



Triticeae CAP  
Coordinated Agricultural Project

# TCap Transmission

Spring 2013

Funded by the USDA National Institute of Food and Agriculture



United States Department of Agriculture  
National Institute of Food and Agriculture

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## Directors notes: Gary Muehlbauer and Jorge Dubcovsky

The TCAP is starting its third year and it is maturing nicely. The TCAP held its annual meeting on January 13 in San Diego (see page 2 for details) and it was obvious from the progress reported at the meeting that the TCAP continues to be highly successful and gaining momentum. New database, informatics and **genomics** tools are being developed, novel genes conferring beneficial traits are being detected, and **marker-assisted selection** and **genomic selection** are being implemented in breeding programs. Together, these activities are laying the foundation for an exciting future for wheat and barley breeding in the U.S. In addition to these technological advances, perhaps the TCAP's greatest contribution will be the education and training of the cohort of undergraduate and graduate students. 125 students have participated while 36 graduate and 20 undergraduate students have received funding through the TCAP. These students form the core of the research effort on the TCAP. For an example, see page 5 for Celeste Falcon's (University of Minnesota) description of her research on **nitrogen use efficiency** and **genomic selection** for low temperature tolerance in barley. Moreover, twenty-one students from Minority Serving Institutions have collaborated with TCAP PIs. See page 7 for Dr. Chris Botanga's (Chicago State University) description of his and his students experience with the MSI-TCAP collaboration. All TCAP students are bound together by the online Plant Breeding Training Network where they can collaborate and learn via courses, seminars, and discussions. As these students graduate and take positions in industry and academia they will be the true legacy of the project.



## CSR Report—Luther Talbert

Definitions to all red words can be found in "TCAP Terminology" on page 14

Approximately 30 T-CAP scientists participated in a discussion of the use of **canopy spectral reflectance (CSR)** to identify superior genotypes in wheat breeding populations. Several groups have obtained CSR data on diverse lines included in the wheat **Association Mapping** panels, while others have concentrated on refined genetic materials. Initially, a discussion ensued about using CSR for phenotype predictions. The broadest goal was to use CSR as a prediction of grain yield, while other goals were to use CSR to predict difficult to measure traits such as plant water and nitrogen status. Several instruments from different manufacturers are being used. Operation of the Ocean Optics Jazz machine has been greatly enhanced by the development of new scripts by T-CAP personnel, especially Tyson Howell at University of California-Davis. Four Ph.D. students gave presentations of their own CSR research using the diverse materials included in the T-CAP populations. These included Shiferaw Gizaw (Washington State University), Kyle Shroyer (Kansas State University), Kaitlyn Hitz (University of Kentucky), and Brian Bowman (University of Idaho). In general, the CSR experiments are progressing from addressing technical issues related to operation of the instruments, to scientific questions related to the use of canopy spectral information to aid selection in wheat breeding programs.



# TCAP Annual Meeting by Gary Muehlbauer

The TCAP held its annual meeting on January 13, 2013 in San Diego, CA at the Town and Country Convention Center. Approximately 100 people attended the all day meeting (see attached picture). The meeting was divided into three sections. The first portion of the meeting was devoted to stakeholder groups. Gary Muehlbauer (University of Minnesota) gave a short presentation that outlined the project and described the approaches that the TCAP was using to advance the development of wheat and barley varieties and then opened up the floor for questions. A vigorous discussion ensued about various topics including: graduate student education, industry-University partnerships, and TCAP-international collaborations. Following the stakeholder session, the second portion of the meeting was devoted to reporting to the scientific advisory board and the USDA representatives. Jorge Dubcovsky (UC, Davis) started off this session with an overall view of the TCAP and the major advancements over the past year. Jamie Sherman (Montana State University) described the overall education effort that included the TCAP collaborations with various Minority Serving Institutions (MSIs), the Plant Breeding Training Network, the plant breeding films, and the **association mapping** course. Following the education session, a series of talks that highlighted the research portion of the TCAP were presented. These included presentations by Jean-Luc Jannink (USDA-ARS, Ithaca, NY) on the progress of the T3 database, Eduard Akhunov (Kansas State University) and María Muñoz-Amatriáin (University of Minnesota) on SNP **genotyping** and **gene** capture in wheat and barley, Kevin Smith (University of Minnesota) discussed the progress of genomic selection for winter hardiness. Mike Pumphrey (Washington State University) and Pat Hayes (Oregon State University) discussed **association mapping** for fungal disease resistance in wheat and low temperature tolerance in barley, respectively. Following the formal presentations, breakout groups in barley, wheat, T3 and **genotyping** met to plan and coordinate the third year of the project. Peter Langridge (University of Adelaide, Australia), a member of the Scientific Advisory Board, ended the reporting session with very positive feedback on the outputs and direction of the TCAP. After the reporting session, there was a graduate student poster session. Thirty posters were presented by the students and there was energetic discussions between TCAP PIs and students.



