

Proceedings of the 2007 APSA-AVRDC Workshop

18-19 April 2007
AVRDC-The World Vegetable Center
Shanhua, Tainan, Taiwan



AVRDC

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THE ASIA & PACIFIC
SEED ASSOCIATION

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APSA – AVRDC WORKSHOP

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The Center

AVRDC-The World Vegetable Center is the leading international not-for-profit research and development institute committed to ensuring food security and stronger economies through vegetable research, development and training.

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CONTENTS

1. Executive Summary	1
2. Program	2
3. Minutes	7
4. Impressions	24
5. Participants - APSA	26
6. Participants - AVRDC	33
Appendix: CD ROM	(enclosed)

1. Executive Summary

The joint workshop between AVRDC – The World Vegetable Center and APSA – The Asia and Pacific Seed Association was a successful exchange of information and partnership building. Participating in the two-day meeting held on 18-19th April were 28 representatives of the 24 seed companies which contribute to core funding of AVRDC. Workshop participants from the private sector and 29 AVRDC staff were welcomed by Dr Jackie Hughes, AVRDC's Deputy Director General for Research and Dr Sampan Campiranon, Acting Director of APSA. Company owners, managers and scientists from Thailand, Philippines, India, China, Taiwan, Japan, The Netherlands, and South Korea joined in one and a half days of discussions with AVRDC's management and scientists followed by an afternoon viewing field demonstrations at AVRDC's Headquarters in Shanhua, Taiwan.

A series of presentations from AVRDC scientists showed the Center's recent developments in tomato, pepper, leafy crucifers, and cucurbit breeding, in addition to a joint presentation by the seed companies on market status and market development of cucurbits in Asia. Training needs, research work on the impact of the vegetable seed industry in Asia and a possible industry visit to Central Asia were also presented and discussed. A questionnaire on a potential training course in screening for resistance to vegetable diseases which was distributed to the participants received favorable responses which enabled it to be put into practice as a two-week training course at AVRDC's Headquarters from 4 June to 15 June 2007.

Field displays highlighted six heat tolerant and 20 cytoplasmic male sterile sweet pepper lines, and 11 geminivirus resistant and 26 late blight resistant tomato lines. In the cucurbit observation plots, more than 600 entries were being evaluated for heat tolerance, disease resistance, and fruit types.

AVRDC will continue shipping seeds to APSA members which indicate interest in particular lines, while APSA members may also share lines with interesting horticultural characteristics with AVRDC. Other areas for future collaboration include sharing information on virus incidence in cucurbits and doing screening work, developing targeted research proposals for special funding by interested groups of APSA members and collaborative testing of new variety releases across a wide geographical area. A combination of cutting-edge science from AVRDC and the expanded distribution of new germplasm that APSA members may provide will mean a greater impact in improving farmer incomes than either partner could provide alone.

2. PROGRAM

18 April 2007

08:30-09:00 Registration

Chair: Anthony Tse

09:00-09:15 Welcome remarks
- Jackie Hughes/Sampan Campiranon

09:15-09:30 What can APSA do to alleviate poverty among smallholder farmers?
- Sampan Campiranon

09:30-10:00 Vegetable seeds synergy between AVRDC and the private sector
- Jackie Hughes

10:00-10:30 Group photo and coffee

10:30-11:00 Breeding update: Tomato
- Peter Hanson

11:00-11:30 Breeding update: Pepper
- Paul Gniffke

11:30-11:45 Breeding for health: Nutrients and bioactives in cucurbits, solanaceous vegetables, and leafy crucifers
- Ray-Yu Yang

11:45-12:00 Variation in glucosinolate content of leafy crucifers
- Lance Ledesma

12:00-13:00 Lunch

Chair: Peter Hanson

13:00-14:30 Market status and market development of cucurbits in Asia
- Anthony Tse, Simon de Hoop, and Jai Singh

14:30-15:00 Discussion (*Rapporteur: Warwick Easdown*)

15:00-15:20 Example of a public-private partnership: Overview study on the vegetable sector in tropical Asia
- Katinka Weinberger

15:20-15:50 AVRDC cucurbit breeding program startup
- Zhanyong Sun

15:50-16:20 Coffee break

Chair: Sampan Campiranon

- 16:20-16:50 Cucurbit viruses (Zucchini mosaic virus resistance)
- *Sylvia Green*
- 16:50-17:20 Molecular breeding program at AVRDC
- *Robert de la Peña*
- 17:20-17:50 Discussion (*Rapporteur: Warwick Easdown*)
- 18:30 Welcome dinner at AVRDC Cafeteria

19 April 2007

Chair: Jackie Hughes

- 08:30-08:45 Central Asia workshop and study tour
- *APSA*
- 08:45-09:00 Announcement of training courses on "Screening methods
for tomato and pepper"
- *Jaw-fen Wang*
- 09:15-09:30 *An infiltration method for screening resistance to bacterial
spot in pepper*
- *Jaw-Fen Wang*
- 09:30-10:00 Discussion (*Rapporteur: Warwick Easdown*)
- 10:00-10:30 Coffee break
- 10:30-12:00 APSA members: Wrap-up session to discuss issues
- 10:30-11:30 AVRDC participants return to AVRDC
- 11:30-13:00 APSA members: Lunch at Sincere Hotel
- 13:00-13:20 APSA members proceed to AVRDC
- 13:30-17:00 AVRDC field tour
- 17:00 APSA members return to Sincere Hotel
- 18:10 AVRDC participants proceed to Sincere Hotel
- 18:30 Farewell dinner at Sincere Hotel

AVRDC FIELD TOUR

AVRDC Field Tour

- Coordinators: Tien-Chen Wang and Sylvia Green

13:30-14:00 **Pepper Breeding (Field No. 32)**

- presented by Paul Gniffke

Topic 1: Heat tolerant sweet pepper selections

Six lines display plant habit, fruit type, and field performance.

