TEXAS A&M AGRILIFE RESEARCH | EXTENSION

TEXAS A&M UNIVERSITY

TEXAS A&M PLANT BREEDING BULLETIN

February 2017

TEXAS A&M UNIVERSITY--EDUCATING AND DEVELOPING PLANT BREEDERS WORLDWIDE TO ALLEVIATE HUNGER AND POVERTY THROUGH GENETIC IMPROVEMENT OF PLANTS

The following item was written and published by CIMMYT (International Maize and Wheat Improvement Center) and reprinted herein by permission. Bhoja Raj Basnet received his MS at South Dakota State University under the direction of Karl Glover and Amir Ibrahim and his PhD in Plant Breeding at Texas A&M under the direction of Amir Ibrahim.

Mexico City, Mexico
February 1, 2017

Bhoja Raj Basnet joined CIMMYT as a postdoctoral fellow working in the bread wheat improvement program in 2012. Photo: A. Cortes/CIMMYT

Scientist Bhoja Raj Basnet knows first hand what it is like to be a smallholder farmer. Basnet's earliest memories were formed on a one-acre subsistence farm in Jhapa, in southeastern Nepal, a fertile area in a country where the livelihoods of nearly 65 percent of people depend on agriculture.

The tiny farm provided the foundation for a journey that led ultimately to a doctoral degree in the United States and a career as a wheat breeder in Mexico at the International Maize and Wheat Improvement Center (CIMMYT).

Wheat plays a major role in Nepal's agricultural landscape. It is the country's third largest crop, cultivated on about 750,000 hectares of arable land each year with an average yield of 2.5 tons per hectare. Above wheat, farmers favor only rice and maize.

"I grew up playing with the plants and soil on my family's farm and before I entered high school I knew I wanted to pursue a career in agricultural science." Basnet explained. "As I got older I started to realize the importance of agriculture and how agriculture can really shape a child's health and future. This is what really pushed me to pursue my career."

Basnet went on to earn his master and doctoral degrees in plant breeding. After graduation in 2012 from Texas A&M University, Basnet joined CIMMYT as a postdoctoral fellow working in the bread wheat improvement program.

In 2014, Basnet began leading a project conducting research into hybrid wheat in collaboration with Syngenta, which involves researching and developing tools and technology for developing commercially viable hybrid CIMMYT wheat varieties.

Hybrid wheat is created when a breeder intentionally crosses two genetically distinct and stable wheat lines to produce an offspring that combines the best traits of the parents. The process of developing a hybrid can take years, as traits are carefully chosen to achieve desired characteristics, such as increased grain yield or stress tolerance.

The principle behind hybrid varieties is exploitation of heterosis, the superiority of the hybrid offspring over its parent varieties. This is a biological phenomenon observed in almost all living organisms. However, the magnitude of "heterosis" varies significantly based on several biological and environmental factors.

"Hybrid wheat has always fascinated me," Basnet said, adding, "I really want to see the end results and to see this work succeed." Hybrid wheat varieties have proven to be tricky. In fact, CIMMYT's first attempt to develop hybrid wheat occurred in the 1960s and despite stops and starts over the years, has been ongoing since 2010.

Increasing investment and long-term funding commitments are a key prerequisite to achieving success in crop improvement, especially in breeding, Basnet said. Unlike traditional wheat variety development, successful research into hybrid wheat varieties depends largely on the willingness and active engagement of private sectors into research and seed businesses.

Basnet is working to develop a hybrid wheat foundation at CIMMYT by using new technology and existing research on hybrids. This hybrid wheat foundation will create genetic diversity within wheat to increase genetic gains and develop tools that can produce large amounts of hybrid seed.

"Currently less than one percent of wheat crops globally are hybrid wheat," Basnet explained. "We need to continue with this research, as hybrid crops could lead to 15 to 20 percent greater yield potential and in particular higher stability, a very important trait with climate change."

Meetings of Interest

National Association of Plant Breeders, NAPB will hold their annual meeting at the UC Davis Activities and Recreation Center August 7 – 10, 2017. More information will be available soon at https://www.plantbreeding.org.

American Society of America, Crop Science Society of America, and Soil Science Society of America will host more than 4,000 scientists, professionals, educators, and students at the 2017 International Annual Meeting, Managing Global Resources for Secure Future," October 22 – 25, 2017 in Tampa Florida. Additional information at https://www.acsmeetings.org/.

Distance Plant Breeding at Texas A&M

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

Continuing Education

Spring Courses: January 17 – May 9, 2017

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 2017

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
January 17 -May 9, 2017

Introduction to the field of plant breeding for students without a plant breeding background. Includes common plant breeding terminology and introduction of concepts. Genetic improvement of crops by hybridization and selection; special breeding methods and techniques applicable to naturally self-pollinated, cross-pollinated and asexually reproduced plants.

Basic Plant Breeding - Full Course (3 Units) - Cost - $679.65
January 17-May 9, 2017

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 17 – February 17, 2017
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 20 – March 31, 2017
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 3 – May 9, 2017

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 17-May 9, 2017

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 17 – February 17, 2017

Unit 2 – Recombinant DNA and Cloning *Cost - $226.55*
February 20 – March 31, 2017

Unit 3 – Sequencing Genomes and Other Genomic Tools *Cost - $226.55*
April 3 – May 9, 2017

Intellectual Properties in the Plant Sciences - Full Course (3 Units) - Cost - $679.65
January 17-May 9, 2017

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 17 – February 17, 2017
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 20 – March 31, 2017
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 3 – May 9, 2017

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.

Introduction to Host Plant Resistance (1 Unit) - Cost - $226.55
January 19 – February 19, 2016
Host plant resistance programs from the standpoint of the plant breeder.

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 Degrees in 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.