Jorge Dubcovsky



María Muñoz-Amatriáin



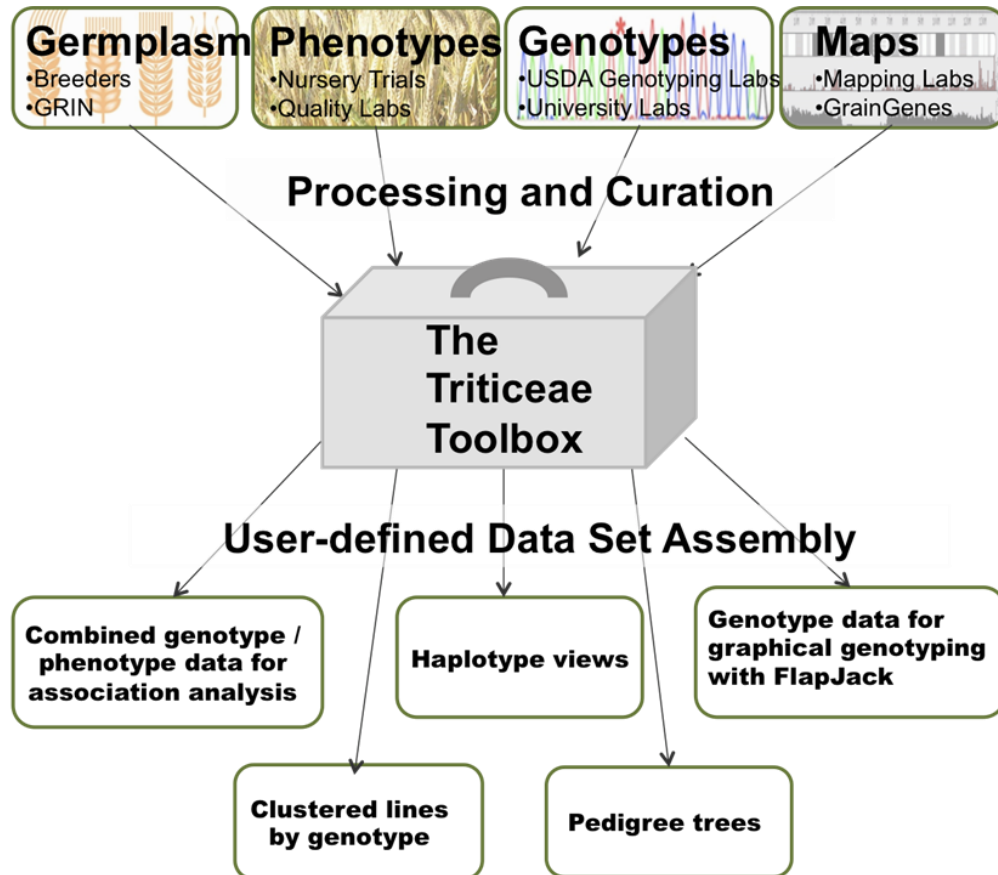
Sonny Ramaswamy (USDA-NIFA)



# Triticeae Toolbox Report

Victoria Carollo Blake

The Triticeae Toolboxes are the databases and built-in bioinformatics tools for data generated by the T-CAP project and other collaborators. There are two production databases with T3 Wheat at [triticeaetoolbox.org/wheat](http://triticeaetoolbox.org/wheat) and T3 Barley at [triticeaetoolbox.org/barley](http://triticeaetoolbox.org/barley). Both crop toolboxes have mirror databases called User Sandboxes where T3 participants can test-load data files to be sure they are properly formatted prior to upload to the production database.



**Figure 1.** Model of The Triticeae Toolbox (T3) illustrating the ability to take diverse types of genetic and phenotypic data for wheat or barley, combine these data for individual **germplasm** lines and then provide online tools for data analysis or deliver downloadable user-defined datasets for further study.

## Current Projects

*Now that the data is in T3, what can we do with it?*

**Canopy Spectral Reflectance** is a remote sensing tool where plant performance under nitrogen and water stress can be predicted by light reflectance at various wavelengths. The T3 team is working with T-CAP participants to create tools to upload and use these data including the creation of user-defined indices.