Topic 2: Advanced generation selections of sweet peppers

Several selections display heat tolerance and some disease resistance; these are candidates for inclusion in future ISPN trial sets.

Topic 3: Twenty cytoplasmic male sterile lines

The demonstration includes both the sterile A-line, and the maintainer B-line of each entry, for observation of similarity of plant habit and fruit type.

14:00-14:30 **Tomato Breeding (Field No. 34)**

- presented by Peter Hanson

Topic 1: Geminivirus resistant determinate tomato lines (n = 11 + 3 checks)

Beginning in 2001, AVRDC distributed lines such as CLN2116, CLN2123, and CLN2498 that carried the Ty-2 allele for geminivirus resistance. We are diversifying the virus resistance in our lines by developing lines derived from other resistance sources and assisting our molecular marker group to identify markers linked to Ty-3 and Ty-1.

Eleven new AVRDC F7 lines are derived from three crosses:

CLN2777 = FLA478-6-1-11xCLN1621E

CLN2768 = CLN2123C x FLA653-3-4-12

CLN2764 = FLA496-11-6-1 x CLN2498C

CLN-prefixed parents were bred at AVRDC; FLA-prefixed parents were bred at the University of Florida and possess virus resistance derived from *S. chilense* and Tyking. The F7 lines were selected for virus resistance, improved fruit quality and firmness, and resistance to bacterial wilt and Tobacco mosaic virus (TMV).

Topic 2: Late blight resistant F6 lines (n = 26 + 1 check)

A total of 26 F6 lines are included in this observation trial. Late blight screening was conducted by the AVRDC Mycology unit and all entries contain both the Ph-2 and Ph-3 resistance genes. Some entries are also early blight resistant but all are susceptible to geminivirus. The objective of the trial is to select 5-10 lines for international distribution.

14:30-15:00 **Crucifer Breeding (Field No. 34)**

– presented by *Lien-Chung Chang*

Topic: Methodical collection of leafy crucifer germplasm and evaluation of 100 entries for horticultural characteristics

Leafy crucifer breeding is a new activity at AVRDC and the work is in its early stages. Current objectives include: (1) methodical collection of leafy crucifer germplasm in East and Southeast Asia, particularly commercial germplasm; (2) evaluation of entries for plant vigor, earliness and yield, heat tolerance, and ease of seed production.

Field evaluation of 30, 40, and 30 varieties of kailaan, pakchoi and choysum, respectively, is being undertaken. Entries are observed for relative disease resistance, summer stress tolerance, and key horticultural characters such as erect growth habit, shiny leaf and petiole color. For pakchoi, broadness and thickness of the petiole is important while good flower stalk development with few side shoots is critical for choysum and kailaan. Large differences in vigor, plant characters, and yield have been observed among entries and sometimes among plants within entries.

From past evaluation trials, the Crucifer Unit selected 55 individual plants from 14 green-petioled pakchoi, and 49 individual plant selections from 8 white-petioled pakchoi varieties. For choysum, 96 individual selections were also selected from 8 varieties. Individual plant selections will be purified by selfing and additional selection in order to develop improved lines which could be used for the creation of synthetic or hybrid varieties.

15:00-16:00 **Cucurbit Breeding (Field No. 65)**

– presented by *Zhanyong Sun*

Topic 1: Cucumis sativus germplasm observation

The objective is to select top performing entries, which have heat tolerance, disease resistance, and different market types. The selected entries will be used to form the base of a breeding population. There are two groups including 383 entries with 6 plants per entry. The first group (161 entries) was planted on February 16th and transplanted on March 1st. The second group (223 entries) was planted on February 21st and transplanted on March 2nd.

Topic 2: Pickling type cucumber evaluation

The objective is to select pickling cucumber lines which are adapted to Asian climatic conditions. The selected lines will be trialed on a large scale next season. In the meantime, top performing lines will be used to develop hybrids. There are 160 recombinant inbred lines (RILs) with two plants per line. RILs were planted on January 24th and transplanted on February 13th. In addition, there are 23 inbred lines, which were planted on January 29th and transplanted on February 13th with 8 plants per entry. Different plant types, e.g. determinate vs. indeterminate, little leaf vs. normal leaf, multiple laterals vs. single stem, gynoecious vs. monoecious will be shown.

Topic 3: Cucurbita moschata germplasm observation

The objective is to select top performing entries which are heat tolerant, disease resistant with a medium size vine with good fruit quality. The selected entries will be used to form the base of a breeding population. There are a total of 24 entries with 6 plants per entry. These were planted on February 16th and transplanted on March 1st.

16:00-16:20 **Virology Unit (Field No. 65)**

- presented by Sylvia Green

Topic: Screening of the AVRDC cucurbit germplasm collection for resistance to ZYMV

16:20-16:40 **Bacteriology Unit (Bacteriology glasshouse)**

- presented by Jaw-Fen Wang

Topic: An infiltration method for screening resistance to bacterial spot in pepper

16:40-17:00 **Mycology Unit (Mycology glasshouse)**

- presented by Tien-Chen Wang

Topic: Race identification of Phytophthora infestans on tomato and pathotype identification of P. capsici on pepper

3. MINUTES

DAY 1 **18 April 2007**

Guan-yi hall, Sincere Hotel
Shin shih, Tainan, Taiwan

Welcome remarks

- Jackie Hughes and
Sampan Campiranon

Dr Sampan Campiranon was welcomed as the Acting Director of APSA. He stated that the initiation of the APSA core funding of AVRDC last year was a good example of public-private partnerships. APSA members were also thanked for their contributions which allow them to gain earlier access to new technologies, and they looked forward to an interesting and productive program.

What can APSA do to alleviate poverty among smallholder farmers?

