The World Vegetable Center Newsletter

12 June 2009

Published by Public Awareness and Information

Inside Insight: Dr. Andreas Ebert, Global Theme Leader-Germplasm, protects agricultural biodiversity. *Page 3.*

Collaboration in the field: AVRDC vegetable trials with network partners in Georgia. *Page 5*

A decade of effort in developing sweet pepper hybrids bears fruit at AVRDC

CMS: How sweet it is

Often used with hot peppers for F_1 hybrid seed production, **cytoplasmic male sterility** or CMS can reduce production costs by as much as 47 percent. The technique is a valuable tool for the vegetable seed industry, where CMS is used to rapidly combine traits and protect proprietary lines.

CMS lines in peppers are often unstable under low temperatures, and thus had limited applications. CMS in sweet pepper is also limited by a lack of fertility restorer parents, whose genetic contribution reverses the sterile status of the female parent.

Pepper breeders at AVRDC – The World Vegetable Center took on the challenge and worked for more than a decade to develop methods and materials for cytoplasmic male sterility (CMS) in both hot and sweet peppers. To date, the breeding program has made available more than 20 sterile lines and their maintainers.

The success of their long effort was showcased in a workshop held on 4 June at AVRDC headquarters in

Taiwan. More than 60 representatives from Taiwan's seed industry, universities, and government agricultural research stations including the Taiwan Agriculture Research Institute, District Agricultural Research and Extension Stations, and the Taiwan Seed Station attended the event. **Dr. Paul Gniffke**, head of the Center's pepper breeding unit, recapped the history of CMS breeding at AVRDC, which began with a grant from the Seminis Seed Company and continues with support from the Taiwan Council of Agriculture.

Commercial production of hybrids is feasible only if a reliable and cost-effective pollination control system is available. During hybrid seed production, several methods can be used to prevent self-pollination of the female line, including removing the anthers or male flowers by hand or machine, applying male-specific gametocides, or employing cytoplasmic or genic male sterility systems. Cytoplasmic male-sterile lines have a mutation in their mitochondrial genome, and the male sterility is inherited as a maternally transmitted trait. Fertility can be restored through a dominant allele in a normally inherited nuclear gene.

As Principal Research Assistant **Jin Shieh** told the audience, cytoplasmic male sterility can be used for hybrid sweet pepper seed production only if a CMS mutant is available and restorer genes are available to restore fertility in the hybrid variety for normal fruit development. She provided evidence that in some cases, fertility restoration is controlled by two loci (fixed positions on a chromosome). Principal Research

Assistant **Susan Lin** reviewed AVRDC's accomplishments in addressing low temperature instability of sterility in sweet pepper, the identification of effective restorer lines, and the use of honeybees to save labor. **Prof. Wen-Ju Yang** of National Taiwan University confirmed the utility of molecular markers associated with mitochondrial factors and nuclear genes in AVRDC's CMS lines. Although the marker associated with fertility restoration in hot peppers worked for some sweet peppers, it failed to identify restorers in other cases—a possible indication that different (or additional) genes condition CMS in sweet pepper.

The presentations were followed by a tour of a field demonstration of several CMS sweet pepper hybrid combinations using AVRDC-developed parents, and a comparison of hybrids using CMS sterile parents vs. hybrids generated with related maintainer lines. Cages for bee-mediated cross-pollination and seed production were also displayed. Participants received seed samples of some lines and will report the results of their own trials. Comments from participants were generally positive, and the Center's continued effort to advance CMS in sweet pepper was encouraged.

At the AVRDC Library:

Cytoplasmic Male Sterility in Sweet Pepper to Produce Hybrid Seed by PA Gniffke, SW Lin and SC Shieh

http://libnets.avrdc.org.tw/fulltext_pdf/eb0108.pdf

inside insight

Vegetable production in the developing world requires hardier, more productive, and more nutritious varieties able to thrive as the world's climate changes. ***Dr. Andreas Ebert****, the Center's Global Theme Leader for Germplasm, collects and protects vegetable genetic resources; plant breeders use this germplasm to develop improved vegetable varieties. At stake is the health and economic well-being of millions of poor farmers, their families, and communities.*

Why does the Center maintain core collections?

Genebank curators aim to preserve the widest possible range of genetic diversity within a given crop species. However, large collections are difficult to manage and use; AVRDC's genebank, for instance, has 15,314 accessions of vegetable soybean alone. A core collection is small in size, but contains maximum diversity. If the core accessions are well-selected, 10 percent of the original or base collection can retain 70 to 80 percent of all alleles present in the whole collection. At AVRDC, we are just beginning to form representative core collections of our major crops.

Genotype or phenotype: Which is more important?