**User-defined Datasets** combining genotype and phenotype data for selected **germplasm** lines enable T3 users to quickly assemble input files for **association mapping** linking genetic **markers** to plant traits in a diverse population. Improved data Wizards are making this easier than ever, allowing T3 users the flexibility of starting the dataset from a collection of lines, breeding programs, traits or locations.

**A BLAST Server** now allows T3 users to search within the vast collection of **marker** sequences held in T3 starting with a nucleotide sequence from their **gene** or **marker** of interest.

**Genome-Wide Association and Prediction Tool** enables T3 users to select a training set and tailor it according to minimum minor allele frequency and missing **marker** data. The tool then uses a baseline genomic prediction model, GBLUP, to predict performance of a second set of lines, and to show, using cross validation, what prediction accuracy can be expected.

# New Wheat and Barley Phenotype Data in T3

By: Victoria Blake

**Table 1.** Recent wheat phenotype data contributions to T3



Population	Location	Traits
* Spring Wheat <b>Association Mapping</b> Panel	Bozeman, MT	WUE, NUE, agronomic, stem solidness
* Spring Wheat <b>Association Mapping</b> Panel	Huntley, MT	WUE, NUE, agronomic
* Spring Wheat <b>Association Mapping</b> Panel	Saskatoon, CA	WUE, NUE, agronomic
Solid stem near inbred lines (NILs)	Bozeman, MT irrigated	WUE, NUE, agronomic, stem solidness
Solid stem near inbred lines (NILs)	Bozeman, MT dryland	WUE, NUE, agronomic, stem solidness
Solid stem near inbred lines (NILs)	Huntley, MT dryland	WUE, NUE, agronomic, stem solidness
Solid stem near inbred lines (NILs)	Lind, WA	WUE, NUE, agronomic, stem solidness
Solid stem near inbred lines (NILs)	Pullman, WA	WUE, NUE, agronomic, stem solidness
Elite Hard Winter Wheat <b>Association Mapping</b> Panel	Ithaca, NE	WUE, NUE, agronomic, BYDV
Hard Spring Wheat <b>Association Mapping</b> Panel	Othello, WA irrigated	WUE, NUE, agronomic
Hard Spring Wheat <b>Association Mapping</b> Panel	Othello, WA dryland	WUE, NUE, agronomic

\*genotyping data in process of upload

**Table 2.** Recent barley phenotype data contributions to T3



Population	Location	Traits
T-CAP Facultative Winter 6row	Corvallis, OR high N	WUE, NUE, agronomic, malting quality, stripe rust, scald
T-CAP Facultative Winter 6row	Corvallis, OR low N	WUE, NUE, agronomic, stripe rust, scald
T-CAP Facultative Winter 6row	Corvallis, OR well irrigated	WUE, NUE, agronomic
T-CAP Facultative Winter 6row	Corvallis, OR low water	WUE, NUE, agronomic
U.Minn. F3 lines from a low temperature tolerance genomic selection, Cycle 1	St. Paul, MN	Heading date, % winter survival
Selected winter lines	Ft. Collins, CO 2006	% winter survival
Selected winter lines	Pendleton, OR 2006	% winter survival
Selected winter lines	St. Paul, MN 2009	% winter survival
Selected winter lines	St. Paul, MN 2011	% winter survival

## Student Success Story - Celeste Falcon

After graduating from Cornell University in 2011 with a BS degree in Plant Science, I began working on my PhD in Applied Plant Sciences with Dr. Kevin Smith at the University of Minnesota. I am currently in my second year and am working on two projects. My research interests are in using breeding methods to improve crops in terms of their nutritional quality and adaptation to lower input systems.

For my first project, we are attempting to discover new alleles within a panel of elite breeding lines for improving **nitrogen use efficiency (NUE)** in barley. We are interested in this trait because the production and overuse of nitrogen fertilizer have negative environmental effects, and, as CO<sub>2</sub> concentration increase with global climate change, it will be more difficult for small grain crops like wheat and barley to take up nitrates. Because the malting and brewing process requires barley with an intermediate level of protein, the eventual goal is to create barley lines which maintain the optimal level of protein while having increased yield and decreased need for nitrogen fertilizer. Along with our TCAP collaborators, we have collected phe-



notypic data for a number of traits related to yield and protein in low and normal nitrogen application treatments. Indices comparing the performance of each line under

these two treatments will be calculated as a measure of **NUE**, and these calculated values will be used in **association mapping** to discover useful alleles associated with NUE.