- Sampan Campiranon

APSA is a small organization with 415 members of which 269 are company members, with 88 associate members outside the region. The global mission is sustainable agriculture through the production and trade of quality seeds and planting materials for the world. APSA seeks to empower its members by providing a regional forum for discussing seed policy issues, stimulating technical and economic cooperation among seed members and encouraging systematic interchange of information between members.

The Asian region is the most diversified in the world, with 21% of arable land, but 60% of the world's population. Food security depends on seed security.

The key priorities of APSA are:

- Harmonizing phytosanitary regulations in Asia;
- Trainings in seed testing;
- IPR and other seed regulations;
- Accreditation of seed laboratories;
- Seed industry interaction/exchange of expertise; and
- Technical lab/field tours.

New challenges are:

- Strengthening the seed industry in the region;
- Helping establish seed industry associations in West and Central Asia;
- Encouraging partnerships and cooperation between regional seed associations;
- Developing more effective communication tools; and
- Holding the Asian Seed Congress in the Philippines 6-10th of November 2007, with more than 700 attendees expected. This is a major event for APSA this year.

Vegetable seeds synergy between AVRDC and the private sector

- Jackie Hughes

The Center is transforming into the World Vegetable Center with an expansion of its global coverage and program. An external review will be held this year, and the main administrative buildings are being renovated. Breeding programs are focusing on stable, high yields with good nutritional value. The Center has over 56,000 vegetable accessions which are accessible via the Center's website and genebank.

Our recent Board meeting encouraged us to better trace the use of our genetic material. This is critical for us – which lines have been used and which varieties incorporate our lines. We do not wish to have our names on seed packets, but we would like to see acknowledgement of our genetic material on seed catalogs.

Our Vegetable Breeding and Seed Systems (vBSS) project in Africa is a new and large project that will develop public-private partnerships. It will develop national breeding hubs and the experience of smaller companies in Asia would be very useful to us. The aim is not just to produce more seed but sustainable rural development through building up the public and private seed sectors. The hubs chosen cover all the major ecological zones of Africa, and are based in Tanzania, Cameroon, Mali, and Madagascar, with support services from South Africa. The coordination of the whole project will be done from Tanzania, relying on germplasm from the public and private sectors.

National programs, private sector, and NGOs will be involved in seed distribution. The project manager has been recruited and the hub managers are soon to be appointed. The advice of APSA in working with small companies in Africa and how to help them develop sustainably would be very welcome.

Breeding update: Tomatoes

- Peter Hanson

Varieties are a package of key traits needed by many stakeholders. We mainly address the needs of farmers in the lowland tropics – breeding for heat tolerance, multiple disease resistance, fruit quality, and nutrition. Two major priorities are breeding for late blight resistance (*Phytophthora infestans*) and resistance to geminiviruses.

Late blight resistance: This is a major problem in tropical highlands and temperate areas, and a major problem in Africa. It is a highly diverse pathogen. Breeding began in 1993 with screening of our entire collection. There were no sources of resistance so that wild species were screened and the gene Ph-3 was identified and backcrossed. Isolates from Taiwan and USA can already overcome this source of resistance. There are two other genes for resistance in wild species – Ph-1 and Ph -2. Ph-1 is ineffective in the tropics and Ph-2 is race specific and tends to complement Ph-3. Lines are being developed that carry Ph-2 and Ph-3. We have 28 lines homozygous for Ph-2 and Ph-3 that also have some resistance to grey leaf spot and some races of *Fusarium*. We don't know how long the resistance will last. There are

other sources of late blight resistance but it is not clear if it is worth pyramiding extra sources of resistance.

Geminivirus resistance: Geminiviruses are now trans-tropical with over 35 different viruses transmitted by whiteflies. Resistance is being developed as part of an Integrated Pest Management (IPM) strategy. All resistance is from wild species. At least three genes have been mapped - Ty-1, Ty-2, and Ty-3 which are valuable to pyramid into heat tolerant and bacterial wilt resistant tropical tomato types. We have received some good lines from international cooperators with polygenic resistance that complements that of Ty-2 in many of our lines.

Once we have gene markers, we can better identify lines with combinations of different genes. We can also exploit virus resistance from other wild species that have already been developed and incorporate this into lines with *Fusarium* resistance.

Questions & Answers

Dr Hanson said that in potato, 9-10 genes have been introduced to control late blight so we need to be cautious – farmers may be able to reduce sprays but not eliminate them. We are breeding for a global problem and races of late blight tend to overlap in mid altitude areas of the tropics, such as found in Indonesia or Nepal.

Dr Jaw-fen Wang mentioned that it is not just elevation but the season that affects incidence. It is higher in cooler seasons. The pathogen has great diversity and resistance is only one means of control along with rotations and grafting. Dr Green asked if it would be possible to produce a series of test varieties with the different known genes available, but Dr Hanson said that until we have markers we cannot be sure which lines have which genes and it is difficult to get the genes in

pure form. He was asked if there were any compromises for fruit quality in gaining multiple disease resistance? He replied that we seek late blight resistance first and then add early blight resistance and others later. Improving fruit quality is partly a problem for the private sector to work on. He was asked which Ty genes work best in Thailand and the Philippines and replied that in the Philippines the Florida 456 line works best but it was a diverse situation in Thailand. We cannot be certain exactly which genes are involved in each location.

Breeding update: Peppers

- Paul Gniffke

AVRDC's pepper program has typically developed lines through funded projects and made them generally available through the International Sweet Pepper Nursery (ISPN) and the International Chili Pepper Nursery (ICPN) networks. Additionally, we have developed peppers with cytoplasmic male sterility (CMS) for production of hybrid varieties. This series has been popular with seed companies.

