TEXAS A&M PLANT BREEDING BULLETIN

March 2016

Our Mission: **Educate and develop Plant Breeders worldwide**
Our Vision: **Alleviate hunger and poverty through genetic improvement of plants**

I want to deviate from my usual PBB format highlighting TAMU plant breeding faculty and students to share with you a recent Plant Breeding Symposium at the 2016 American Association for the Advancement of Science (AAAS) meeting held in Washington, DC in February. I had the pleasure of assisting Dr. Patrick Byrne, Professor of Plant Breeding and Genetics at Colorado State University, and Dr. Ann Marie Thro, National Program Leader-Plant Breeding and Genetic Resources-USDA/NIFA, in organizing the event. The following summary was composed by Dr. Byrne with assistance from Dr. Thro and the speakers. I hope that you enjoy reading what the speakers had to say about "Unlocking Plant Genetic Diversity for Food and Nutritional Security."

The urgent need to conserve and characterize plant germplasm due to climate change and human activities, and efforts to exploit genetic diversity in plant breeding programs were highlighted at this symposium, part of the annual meeting of the American Association for the Advancement of Science. The symposium was organized by the **Plant Breeding Coordinating Committee, the USDA-sponsored group made up of public sector plant breeders, and the National Association of Plant Breeders**. These organizations have identified genetic diversity and plant genetic resource conservation as critically important areas, given that diversity is the raw material required for crop breeding progress.

Paula Bramel (currently the Scientific Adviser and formerly Deputy Executive Director of the Global Crop Diversity Trust, www.croptrust.org) provided a global overview of crop germplasm conservation efforts. Given the expected shift in optimum production environments due to climate change, germplasm bank collections will be crucial for increased breeding efforts for heat and drought tolerance. The Crop Diversity Trust's goal is a cost-effective, rational, and global system for the conservation and availability of crop diversity. The Trust has three priorities: (1) conserve germplasm forever, (2) strengthen gene bank information systems, and (3) collect and use wild relatives of our life-sustaining crops. It seeks long-term funding for the Crop Trust Fund, an endowment; and short-term grants to support conservation and enhanced use of key collections around the world, as well as operating costs for the Svalbard Global Seed Vault in Norway. Genesys has been the primary information system in use, but it is

hoped that the new GRIN-Global will become a standard gene bank management system. Crop wild relatives have been identified as a gap in current collections and are especially threatened by climate change. Priorities for the Crop Wild Relatives project include collection from areas of high diversity, developing human capacity, especially in developing countries, and incorporating wild germplasm into pre-bred lines to facilitate their use in breeding programs.

Chiedozie Egesi (head of the cassava breeding team at the National Root Crops Research Institute in Nigeria and project manager for Cornell University's NextGen Cassava project) reported on breeding activities to improve performance of cassava in Africa. Cassava is a critical source of food and nutritional security for 500 million farm families in sub-Saharan Africa, and is especially important for women. It is subject to many disease and insect stresses, yet breeding to address these stresses is hampered by the long breeding cycle and the fact that many genotypes flower and set seed poorly. In addition, the genetic diversity of African cassava is limited, because only a few germplasm introductions were made by Portuguese traders from Latin America, the birthplace of cassava, in the 16th and 17th centuries. Susceptibility of Latin American germplasm to African cassava mosaic disease (CMD) has restricted the use of that source of genetic diversity in African breeding programs. Recently, however, molecular markers allowed cassava breeders to identify a major gene for CMD resistance, at last enabling the use of South American cassava germplasm in African breeding programs. Development of high-resolution linkage maps, improved phenotyping methods, and genomic selection schemes are other recent innovations implemented to accelerate cassava breeding progress. A video of Chiedozie's presentation is available on the NextGen Cassava site, www.nextgencassava.org, and a follow-up news story appeared in The Economist (http://www.economist.com/news/science-and-technology/21693184-annual-aaas-meeting-looked-immune-system-roman-portraits-and-genetic).

Walter Trevisan (maize breeder with 44 years of public and private sector experience in the tropics and subtropics) described how relatively little of the genetic diversity of maize has been incorporated into elite hybrids. In the U.S. Corn Belt, Europe, and most of China, for example, maize hybrids rely primarily on just two of over 250 recognized global races of maize. Emerging disease threats (e.g., tar spot in southern Mexico and maize lethal necrosis disease in East Africa) require fuller use of plant genetic resources to identify and incorporate resistance. The Genetic Enhancement of Maize (GEM) project (www.public.iastate.edu/~usda-gem/) is successful, long-running public/private collaboration to introgress exotic germplasm into U.S. commercial hybrids. USDA-ARS provides annual funding of about $1.5 million and GEM cooperators provide in-kind contributions for trials, nurseries, and disease evaluations in the U.S. and abroad. GEM partners include about 26 U.S. private cooperators, 21 U.S. public cooperators, one non-governmental organization, 12

international private cooperators, and 4 international public cooperators. In 22 years, the project has developed 501 inbred lines (conventional and doubled haploids) from over 90 races of maize. Due to the importance of GEM in increasing genetic diversity of maize in temperate areas, it has been decided recently to continue the GEM project, while incorporating improvements to make it more compatible with the present speed and needs of maize breeding.