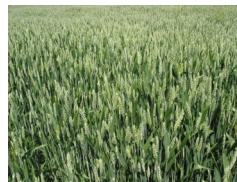
For my other project, we are looking at how well genomic selection can be implemented into a breeding program. Specifically, we seek to increase the low temperature tolerance of facultative malting barley lines to create a crop that can be planted in the fall, withstand Minnesota's harsh winter weather, and be harvested in the early summer. For this project, we will report accuracy in predicting the performance of progeny, gain from selection and maintenance of genetic variation comparing these values for phenotypic and genomic selection. We will also identify changes in allele frequency for several **genes** known to affect winter survival traits and look for other **genes** which have changed drastically in terms of allele frequency indicating that they may also be associated with winter survival. Proving the utility of genomic selection in the context of a breeding program is an important step in encouraging the use of this method.



## Small Grain growers and Climate Change

By Dave Van Sanford - University of Kentucky

In the summer of 2011 the Kentucky Small Grain Growers Association (<http://www.kysmallgrains.org/>) solicited a grant proposal to address climate change and its potential impact on wheat production in Kentucky. The proposal that followed has resulted in a unique partnership between University of Kentucky researchers and stakeholders. The proposal initially fostered a collaboration between researchers who had never worked together before and involved the disciplines of ecology, agronomy and plant breeding. A workshop was held in February, 2012 that examined the question of climate change and Kentucky's future as a wheat producing state. Speakers included national luminaries in the area of climate change and its effect on agriculture ([http://www.uky.edu/Ag/Wheat/wheat\\_breeding/Climate-Change.htm](http://www.uky.edu/Ag/Wheat/wheat_breeding/Climate-Change.htm)). Outcomes of this workshop included the development of new collaborations between the University of Kentucky and Western Kentucky University, between the University of Kentucky and the University of Florida crop modeling group (<http://www.agmip.org/>), and several proposals to the grain commodity groups and National Oceanic and Atmospheric Administration, (NOAA) to develop a farmer-friendly AgWeather website that will allow growers to build climate variability into their risk management schemes. The AgWeather website will be designed to take advantage of Kentucky's state of the art mesonet weather system (<http://www.kymesonet.org/>). This is an example of stakeholders defining their needs and the land grant university responding, with the result being new collaborations and new energy to address climate change, one of the great challenges facing agriculture and society. This effort has enhanced our ongoing TCAP project on **Nitrogen use efficiency** by introducing a crop-modeling component into the research. We hope to use information from the **genotyping** effort in concert with crop models to model individual genotype needs in terms of optimal Nitrogen rates and timing.





**Triticeae CAP**  
Coordinated Agricultural Project

# Education News

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Arron Carter on TCAP/MSI Interactions

## TCAP Annual Meeting Presentations

During the annual TCAP meeting at PAG, successful aspects of the education component were featured, a graduate student, Sarah Grogan (Colorado State University) and Arron Carter (Washington State University) discussed their mentoring and interaction with MSI students. The collaborations with the MSIs was considered a high point of the education effort and one of the MSI students is planning to attend graduate



Sarah Grogan presents Mentoring



Jeff Endelman—online success

school in plant breeding. Jeff Endelman (USDA-ARS) ended the education session with a presentation that described the highly successful **association mapping** course that he, Jean-Luc Jannink (USDA-ARS), Mark Sorrells (Cornel) and Clay Sneller (Ohio State University) conducted.

## Workshop for Analysis of Augmented Design.

Many research projects in the TCAP are implementing an Augmented Experimental Design, allowing more experimental lines to be evaluated while requiring fewer plots. This spring we will support implementation and analysis of augmented design with several lectures. On March 27th Araby Belcher, Celetste Falcon and Alfonso Cuesta-Marcos, will present Type

### Type 2 Modified Augmented Design:

Rows, Columns, Whole Plots, Subplots Primary Check

The field is divided into rows and columns, which form a grid of whole plots (i.e., incomplete blocks). The experimental units (plots) within each whole plot are referred to as subplots. At the center of each whole plot, there is a subplot of the primary check cultivar.

		Column					
		1	2	3	4	5	6
Row	1	WholePlot (wp1)	wp2	wp3	wp4	wp5	wp6
	2	wp7	wp8	wp9	wp10	wp11	wp12
	3	wp13	wp14	wp15	wp16	wp17	wp18
	4	wp19	wp20	wp21	wp22	wp23	wp24

= Primary Check (Check1)

2 Modified Augmented Design at 3:30 pm central at <https://connect.unl.edu/pbtn/>. Prior to that students are encouraged to view Introduction to Augmented Design on PBG works <http://www.youtube.com/playlist?list=PLC4CC69C1DED5D7CE> created by SolCAP. Other presentations supporting augmented design will follow later in the spring.