Many CMS sterile peppers are unstable under low temperatures and in sweet peppers, there is also a lack of good restorer lines. Our first CMS lines were released in the late 1990s and have been popular with seed companies. In 2001 the sweet pepper CMS program began. We now have 5 lines of uniform CMS A lines in peppers; the majority of these begin to produce viable pollen when moved from warm to cool growing conditions. However, CCA7234 and CCA7235 display stable sterility under both high and low temperature in the field, glasshouse, and

growth chambers. Without cross pollination, these two lines produced entirely seedless fruit. A number of superior restorer lines have also been identified for sweet peppers contrary to suggestions in the literature that these did not exist. These will be released for seed companies to test.

Multi-location testing of lines from the ISPN and ICPN trials continues, and the latest set in the series (ICPN17 and ICPN7) are now being distributed. Very few complete reports of trial results have been received back from recipients – only 9 complete sets were returned on the ICPN15 series, out of more than 90 seed sets distributed. A complete data set from cooperators is very helpful for assessing the stability of performance across different regions and conditions.

In conducting the multi-location stability analysis in ICPN 15, we identified two lines that may be more stable in yield, and preferred by risk-averse smallholder farmers. Other lines, however, were much higher yielding under favorable conditions, and would reward high levels of crop management.

Yields of sweet peppers in summer are half or even less than yields in spring. Screening for heat tolerance in sweet peppers has focused on lines with a 'squash' type fruit, which tend to set high numbers of fruit under warm conditions; fruit size is still smaller, but the resulting yield reduction is minimized. A replicated trial is being grown under both spring and summer conditions to evaluate these lines, as well as others that have been noted to carry heat tolerance. New sweet pepper lines are being made available for multilocation testing through the ISPN7 trial set; some lines carry

resistance to Cucumber mosaic virus (CMV), *Phytophthora*, and/or bacterial wilt.

Questions & Answers

Paul was asked about evaluation of anthracnose. He replied that all screening for anthracnose resistance is performed in the lab. While resistant lines show improved performance under severe field conditions, none remained completely disease-free. Some lines that recently showed low disease incidence in field trials do not display resistance under lab assays, so physical defense by a strong fruit cuticle may be an important component of resistance. He was also asked about the commercial prospects for the CMS lines in sweet pepper, and replied that AVRDC invites feedback from private sector experts to suggest which lines look most interesting for doing test crosses. Current advanced lines will be documented and announced for official release. Lack of low-temperature stability in the sterile trait may not limit a line's utility in environments with year-round growing conditions.

Breeding for health: Nutrients and bioactives in cucurbits, solonaceous vegetables, and leafy crucifers

- *Ray-yu Yang*

Vegetables are being promoted globally for health reasons. They are a source of micronutrients (vitamins and minerals) as well as some macronutrients and health promoting chemicals. These can perform a number of functions including anti-cancer, and anti-inflammatory roles, positively influence blood lipid profiles, and provide bone protecting functions.

We are defining the major nutrients and bioactives in cucurbits, solanaceous vegetables, and leafy crucifers. The focus is more on vitamin A precursors and iron because these deficiencies are the most severe in the world. Conventional breeding or genetic techniques can be used to increase the content of such chemicals in vegetables. We are doing germplasm screening of 50 tomato accessions to check for antioxidant content and the presence of other chemicals and minerals. Pepper accessions are also being screened. This has resulted in the identification of high anti-oxidant accessions of *Capsicum* and high vitamin A tomatoes. The development of markers to help the selection process is ongoing. Gene discovery is also being done in wild tomato to introduce higher flavonoids and lycopene into tomato. We have evaluated 64 inbred lines which have shown a 40% increase in lycopene and 100% increase in flavonoids.

Questions & Answers

What is the stability of these chemicals and minerals under cooking?

That depends on the chemical. For carbohydrates, it will increase digestibility, but the amount of some vitamins can be decreased by cooking and some minerals like iron may become more available. It was stated that in India bottle gourd juice is widely promoted for health reasons and there is a growing demand for it. Dr Ray-yu Yang replied that it is not clear what concentrations are needed or what the main benefits are – it may be something for our cucurbit program to consider. There was also a question about any studies on the impact of capsate on reducing fat cells. Dr Paul Gniffke replied that there had been some studies done in Taiwan, but other chemicals derived from peppers have also been shown to have an impact on fat cells.

Variation in glucosinolate content of leafy crucifers

- Lance Ledesma

Lines of three species of *Brassica* were evaluated for yield and total glucosinolate content - pakchoi, choysum, and kailaan. Glucosinolates have anti-cancer properties, and are highest in brassicas and responsible for their flavor. Levels varied between the lines, the species, and the growing season. Pakchoi generally had higher glucosinolate levels during the hot wet season. In contrast, both choysum and kailaan attained higher levels during the cold dry season.

In pakchoi, high yielding accessions generally had low levels of glucosinolates in both cold dry and hot wet seasons. The opposite is true for choysum during the cold dry season. No distinct relationship was observed in kailaan.

Questions & Answers

It was stated by Dr Srinivasan that although higher glucosinolates added to the nutritional value, this also made the crop more attractive to insects. Crucifers are the vegetables which suffer from the highest pesticide abuse, so increasing the level of glucosinolates could also increase the pesticide problem in these crops. It was also stated that higher glucosinolates would tend to result in more pungent smell and taste and may not be acceptable to consumers. Mr Ledesma replied that balancing the amount of glucosinolates present in the plant is one of the major challenges in crucifer breeding.

Market status and market development of cucurbits in Asia: Cucurbits in South China

- Anthony Tse

Pumpkins: Other than cucumber, pumpkins are the most important crop. Production is mostly *Cucurbita moschata*, mainly based on the local hybrid 'Mibien,' which has strong resistance against Zucchini yellow mosaic virus (ZYMV) and is well adapted to wet and humid conditions. It has very early flowering with 12 -14 nodes, and offers good eating quality and a high sugar content.