Plant diversity can be considered on many different levels. Phenotypic variation is important to identify plants for agricultural and industrial purposes. The analysis of variations in genotype highlights the genetic basis of phenotypic variation. The genotype is the genetic code—the inheritable information carried by all living organisms, plants, animals, and microbes. The phenotype is the outward physical manifestation of this inheritable information in interaction with the environment. Plant breeders deal with traits such as yield, color, fruit shape, pest and disease resistance; these traits, in turn, are influenced by biotic and abiotic stress, and by the interaction of genes. Breeders have to scan the total variation in the breeding population (phenotypes) and partition it into genetic (heritable) and environmental components. Hence, genotypes and phenotypes are both essential components of any breeding effort.

The Genetic Resources and Seed Unit has amassed a great deal of information about each accession. How is that information organized and shared?

All relevant data about the Center's germplasm collection is stored in the AVRDC Vegetable Genetic Resources Information System (AVGRIS). It links all operations associated with germplasm conservation and management, from registration, characterization, evaluation, and seed inventory to seed distribution to end-users. This information is freely accessible on the AVRDC website for users worldwide. The AVRDC genebank is also part of the System-wide Information Network for Genetic Resources (SINGER), an information exchange network of the Consultative Group on International Agricultural Research (CGIAR).

Why are indigenous vegetables receiving more attention?

Indigenous vegetables play a significant and increasingly important role in human diets and the rural economy in most countries in Asia and sub-Saharan Africa. Indigenous vegetables are locally adapted and hardy, they can be grown with minimal external

inside insight

inputs, and they are often tolerant to drought and heat, and thus are valuable assets as the climate changes. Many indigenous vegetables are highly nutritious and are the most important source of micronutrients for the poorest of the poor. In recent years, AVRDC has recognized the true value of indigenous vegetables and has embarked on germplasm exploration and collecting missions in collaboration with national programs, especially in Southeast Asia. Meanwhile, the Center has assembled nearly 12,000 accessions of about 200 different species of indigenous vegetables.

Can genebanks halt the loss in biodiversity?

With multiple threats to agricultural biodiversity worldwide, including population growth, reduction of arable land, habitat fragmentation and loss, and modern plant breeding—which led to the replacement of thousands of farmer-developed landraces by just a few high-yielding crop cultivars—genebanks are essential to the preservation of valuable germplasm for the survival of mankind. It has been estimated that over six million samples of seeds are currently being conserved in more than 1300 genebanks. The 11 CGIAR genebanks and AVRDC's genebank of vegetable germplasm are pivotal to the global conservation effort; they currently hold more than 660,000 accessions of important crops for food and agriculture and, in contrast to many national genebanks, are easily accessible to plant breeders and other scientists worldwide. Ideally, ex situ conservation should be combined with in situ conservation in natural habitats or on-farm, which allows for the continuous adaptation of plants to the changing environment.

What is the procedure for making deposits or withdrawals?

A Material Transfer Agreement (MTA) or a Germplasm Acquisition Agreement (GAA) describes the materials to be deposited. These agreements confirm that the provider is legally free to provide the germplasm and related information to AVRDC, and that all necessary national permissions have been obtained. The GAA further states that AVRDC undertakes to use and conserve the germplasm for the purposes of research, breeding, and training for food and agriculture and that the Center is free to make the germplasm and related information available to any third party for agricultural conservation, research, breeding, and training purposes.

Crop Diversification

Collaboration in the Caucasus

Georgian scientists survey trials of AVRDC vegetable lines.

Scientists from the **Georgian Research Institute of Crop Husbandry** are conducting competitive variety trials of promising lines of AVRDC sweet pepper (0636-6018-2, 0437-7031, 0537-7061), eggplant (EG 220), and vegetable soybean (AGS 292, Jasuko-15). Georgia collaborates with seven other countries and AVRDC - The World Vegetable Center in the **Central Asia and Caucasus Regional Vegetable System Research & Development Network** (CACVEG), which was established in 2006. A total of 29 accessions of five vegetable crop species from AVRDC were introduced in Georgia from 2007-2009, including tomato, eggplant, sweet pepper, cabbage, and vegetable soybean.

– Nato Kakabadze
Georgia CACVEG coordinator

(CACnews, January-March, 2009, #39 http://www.icarda.org/cac/cac_news/en/cac39e.pdf)

Focus: AFRICA

Community gardens increase vegetable production, reduce poverty and malnutrition in West African households

Farmers Mrs. Astan Diaby (l) and Mrs. Goundo Dansira (r) explain their activities in the Mahina community garden.

In Mahina, Mali, the Angata Lambersart Association offers farmers space in a large, irrigated **community garden**. The original garden area consisted of 14 bands composed of 12 plots measuring approximately 6 m x 3 m each. Recently, more bands have been added to meet increasing demand from local farmers—primarily women—who grow vegetables for sale and for household consumption.