## TCAP Undergraduate Research Internships

More than sixty undergraduate students at nearly thirty universities, including eight minority serving institutions, are receiving training in plant science research under the TCAP. Online meetings provide a way for these students to connect with each other and with TCAP faculty researchers. These are informal meetings during which students talk about their projects, share research tips, and build connections with a broader community of scientists. Students also learn about internship opportunities in industry and how to prepare for graduate school. Dates and times of online meetings vary depending on the availability of students who lead the discussion. See below for several scheduled meetings. The meetings are held in the online meeting space of the TCAP Undergraduate Community of the Plant Breeder Training Network (<http://passel.unl.edu/communities/tcapundergrads>). Additional meetings will be posted on the site as dates are identified.

### **Wed. Feb 20, 2:00 CENTRAL – Avarie Skinner (Washington State University).**

Avarie is working in Arron Carter's lab. She'll tell us about her work measuring gluten content and other quality characteristics of western-grown wheat varieties and populations.

### **Fri. March 8, 11:00 CENTRAL – Alexander Chin (Cornell University).**

Alexander is working with grad student Lynn Veenstra in Mark Sorrell's lab. He'll be talking about his experiences looking for **genes** involved in male sterility in wheat.

### **Wed. March 13, 2:30 CENTRAL – Margaret Krause (University of Minnesota).**

Margaret is working with grad student Austin Case in Brian Steffenson's lab. She's studying low temperature tolerance in the Wild Barley Diversity Collection.

### **Date TBD – Paige Walker and Delois Moss (University of Arkansas, Pine Bluff).**

Paige worked with Martin Matute and will be discussing the effects of sampling time on populations of parasitic nematodes associated with wheat in Colton, WA. Delois also worked with Martin Matute and will be talking about beneficial bacterivorous nematodes in wheat in Colton, WA.

### **Date TBD – Michael Van De Weghe (University of Minnesota).**

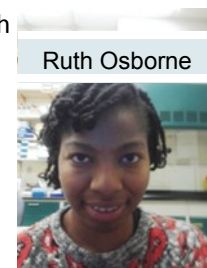
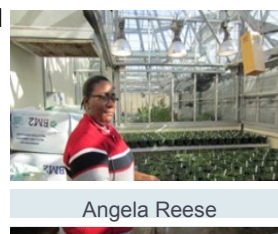
Michael worked with grad student Liana Nice in Gary Muehlbauer's lab. He'll tell us how he used histology to investigate meristematic tissue in unicum barley.

## T-CAP at Chicago State University (CSU) – Dr. Chris Botanga

Chicago State University is in the second year of partnership with the USDA-NIFA Triticeae Coordinated Agricultural Project. This partnership, as with other MSIs involved in this project, is aimed at conducting research that is tailored to student mentoring/training. CSU participation, in a way, has been unique in that the collaboration involves two independent projects with two different institutions, the University of Minnesota (Dr. Jim Anderson) and Montana State University (Dr. Jamie Sherman). In the collaboration with Dr. Anderson, we are evaluating the cause of tall mutants that arise naturally in the semi-dwarf spring wheat cultivar "Rollag" using PCR- and cytogenetic-based approaches. Our working hypothesis is that the tall off-types are aneuploids (See Crop Sci 33:1131-1135), i.e., lacking chromosomes 4B or 4D and thus the **gene** for reduced height (Rht) that confers gibberellin insensitivity. Two CSU undergraduate students, (Angela Reese and Devona Gamble) have used SSR **markers** from both chromosomes 4D and 4B to assess the ploidy level of the tall off-type genotypes. While the SSR **markers** evaluated thus far do not discriminate the copy numbers of the different genotypes in the population based on the phenotypes as hypothesized, we are

hoping that qRT-PCR and cytogenetics (chromosome count through chromosome squashes) will offer a good level of discrimination, and for qRT-PCR in particular, even when there are only minor variations in **gene** copy number. In the second collaboration with Dr. Sherman, we are using both molecular and histological approaches to characterize hollow- and solid-stemmed genotypes of wheat, using near isogenic lines (NILs) for these phenotypes. A graduate (M.S.) student, Ruth Osborne has been working on this project. Working with Dr. Andrew Maselli and Shannon Smith of the CSU Electron Microscope Facility, Ruth has gathered some preliminary data, and presented a talk, titled *Histological characterization of hollow- and solid-stemmed genotypes of wheat (Triticum aestivum)*, to the 2013 Spring Symposium & Student Research Conference taking place in Chicago, for which she was awarded 3rd place.

Congratulations Ruth!