Cucurbita maxima varieties are not as well adapted and the main ones grown are F2 and F3 from imported seeds. They have good eating quality and are grown in cooler drier seasons. They have poor resistance to disease and insects. In addition, there are many different open pollinated varieties grown for their seeds which are eaten as snacks while the rinds are used for cattle feed. Another form of *C. maxima* are the Yunnan types which are eaten as young or mature fruits – they have very early setting and set several fruits per vine. The market wants earliness, high sugar content, small cavity, and good eating quality.

Wax gourd: *Benicasa hispida* is grown on trellises due to rain. It only needs one fruit per vine and there are two types grown - dark green skins and waxy types. All are open pollinated varieties. The dark green types are purchased by county governments and put into storage to help stabilize vegetable prices. Seeds are extracted for the candy factories and supplied as a by-product. Haired gourds are another type of *Benicasa* harvested

in the immature stage and eaten like zucchini – this is unique to the Guandong area.

Angled luffa: The long green type of *Luffa angulata* can be up to one meter and is grown in eastern areas. About 50-60% of the market is domestic hybrids.

Sponge gourd: Open pollinated varieties of *Luffa cylindrica* are mostly produced domestically.

Bitter gourd: Two types of *Momordica charantia* are grown. The most popular is long with pronounced ribs.

Growers want earliness and low temperature tolerance as they are planted in February under plastic in the field. It is susceptible to melon fly. Varieties are mostly hybrids from research institutes and private companies.

Bottle gourd: This type of *Momordica charantia* is not so important and most crops are from farm-saved open pollinated seeds.

Questions & Answers

Mr. Tse was asked how are hybrids superior. He replied that growers want uniformity and earliness with resistance to powdery and downy mildew. Virus disease resistance is not a big issue in China.

Pumpkin, cucumber, and bitter gourd markets and breeding in Southeast Asia

- Simon de Hoop

Pumpkin: Pumpkins grown are mainly *Cucurbita moschata* as it is easier to grow. *C. maxima* is not adapted to the tropics. Pumpkin is a good source of beta carotene and the fruit stores well. Flowers and shoots and young fruits can also be eaten. Both flat and elongated types are grown, with smooth or warty skins – the latter are particularly favored in Thailand. Hybrid penetration varies across the region, from 90% of the 15,000 ha in the Philippines (mainly the variety 'Suprema') to 10% of the long smooth types grown in Vietnam (40% of the 20,000 ha grown). Vietnam has the largest production with 20,000 ha, Thailand with 18,000 ha, Philippines with 15,000 ha, and Indonesia with 5000 ha.

The first pumpkin hybrids were produced in the late 1980s and first generation hybrids such as Suprema and 'Sri Muang' are still popular although these cannot produce at latitudes higher than 12-15 degrees due to their day length reaction. Viruses are the main problem – geminiviruses, potyviruses, and CMV. Breeding is also focusing on fruit quality, earliness, and plant structure.

Cucumber: These are mainly grown on trellises in Southeast Asia and on the ground in South Asia. The areas of production are: Vietnam (25,000 ha), Philippines (4000 ha), Thailand (45,000 ha), and Indonesia (100,000 ha).

The preferred types are:

- Bicolor medium to long (all over Southeast Asia, South Asia, and South China);
- Bicolor short (Thailand and Indonesia);
- White (Philippines, Indonesia, Sri Lanka, India, and China); and
- Uniform green slicer (Philippines, Vietnam, Taiwan, and India).

Estimated production data are:

- Philippines: 4000 ha, 40% white, 30% UG slicer;
- Vietnam: 25,000 ha 60% bicolor medium, 80% hybrid, 40% bicolor;
- Thailand: 45,000 ha, 60% bicolor short, 95% hybrid, 40% bicolor long, and 90% hybrid; and
- Indonesia: 100,000 ha 45% bicolor long (50% hybrid), 40% bicolor medium – 'Venus type' (10% hybrid), 10% white, and 5% bicolor short. The bicolor medium market is dominated by the old open pollinated variety 'Venus.'

The main breeding objectives are improved fruit shape (reduction in the high relative percentage of culls) and resistance to the diseases: downy mildew, geminiviruses, potyviruses, CMV, criniviruses, and leaf spots.

Bitter gourd: It has a high nutritional value with a high diversity of fruit types. It requires high inputs and is difficult to grow. The more wild types are smaller and darker with more small pointed warts. It is more often found

in South Asia while the more domesticated varieties are larger, lighter green or white, with fewer large rounded warts. These are more likely to be found in China.

Estimated production figures are:

- Philippines: 12,000 ha, 90% long dark smooth (75% hybrid), 10% small dark native type;
- Vietnam: 12,000 ha, 50% medium smooth light green (75% hybrid), 35% small sized smooth light green (90% hybrid), 15% medium sized medium diameter wart;
- Thailand: 3500 ha, 95% large smooth broad (95% hybrid), 5% small spiny dark green (50% hybrid); and
- Indonesia: 8000 ha, 50% large smooth broad shoulder (40% hybrid), 30% medium smooth broad shoulder (50% hybrid), 20% white fruited (30% hybrid).

The first hybrids were introduced in the 1980s and had better shelf life with reduced fruit cracking. Major diseases encountered include Namamarako/'crazy bitter gourd,' fusarium wilt, bacterial wilt, potyviruses, *Cercospora*, powdery mildew, phoma, fruit fly, and nematodes.

Namamarako is a virus detected in the Philippines that results in reduced flowering and leaf veining. It is spread by *Aphis gossypii* and *Myzus persicae* and through grafting. It is caused by a luteovirus similar to Cucurbit aphid-borne yellow virus (CABYV). Similar symptoms are found in

Thailand, but infected plants do not give a strong ELISA reaction with antisera developed from Philippine isolates.