Discussion

What importance is being placed on *in situ* conservation?

Conserving genetic resources *in situ* (landrace varieties in farmers' fields and wild relatives in natural areas) is a necessary complement to *ex situ* storage, as it captures ongoing evolutionary changes in plant populations. Everything conserved *in situ* should also be collected for *ex situ* conservation as a backup. Farmers or communities may have to be compensated in some way to ensure continuity of *in situ* conservation.

What about specialty crops or crops as yet undiscovered?

The Crop Trust has focused mostly on agronomic crops and a few vegetable crops specified in the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The Trust recognizes the importance of minor and specialty crops and hopes to expand to cover those crops in the future.

Are there issues of ownership that affect availability of the germplasm?

Concerns about the use of the Standard Material Transfer Agreement (SMTA), the access and benefit-sharing instrument of the ITPGRFA, have slowed the availability of crop diversity within the multilateral system. The Crop Trust is a key supporter of the multilateral systems and thus ensures that all collections that it supports utilize the SMTA to exchange germplasm. There are issues with the SMTA that need to be addressed for the future and currently there are efforts ongoing to find solutions.

What can researchers do to help the press describe the value of plant genetic resources?

Researchers can help to better communicate the future value of conservation and use of crop genetic resources. Better understanding of this value is critical given the current cost for conservation in relation to an as yet-unknown future value. The value of conservation is not always an economic value but a social value as well. Gene bank curators, researchers, private companies, and others can help by highlighting good examples with economic or social value, to help demonstrate future value. Thus researchers need to work collaboratively with the press to document cases of past impact.

Audience size ranged from 35 to 50 over the course of the symposium, with participation from researchers, students, science writers, and representatives of communications offices.

THIS and THAT

Congratulations to Dr. David Stelly, Professor, Soil and Crop Sciences, TAMU, who recently was awarded the Lifetime Achievement Award at the National Conference on Genetics and Cytogenetics at the University of Agricultural Sciences, Dharwad in Karnataka, India.

Congratulations to the Plant Breeding Symposium graduate students at Texas A&M University for developing and completing another outstanding and successful symposium, one of the DuPont Plant Sciences Symposia Series sponsored by DuPont Pioneer.

The annual meeting of the National Association of Plant Breeder will be held in Raleigh, NC, 15 – 18 August. More information can be found at https://www.plantbreeding.org/annual-meeting-2016.

Distance Plant Breeding Program and Continuing Education courses available for Spring 2016 (https://scsdistance.tamu.edu/available-courses/).

Continuing Education Available Courses

Spring Courses: February22 – May 11, 2016

To fully participate in our continuing education courses, students should have:

- High speed internet connection and updated browsers, including Internet Explorer and either Chrome of Firefox
- Common plug-ins (e.g. Adobe Reader, Flash Player, Virus Protection, Java, etc.)
- Speakers and Webcam with microphone
- Skype
- Ability to either scan or fax course documents to the instructor

Spring 2016

Basic Plant Breeding - Full Course (3 Units) - Cost - $679.65

January 19-May 11, 2016

Basic Plant Breeding can be taken as an entire course (all three units) or each unit can be taken individually. For participants in our Professional Certificate in Plant Breeding and Genetics, completion of all three units is required.

Unit 1 - Introduction to Basic Plant Breeding *Cost - $226.55*

January 19 – February 19, 2016 ***[CLOSED]***

Introduction to Basic Plant Breeding provides a review of plant reproduction, genetic variation, gene banks, germplasm preservation, gene segregation, the power of selection and its role in plant breeding, and an introduction to intellectual property and its role in the life of a plant breeder. This unit is designed to prepare the participant to explore the genetics and methodologies employed by plant breeders of self and cross pollinated crop species in units two and three of Basic Plant Breeding.

Unit 2 - Breeding Self Pollinated Crops *Cost - $226.55*

February 22 – April 1, 2016 [CLOSED]

The frequency of any specific heterozygous locus will be reduced by 50% for every generation of selfing, resulting in a mixture of homozygous lines within any natural population. Phenotypic selection within heterozygous generations will lead to homozygous or near homozygous germplasm lines or cultivars under self-pollination. This unit is designed to communicate plant breeding methodologies that take advantage of the genetic consequences of natural or forced self-pollination in agronomic crops. Topics will include: [1] the basics of segregation, [2] breeding methodologies, [3] the grain sorghum conversion program-an example of backcrossing in a different direction, [4] review of a commercial soybean cultivar development program, and [5] a review of the types of genetic releases from Texas A&M AgriLife Research.

