives of the 1981 AVRDC Garden Program. Both of these consumption-type gardens were designed to grow crops that are not only culturally acceptable, but respond to some of the nutritional deficiencies in target populations.

Home gardens containing a nutritious intercrop of culturally acceptable vegetables were tested in 4 x 4 m plots for Indonesia, the Philippines and Thailand. The gardens were designed to provide a significant percentage of a five-member family's minimum daily requirements for calcium, iron, vitamins A and C, as well as provide small amounts of protein. Targets for all vitamins and protein were met in all but the Philippines garden, which was deficient because of the inclusion of some nutritionally unsuitable vegetables.

The school gardens produced enough vegetables in a 96-day growing period to provide 100 children with 78.7 g of vegetables per day. This figure represents a significant percentage of a ten-year-old child's minimum daily vitamin and nutrient requirements (4.4% protein, 17.6% calcium, 70% iron, 34% vitamin A and 191% vitamin C).



AVRDC home and school gardens were tested in 1981 and showed how low-input gardens could successfully be used in nutrition intervention programs.



This locally manufactured soybean planter was invented by a farmer in Taiwan. Tests at AVRDC showed that it is capable of planting up to one hectare per day. Information on similar technologies are being collected by the Center's Social Anthropology Department as part of its Taiwan Appropriate Technology Survey. The survey is being conducted to identify technologies that might be useful in other developing countries.

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