Cucurbits grown in India

- Jai Singh

A wide range of cucurbits are grown in India, but the main focus is on watermelon, cucumber, and gourds. Estimated production figures are:

- Gourds, pumpkins, and squashes: 350,000 ha (15% hybrid);
- Watermelon: 210,000 ha (40% hybrid);
- Cucumber: 120,000 ha, (11% hybrid); and
- Melons: 30,000 ha.

The open pollinated market is huge with a smaller hybrid market

- Bitter gourd: spiny types preferred;
- Bottle gourd: longer types preferred and powdery mildew and downy mildew resistances preferred;
- Sponge gourd: mildew resistance needed and more female flowers;
- Ridge gourd: mildew resistant types preferred;
- Watermelon: all oblong and striped; and
- Melons: little local work has been done – mildews and leaf spots.

Questions & Answers

The question was asked as to why bitter ground is regarded as a high input crop. Farmers have to put in a trellis system to grow it, there are many disease problems, and farmers may have to wrap the fruits in paper bags to protect them from fruit flies.

Dr Weinberger asked how the production areas were estimated. Singh stated that estimates are mainly from commercial contacts in the market based on the amount being sold and estimates provided by the Department of Agriculture.

AVRDC cucurbit breeding program start-up

- *Zhanyong Sun*

Cucurbits cover a wide range of crops. Our program will focus on crops with limited private sector involvement with the aim of increasing production and their nutritional value. The initial focus is on collecting germplasm, evaluating it, improving disease resistance and nutritional value, establishing a regional trial system, integrating biotechnology into conventional breeding, and training scientists from developing countries. Currently, the main crop focus is on cucumber and winter squash - *Cucumis sativus*, *Cucurbita moschata*, and *Cucurbita maxima* as top three. We have begun by first studying the germplasm in field observations, and these are being done for *C. sativus*, *Cucurbita pepo*, and *C. moschata*. The focus is on these new top three. We have begun by first studying the germplasm in field observations, and these are being done for *C. sativus*, *C. pepo*, and *C. moschata*. The focus is on new traits – disease resistance, short vine, gynoecious, and multiple females.

General Discussion

AVRDC was asked why it is focusing on crops with limited private sector involvement. APSA was concerned that the work of AVRDC would have little relevance for its members, even though the cucurbit breeding program was requested by APSA.

AVRDC cannot do breeding work for all cucurbits, but will be more focused on the South Asia and Central Asian markets. The Center is working with poor farmers who are ignored, and it is necessary to do work that will be supported by donors. Only a small proportion of its funding comes from APSA. Despite APSA's concern that synergy in our efforts is less likely if AVRDC just focuses on small farmers, AVRDC felt that there would be synergy if we focus on general issues of concern to the private sector. Improvements for these farmers and markets would have wider benefits for APSA and other regions. Very little work is being done in the Central Asian market, and this lack of development has also been noted by APSA wanting to build contacts there where few private companies are working. By AVRDC doing work in Central Asia, this may also open up future opportunities for APSA.

APSA asked if AVRDC was focusing on bitterness-free traits in cucumber. AVRDC replied that if bitterness is removed completely, it may also make the crop more susceptible to pests. Studies are ongoing in this area, but performance of selections in the lab can be different from those in the field.

APSA asked about the priorities in biotech work being considered in cucurbits. The diseases of cucurbits

are quite diverse, and there are many viruses involved. Focusing work in one location may not help breeders across the region.

AVRDC is mainly focused on disease resistance. We do not know a lot about viruses on cucurbits yet and we need to find out what is here before we do work. Virus breeding is not limited to work in Taiwan, but we will need to get extra support to expand studies to other regions. Dr Hanson asked APSA members if they could share work that they had done on viruses in South Asia. An APSA member stated that surveys on the major constraints have been done and geminiviruses on pumpkin is a major issue. AVRDC stated that there is potential value in the decentralization of plant breeding within the cucurbit program, but funds would need to be found to make this possible. The selection of viruses in Taiwan would be much different from those in South Asia, and it would be important for AVRDC to be able to work with partners in South Asia to do screening as all the viruses could not be brought to Taiwan for study.

APSA suggested that there are at least four different groups of viruses affecting cucurbits and we do not have much information on them, so there are needs to conduct a systematic study on what viruses are present, in which crops, in which regions, and how to prioritize among them.

Dr Hughes replied that Dr Sun has only been working for five months and his main priority is to get germplasm together. There are many other areas of focus beyond India and his focus will be on the poor countries. It is not his primary focus on what he can do for APSA, but his focus is on poor farmers and APSA will benefit as a result.

Overview study of the vegetable sector within the private sector

- *Katinka Weinberger*

This is part of a larger study in Tropical Asia covering India, Indonesia, the Philippines, Thailand, and Vietnam. It began in 2005 with an initiative between East-West Seeds and the AVRDC management. There are three different components with separate sources of funding:

- Overview study of vegetable production in tropical Asia (with AVRDC as lead);
- Case studies in different countries (with LEI as lead); and
- A symposium to bring together the final results (There is a need to confirm if the International Society for Horticultural Science will lead.)

Preliminary results of the overview study show that per capita production of vegetables and the proportion of cropping area under vegetables are highest in Vietnam and lowest in Indonesia. Different factors have been operating in each country to change crop areas and production. In Thailand, there has been a major increase in the production of baby corn and a drop in garlic due to competition from Chinese imports. The impact of donors in Vietnam is high, but this impact may be imbalanced. Across the region the private sector including supermarkets is forcing change on farmers. The seed industry is helping to improve product variety and quality and disease resistance, as well as helping with farmer training.

In Thailand, major constraints are Good Agricultural Practices (GAP) certification and competition from Chinese imports. There are opportunities for exports, but there are needs to reduce overlap among government departments and to increase domestic consumption.