The farmers make a single payment of a small fee for each band, and can apply for as many bands as they can manage. Irrigation water is drawn from the Bafing River, located approximately 1000 m away, and made available to the farmers for a small monthly charge.

(...continued on page 7)

By Sokona Dagnoko, Albert Rouamba, and Ekow Akyeampong, Subregional Office for West and Central Africa, Mali

Indigenous vegetables grown in the Mahina community garden.

Celosia | Vegetable cowpea | Cucurbits

The community garden provides space for small-scale vegetable growers.

(. . . continued from page 6)

Indigenous vegetables are by far the most predominant vegetable crops grown and include vegetable cowpea, celosia, amaranth, cucurbits (especially pumpkins), okra, African eggplant, and roselle. Peppers, tomato, shallot, and onion are also grown.

Okra is the star of the garden. The farmers have mastered techniques for dry-season okra production. Produce is sold in the local markets of Mahina and Bafoulabé or exported to Kayes, the main city in the region.

Constraints to vegetable production in this area include a lack of improved varieties, limited access to high quality seed, a lack of technical monitoring and support from extension services, limited knowledge of pest and disease management, and limited knowledge of nursery techniques, which accounts for the low production of exotic vegetables in the garden. Mrs. Astan Diaby, a garden farmer, said: "We often buy seedlings of tomato and cabbage from the nearest male growers of Danfagabougou, located 3 km away." If the women were trained in nursery techniques, they could produce their seedlings locally, grow a greater diversity of vegetables, increase their incomes, and promote better health for their families and communities.

Okra, an indigenous vegetable grown in the Mahina community garden.

FOCUS: India

Year Two for Punjab

↑ Participants in the AVRDC-SRTT project annual review and planning meeting, PAU, Ludhiana, Punjab ↓

In collaboration with Punjab Agricultural University, Ludhiana the annual review and planning meeting of the AVRDC-Sir Ratan Tata Trust project **"Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India"** was organized by AVRDC – The World Vegetable Center, Regional Center for South Asia at PAU on 15-16 May 2009. Sixty participants including scientists, heads of various departments, and partners attended the meeting to develop the year II workplan for Punjab.

Dr. P.S. Minhas, Director of Research, PAU, addressed the inaugural session. Scientists from PAU presented reports and AVRDC Entomologist Dr. R. Srinivasan participated in the meeting.

Welcome

Dr. Eguru Sreenivasa Rao, Postdoctoral Fellow from the Indian Institute of Horticultural Research (IIHR), India arrived at the Center on 31 May 2009 to conduct a research project on "Application of association mapping to understand genetic diversity in a subset of AVRDC's *Solanum pimpinellifolium* collection" for one year. Dr. Rao will work in the Biotechnology/ Molecular Breeding Unit under the guidance of Drs. Andreas Ebert and Kadirvel Palchamy. He can be contacted at 420 (office) and 657 (dormitory), e-mail <sreenivasa.rao@worldveg.org>.

— Lydia Wu, Global Technology Dissemination

Networking across Southeast Asia

The 4th Steering Committee Meeting of the **ASEAN-AVRDC Regional Network for Vegetable Research and Development** (AARNET) was held in Bangkok, Thailand on 12 May 2009. Organized by the AARNET Secretariat and AVRDC's Asian Regional Center (ARC), the meeting was hosted by the Horticulture Research Institute, Department of Agriculture, Bangkok. **DDG-R Dr. Jackie Hughes** chaired the meeting and re-affirmed the Center's commitment to AARNET, including support in raising funds for network activities. Asian Regional Center Director **Dr. Peter Ooi** and virologist **Dr. Lawrence Kenyon** also represented the Center at the meeting.

Following an update by the AARNET Chairman, Mr. Leslie Cheong, Director, Food Supply and Technology Department, Agri-Food and Veterinary Authority, Singapore, the participants from Brunei Darussalam, Indonesia, Malaysia, Singapore, and Thailand discussed four projects proposed by AARNET—including a proposal to study bitter gourd pest management in ASEAN countries, the status of which was presented by Dr. Peter Ooi. (An amended version of this proposal was submitted to the Asia and Pacific Seed Association [APSA] for possible funding immediately after the steering committee meeting). Mr. Pengiran Hj. Zaini bin Pengiran Hj. Ahmad, Head of Vegetable Development, Department of Agriculture, Brunei Darussalam informed the group that the budget to set up an indigenous vegetable collection in Brunei had been approved in April 2009 and that the Asian Regional Center was to be appointed to lead the project through the Ministry of Industry and Primary Resources, Brunei Darussalam.

The Center's role in AARNET looks set to increase in the coming years through *a*) the possibility of hosting one of the next steering committee meetings at headquarters, *b*) activities in regard to the AARNET website, *c*) a lead role in a possible AARNET vegetable value chain symposium in 2011 and *d*) increased networking activities.

— Dr. Lawrence Kenyon, Virology