# Sprouting up: T-CAP students grow in professional development session at PAG

By: Rebecca Nitcher, PhD Candidate Dubcovsky Lab, UC Davis

As the T-CAP program enters its third year, members met for the annual meeting at the Plant and Animal Genome Conference in San Diego in January. Educating future plant breeders is one of the primary objectives of the project. The education team continued its excellent standard of training students in the second annual professional development workshop for T-CAP students on January 11th. I was pleased to participate in this year's workshop along with twenty-five other graduate students and one undergraduate from twelve universities. Jamie Sherman led the workshop, which was well received by the student group, using material prepared by Mary Kay Patton and Kim Kidwell from Washington State University.

Most of the T-CAP student training is done online, making these in person sessions useful for building relationships between students from across the country. The session opened with a creative activity, where students anonymously shared career dreams, and the obstacles we see to achieving them. It is easy to forget as a graduate student that fellow students in the room have the same fears you do. Vocalizing solutions to the problems we foresee in our careers helped us to realize that we do have the power to make our dreams a reality. With the ice broken, we found it easy to engage in the workshop that followed.

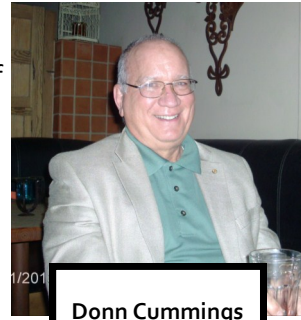
Entitled Life Skill Enhancement: The Gateway to Becoming an Extraordinary Plant Breeder, the workshop encouraged us to examine the ways we each deal with conflict with varying degrees of assertiveness and cooperation. Conflict can be incredibly distracting and disruptive in the work-

place, and the melting pot of cultures and backgrounds in the industry of plant breeding and agriculture can be a catalyst for misunderstandings and struggles. Typical responses to conflict can range from competing to collaborating and from avoiding to accommodating, as described by the Thomas-Kilmann Conflict Mode Instrument (TKI). While each reaction might be appropriate depending on the situation, we learned the importance of removing the personal aspect from conflict. Setting rules from the Interest Based Relational (IBR) Approach to handling conflict can aid us in dealing with problems in a productive manner. The IBR method

centers on maintaining relationships, and appreciating the interests each party represents. Awareness of and empathy with alternative perspectives makes it easier to practice active listening, stating the facts of the problem at hand, and exploring options together to select a solution.

Having reviewed these important conflict resolution skills, we broke out into small groups to address real case scenarios submitted by several company reps and stakeholders. From redirecting breeding program goals in company mergers, to convincing colleagues to move a variety forward, to handling employee scheduling and productivity issues, the T-CAP students identified the issues at hand and proposed solutions to each scenario. The expert panelists then discussed what steps were really taken in an industry setting for each situation. Our students did a great job of handling each problem in a realistic way, speaking to the quality of our training. We appreciated the time and input of the panelists: Tabare Abadie (Pioneer), Fred Bliss (UCD/Seminis), Donn Cummings (Monsanto), Marla Hall (Limagrain) and Edward Souza (Bayer).

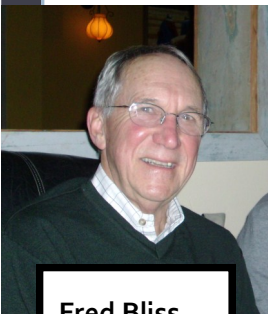
In addition to networking with company representatives and interacting with colleagues in person, most students who participated in the workshop reported an increased awareness of the impact of human relations on scientific contributions, and an expanded knowledge of tools and strategies to improve these interactions. More than 94% showed a higher interest in modifying their behavior to improve interpersonal interactions in the workplace after attending. I would highly encourage those students who were unable to attend this session to participate next year.



Donn Cummings



Tabare Abadie



Fred Bliss



Ed Souza



Marla Hall





## **Invitation to Participate in a Free Introductory Pilot of Washington State University's New On-line *Tidal* Leadership Certificate Program**

***"Tidal Leadership: Potential Revealed"*** is a transformational leadership certificate program created by life-skill enhancement facilitators in the College of Agricultural, Human and Natural Resources Sciences (CAHNRS) at Washington State University. This online, self-paced, non-credit leadership certificate program consists of 8 asynchronous, on-line modules and 3 synchronous, virtual meetings. Participants will engage with a variety of readings, interactive on-line activities, integration challenges and debriefing strategies to improve their interpersonal communication skills. This program is part of a new initiative in the Center for Transformational Leadership and Learning in CAHNRS to provide professional development opportunities for students, staff, faculty, alumni and industry partners in an on-line venue.