In Indonesia, there is a lack of market development and problems with logistics due to weather extremes. The phasing out of cultivation of steep lands will impact the supply of temperate vegetables in the country.

In the Philippines, there is low domestic consumption of vegetables due to support prices for rice and a growing fast food industry combined with poor logistics. There is a need to promote domestic consumption along with contract growing for exports in partnership with the private sector to boost skill levels.

In Vietnam safe production of vegetables is an issue along with producing under adverse weather conditions. There are opportunities to foster farmer organizations, promote indigenous vegetables and exports to nearby markets, and develop the processing industry.

The overall contribution of the seed sector has been in the improvement of the germplasm selection and conservation, the development of intensive production systems, and the strengthening of the supply chains.

The joint research project with East–West Seed has also emphasized the different cultures of the public and private sectors, with more horizontal networking in the public sector and with more vertical coordination in the private sector. Donors in the public sector want deliverables but are less concerned with the

processes, while in the private sector there appears to be more interest in the processes as well as the tangible outcomes. Scientists are interested in publishable findings but the private sector is more interested in the market use of findings.

Questions & Answers

Why do farmers in the Philippines appear to need more training than those in Indonesia for instance?

It appears that the extension service in the Philippines is much worse than in Indonesia and farmers in the Philippines tend to be more conservative than those in many other neighboring countries where there are groups of farmers who pick up new technologies more quickly.

Based on the recent East-West Seeds newsletter from the Philippines, it appears that the private sector is doing a lot of training there.

Maybe the private sector is stepping where the public sector is not performing well. A number of Asian countries have signed tax breaks for importers of Chinese temperate crops and this will kill temperate production – eg. onions in the Philippines will be killed by Chinese imports.

What are the intensive production systems mentioned?

Production will become more intensive. Even in poorer countries there are labor limitations and there will be an inevitable increased focus on technologies to improve production efficiency.

You mentioned that the private sector is more interested in tangible goals and processes – please explain.

Donors determine our deliverables but leave the process up to us. The private sector likes to take more control of the process.

Cucurbit viruses: Zucchini mosaic virus resistance

- *Sylvia Green*

Nine major viruses were discussed. Most of which have worldwide distribution and many are transmitted by aphids. For example, the Watermelon silver mottle virus (WSMoV) is transmitted by thrips; the Squash leafcurl virus is transmitted by whiteflies; and the Cucumber mild green mottle virus is transmitted only through contact and by seed. A preliminary survey of cucurbit crops has been conducted throughout Taiwan to assess some of the viruses present. Of 400 samples tested, less than 5% were found infected with Cucumber mosaic virus and WSMoV, but almost 40% were infected with Zucchini yellow mosaic virus (ZYMV) and Papaya ringspot virus. Screening of the GRSU germplasm collection is being done in the greenhouse to assess resistance to ZYMV. So far, resistance has been found in *Benincasa hispida*, *Coccinia grandis*, *Lagenaria siceraria*, *Luffa acutangula*, *Luffa aegyptiaca* and *Momordica charantia*, but not in *Cucumis melo*, *C. sativus*, *Cucurbita moschata*, and *C. pepo*.

Questions & Answers

A question was asked about cucurbit viruses including geminiviruses. Dr Green replied that these will be addressed in future surveys and resistance screenings as specific diagnostics will become available.

Integration of molecular markers in vegetable improvement

- *Robert de la Peña*

DNA markers and genotyping systems: AVRDC currently uses gel-based DNA fragment segmentation and a new machine will be purchased to make this process more efficient. In tomato there are 156 publicly available SSRs, and the Center is aiming to develop 1000 SSRs. We are keen to work collaboratively in this area as all companies need such markers. In peppers, there are over 1000 public SSRs available.

There are 112,000 single nucleotide polymorphisms (SNPs) in the tomato genome. We need a specialized machine to detect them such as a Taqman SNP genotyping assay machine. We are now looking for specific trait markers for bacterial wilt – Ty-3, Ph-2, Ph-3 and early blight, anthracnose, and *Phytophthora*. We are currently working on 14 different projects in this area.

Using marker assisted selection for tomatoes and pepper: 10 - 20 markers are needed per chromosome and therefore 600-1200 markers are required for tomato and pepper. There are challenges in dealing with a wide variety of vegetable crops. Most breeding in soybeans and maize are now based on marker selection. We are moving towards breeding by design as large companies are doing. Dr de la Peña asked if there is a need for a common consortium to develop markers. He said that since all are using the same markers, it may be cheaper and easier to develop them jointly.

Marker selection is useful for qualitative traits: The trait enhancement program involves work with bacteriology, mycology, virology, entomology, and nutrition units. Our work on geminiviruses resistance in tomatoes found three genes from wild relatives and we are working on mapping these. It is unlikely that there will be a single source of resistance and there is a need to identify markers to be able to pyramid complementary sources of resistance to a wide range of viruses.

Questions & Answers

What is the advantage of having three new markers for Ty-2?

The advantage of more markers is that some markers will be good for some crosses and others for other crosses.

There are a lot of SNPs available for pepper – can these be used in tomato?

No.

Has the capsaicin gene been characterized?

Yes, I can send you the paper.

How relevant is drought tolerance for tomatoes?

It is important for small farmers and even under irrigation there are intermittent droughts. Genes for drought tolerance are related to higher yields.

DAY 2
19 April 2007

Guan-yi hall, Sincere Hotel
Shin shih, Tainan, Taiwan

Central Asia study tour

- Discussion led by
Peter Hanson

The climate and conditions in Central Asia are conducive to vegetable seed production. APSA members had informed AVRDC that they were interested in the potential of the region, seed sales, and contacting possible contract growers. APSA members were asked how many would be interested in a potential visit to Central Asia and six indicated that they would like to join such a trip. During a recent meeting between APSA and Dr Ravza Mavlyanova, she suggested APSA representatives should visit some of the Central Asian research institutes. APSA members were asked if they would be willing to share findings from any study tour. The question was raised whether a consultant should be employed to go with the tour and which would hire such a person. AVRDC does not know the area well and needs to know the varieties, the facilities, and the infrastructure.