Unit 3 - Breeding Cross Pollinated Crops *Cost - $226.55*

April 1 – May 11, 2016

Topics covered include: quantitative genetics and plant breeding, effects of selection on Hardy Weinberg Equilibrium, mating designs with cross pollinated crops, breeding methods for cross pollinated crops, deviations from Mendelian ratios, genetic male sterility and hybrid seed production, seed certification and types of release.

Recommended textbooks are “Breeding Field Crops” by J.M. Poehlman and D.A. Sleper, and “Principles of Cultivar Development” by W.F. Fehr. A final exam will allow the participant to assess their grasp of topics covered. Participants in the Plant Breeding and Genetic Certificate Program must score 70% on the final exam for each unit.

This is a "self-paced" course and is available for viewing for a limited time. Time commitment is individual student driven. Few outside assignments are made. Students should view each lecture, review all previous lectures and be prepared to discuss any issues that are unclear. Each unit has a printable note set and most units have a set of review questions that can be used as a tool to check your comprehension and grasp of unit concepts. Feel free to contact the instructor, Dr. Wayne Smith, by e-mail (cwsmith@tamu.edu) or phone (979-845-3450) with any questions you have or if you need additional information.

Analysis of Complex Genomes – Full Course (3 Units) – Cost - $679.65
January 19-May 11, 2016

Genome structure, organization and function of model organisms and higher eukaryotes; theory and methodology of genetic and physical mapping, comparative genomics, sequencing, sequence analysis and annotation; emphasis on understanding the function of complex genomes, genome-wide expression analysis, genetic and epigenetic mechanisms; X-inactivation, imprinting, gene silencing, transposons, genome duplication and evaluation. Requires an in-depth and working knowledge of basic and advanced plant breeding concepts.

Unit 1 – DNA Marker Technology and Genetic Mapping *Cost - $226.55*

January 19 – February 19, 2016 ***[CLOSED]***

Unit 2 – Recombinant DNA and Cloning *Cost - $226.55*
February 22 – April 1, 2016 [CLOSED}

Unit 3 – Sequencing Genomes and Other Genomic Tools *Cost - $226.55*
April 1 – May 11, 2016

Intellectual Properties in the Plant Sciences - Full Course (3 Units) - Cost - $679.65
January 19-May 11, 2016
This course introduces the major foci of intellectual property (IP) impacting plant sciences, including: 1) traditional vs. emerging knowledge economies, 2) governing U.S. statutes and international treaties, 3) forms of IP protection, and 4) IP asset identification, valuation, capture, and deployment towards an understanding of best practices for the development of effective IP strategies and management of IP portfolios.

Unit I - Introduction to Intellectual Property, International Treaties and Patents *Cost - $226.55*
January 19 – February 19, 2016 ***[CLOSED]***
Unit I of the Intellectual Properties in the Plant Sciences Course. Topics covered include: IP Culture and the Knowledge Economy, Traditional Knowledge vs. Biopiracy, Sui generis Systems, International Treaties, Overview of Patentability, Utility Patents, and Plant Variety Patents.

Unit II - Intellectual Property Documentation *Cost - $226.55*
February 22 – April 1, 2016 [CLOSED]
Unit II of the Intellectual Properties in the Plant Sciences Course. Topics covered include: Trademarks, Copyrights, & Trade Secrets; USPTO; Inventorship, Ownership, Compensation, IP Training; Confidential Information; IP Audit; IP Value; Competitive Intelligence; Cyberspace – IP and IT Cooperation.

Unit III - Intellectual Property Transfer and Enforcement *Cost - $226.55*
April 1 – May 11, 2016

Unit III of the Intellectual Properties in the Plant Sciences Course. Topics covered include: Intellectual Property Transfer and Enforcement, IP Case Studies, IP Portfolio, IP Strategy and Leveraging IP Value.

Other Academic and Continuing Education courses in plant breeding and related disciplines that will be available during other semesters include Host Plant Resistance; Crop Production; Selection Theory; Marker Assisted Selection; Genomic Analysis; Field Crop Diseases; Field Insects; Essential Nutrients in Crop Growth; and others. For more information visit https://scsdistance.tamu.edu/ or contact LeAnn Hague, Distance Education Coordinator in Soil and Crop Sciences at leann.hague@tamu.edu or (979)845-6148.

Distance Plant Breeding

M.S. and Ph.D. degree programs at Texas A&M.

Visit https://scsdistance.tamu.edu/plant-breeding-distance-education/ for details.

Please direct comments concerning this bulletin to Wayne Smith, cwsmith@tamu.edu or 979.845.3450.