**What is "Tidal" Leadership?** Title-driven leadership implies that someone has been granted permission to lead based on the title of the position that they hold. The amount of influence associated with one's title should reflect leadership ability; however, in reality the magnitude of a title often does not accurately reflect the ability of that person to be a positive influencer. We invite you to view leadership from a different perspective: ***"Tidal"*** leadership is a form of leadership that ebbs and flows in a synergistic, powerful way that positively influences the surrounding "environment". By developing tidal leadership skills, you will become a powerful, reliable, highly influential energy source that manifests a value-based vision of excellence by expanding your ability to communicate and engage effectively with others.

**What is the purpose of this program?** The intentions of the certificate program are to: 1) create awareness of conscious communication; 2) empower people to explore and practice effective communication strategies in personal and professional settings, and; 3) explore strategies for transforming one's ability to navigate difficult situations from a value-based perspective.

**How can I determine if this certificate program will be of value to me?** A free introductory pilot opportunity has been created to generate interest in this program. The first 3 module are being offered at no charge (a \$750 value).

Invitation to Participate in a **FREE** Introductory Pilot of Washington State  
University's  
New On-line *Tidal* Leadership Certificate Program Continued.

**Pilot participants must agree to fulfill two requirements:**

**Complete all three of the introductory modules:**

**“Tidal” vs. Title-Based Leadership** – Explore current perspectives of leadership, and create a value-based platform upon which a personal vision of excellence in leadership will be built.

**Catching the Wave** - Explore ACT (*Acceptance and Commitment Training*), the foundational theory upon which the certificate program was developed. (Reference: Harris, R. 2008. *The Happiness Trap*. Shambhala Publications, Inc.)

**Impact Zone** – Explore responses to challenging situations, and the effect of making conscious choices to proactively address these situations.

**2. Complete the assessment form for each module.**

**What is the timeline for the pilot?**

This is a 6 week, self-paced commitment with the on-line course space opening on **March 18, 2013**. The pilot will be completed by the end of April.

Activity	Date On-Line Course Space Opens	Date Module Activities Must Be Completed
Module 1	March 18, 2013	March 31, 2013
Module 2	April 1, 2013	April 14, 2013
Module 3	April 15, 2013	April 30, 2013
Assessment*	May 1, 2013	May 15, 2013

**Timeframes:**

\*You will complete a confidential assessment form to provide feedback on your experience that will be used to improve the certificate program.

**What happens after the pilot is completed?**

Practice what you learned to improve your relationships with people and expand your influence. Pilot participants who wish to continue on to complete the certificate program will be able to do so at the discounted price of \$950 (the full certificate program will be offered at \$1950).

**How do I register for the pilot?**

The registration link is: <http://cm.wsu.edu/tidal>

Registration for the **free** introductory pilot program must be completed by **March 1, 2013**.

Enrollment is limited to 50 participants. People will be registered for the pilot in the order that requests are received.

You will receive your enrollment confirmation for the pilot program by **March 8<sup>th</sup>**.



Free webinars  
Wednesdays  
at 3 pm CST



## SPRING 2013 WEBINAR SERIES AHEAD OF THE CURVE: Technologies for next-gen plant breeding

March 6 <sup>th</sup>	<b>Dr. Gina Brown-Guedira</b> North Carolina State University	KASP workshop
March 20 <sup>th</sup>	<b>Dr. Kevin Murphy</b> Washington State University	Breeding quinoa for North America
April 3 <sup>rd</sup>	<b>Dr. Paul Gepts</b> UC Davis	<i>In situ farmer management of genetic diversity as a complement to ex situ conservation</i>
April 17 <sup>th</sup>	<b>REACCH student group</b> c/o Dr. Arron Carter, WSU	Regional Approaches to Climate CHange
May 1 <sup>st</sup>	<b>Dr. Jianming Yu</b> Iowa State University	Topic T.B.A.
May 15 <sup>th</sup>	<b>Dr. Jesse Poland</b> Kansas State University	Topic T.B.A.