APSA is interested in expanding its work in Central Asia but had lost contact with Dr Mavlyanova since the last meeting with her. It was noted that there is a language barrier in communication with the region. With the support of the Swedish International Development Cooperation Agency (SIDA), seed associations were established in Central and West Asia last year. APSA would like to contact them but this has not been organized

so far. APSA has also contacted the International Center for Agricultural Research in the Dry Areas (ICARDA) and the Food and Agriculture Organization (FAO) to check if both are planning some meetings in the area as they would be interested in developing a joint workshop. Initially, APSA wants to take its members there to work with the local seed people, seed associations, and AVRDC.

Dr Hughes suggested that Dr Mavlyanova could facilitate an initial small group to do a scoping visit to be followed by a larger group visit later. AVRDC would need to know the schedule and number of participants. APSA agreed to contact AVRDC to confirm the participants after AVRDC has worked out some internal arrangements with its Central Asian office. Dr Mavlyanova would be interested in sending people from Central Asia for training. It was suggested that if APSA members are interested in establishing production in Central Asia, would it be interested also in accepting and supporting people from the region to work with them to get practical training on the job? APSA replied that this could be discussed following the scoping tour. A preferred time for the visit would depend on the main cropping times to ensure that there would be something to see in the fields. At least five companies are interested, but such a tour should be open to all APSA members and 6-10 companies will probably be involved.

An infiltration method for screening resistance to bacterial spot in pepper

- *Jaw-fen Wang*

In some markets it is essential to breed for resistance to *Xanthomonas campestris*. There are 10 races and five have been collected from Taiwan.

Resistance can be provided by single dominant genes Bs-1, Bs-2, Bs-3, and tentatively Bs-4. There are plenty of other resistant sources in chili but these are not race specific. In the past, the dipping method has been used for screening. This involves dipping the plant in a bacterial suspension. New hybrid material is very scarce and precious and it may not be possible to afford the usual requirement to use six plants. A new method has been devised that uses infiltration of 0.1 mL of bacterial solution into fruit or leaves.

The development of a lesion is later compared to a standard chart for lesion size. The number of bacteria within the lesion can also be assessed. It takes about 12 days to detect bacterial spot and there is a good correlation between the size of lesion and resistance. The results are very similar to those from the dipping method but only three leaves are required.

The method works best on sweet peppers and works no matter what the resistance sources are – including the HR types which give a different type of lesion.

Questions & Answers

We are more interested in the whole reaction, but this does not appear to show it.

The advantage is that it uses less material, particularly when this is very precious, and is able to test more plants at the same time.

For Xanthomonas, it is difficult to see hyper-sensitive reactions. Does the reaction appear within 48 hours?

Some reactions can be very fast. If you have introduced genes which give high levels of resistance, then these can be detected very fast.

This method is very good, but what if there is an intermediate reaction?

Whether a line is highly resistant or not, it will still get typical lesions.

What is the advantage of a low concentration of inoculum?

If we use higher rates, it is not as easy to rate the lesions. We need to be able to see lesions clearly.

Does the age of the plant affect this?

We have not tested all ages, but our tests are usually done before flowering and we prefer to test before senescence.

This test is for resistance or susceptibility, but how can you measure tolerance? It could still express the symptoms but have no effect on yield.

We would need to measure this in the field. The damage to fruit is the issue – lesions reduce marketability so tolerance is not very useful.

You may get different lesions on the same plant – is this caused by different races? If yes, then how do you assess resistance?

All lesions would be due to susceptible reactions, but the shape of lesions and their description may be different – this is usually related to the genetics of the plant.

What are the environmental conditions required for this test?

Higher humidity results in faster reactions. If the leaf is wet, then the reaction will be faster, but lesions can develop under a wide range of temperatures and conditions. We use 28°C.

Potential training course in screening for resistance to vegetable diseases

- *Jaw-fen Wang*

This was a priority identified by APSA last year and we have the facilities for it to be done here. Trainees currently come at any time so it is harder to organize substantial formal training. This course may be offered annually and we will reduce our acceptance of other trainees. We request that people sent to this training are doing actual plant screening as our aim is to build up their capacity. The resource persons will be three pathologists, a molecular geneticist, a statistician, and a communications specialist. The course will run for 10 days from 4- 15 June for a maximum of 10 participants. It will involve lectures, lab work, and field visits. Attendees must have at least a BSc degree and good English. Training will cover the major diseases of tomato, pepper, and cucurbits focusing on isolation, culturing, and disease ratings. APSA attendees were asked to fill in a survey on the training course.

Discussion

AVRDC said that the cost is a real issue and a good estimate is needed of how much APSA members see it as worth to send someone. An APSA member stated that the course is very focused on the solonaceous crops, but would it be more helpful to include other crops such as *Stemphyllium* in alliums. APSA has salesmen and agronomists and would like to see anyone sent to AVRDC for training to be able to return and train others. AVRDC suggested that it may be possible to provide regular updates of new technologies and to consider making training interactive.

Final Suggestions

An APSA member suggested that if some future meetings could be organized at ICRISAT in India, it would attract more people to come and expand contributions to AVRDC. However, it was pointed out that such meeting is not open to all APSA members and by meeting in Taiwan, participants can see the facilities and progress at AVRDC and individually interact with its scientists. If trials had to be planted at ICRISAT, it will not be possible to see all the results of AVRDC research and there would be significant cost implications in moving the meeting out of Taiwan. Dr Hughes suggested that this is an issue for APSA members to discuss.

4. IMPRESSIONS





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