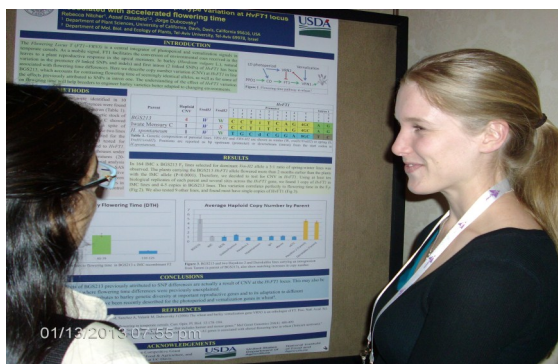
Sign up for email reminders and to pre-register at:  
<http://passel.unl.edu/communities/pbtn>

## Spring Course—Entering Mentoring

Entering Mentoring is a six week module that will be offered in March and April 2013. The **Entering Mentoring Seminar** will accelerate the process of learning to be a mentor by providing an intellectual framework, an opportunity to experiment with different mentoring techniques, a forum to discuss mentoring dilemmas, and second-hand exposure to more students and situations through group sharing. Attendees must be actively involved in mentoring to participate. Required Group discussions of reading materials and experiences will be held on Mondays from 1- 2pm central online beginning March 18<sup>th</sup> and concluding April 22<sup>nd</sup>. Interested parties should become a member of PBTN

<http://passel.unl.edu/communities/pbtn> and enroll in Entering Mentoring by March 8th at <http://passel.unl.edu/communities/pbtn?idsubcollectionmodule=1130274184&idindependentpage=190>

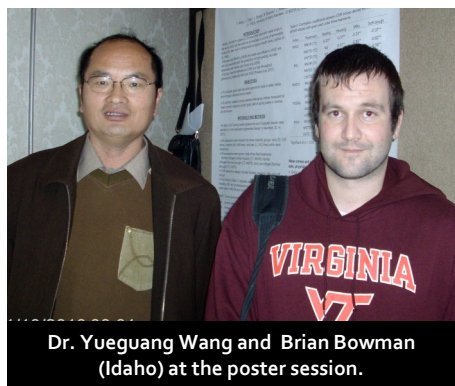
# Poster Session



Rebecca Nitcher (UC Davis) shares her poster.

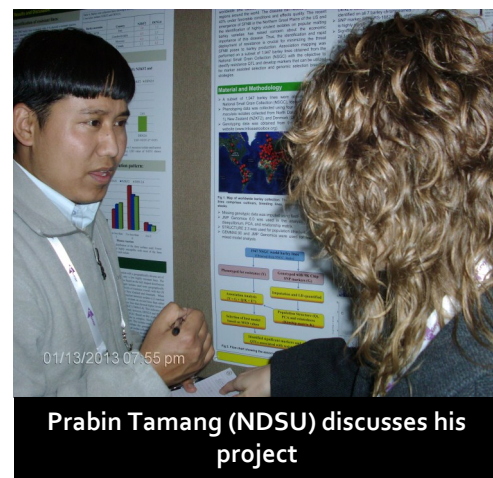


Araby Belcher (Oregon State), Lynne Veenstra (Cornell) and Sarah Grogan (CSU)

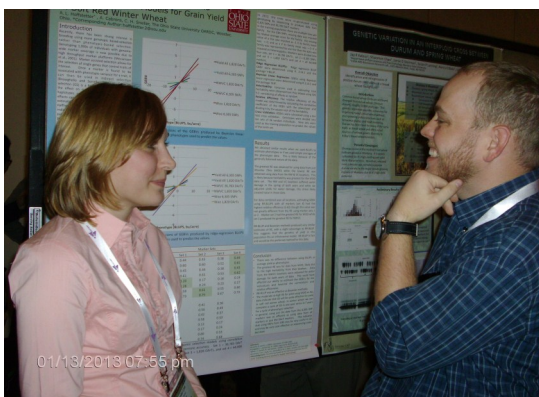


Dr. Yueguang Wang and Brian Bowman (Idaho) at the poster session.

The TCAP meeting at PAG ended with a celebration of graduate student research. 30 of the TCAP graduate students shared posters describing their research efforts. TCAP PIs, students and stakeholders mingled and discussed the work. Industry representatives enjoyed meeting potential future employees.



Prabin Tamang (NDSU) discusses his project



Amber Hoffstetter (Ohio State) and Jay Kalous (Montana State) talk at the poster session.



Ana Gonzales (University of Minnesota) discusses her poster.

## The Jeanie Borlaug Laube Women in Triticum (WIT) Early Career Award

provides professional development opportunities for women working in wheat during the early stages of their careers. Established in 2010 by the Borlaug Global Rust Initiative (BGRI), the award is named after Jeanie Borlaug Laube, mentor to many, and daughter of Nobel Laureate Dr. Norman E. Borlaug. For more information and to apply please visit our website at [www.globalrust.org](http://www.globalrust.org)

**The Jeanie Borlaug Laube Women in Triticum Mentor Award**, established by the BGRI in 2010 and first awarded in 2011, recognizes men and women who have proven to be excellent mentors of women working in Triticum and its nearest relatives. For more information and to nominate a deserving scientist please go to [www.globalrust.org](http://www.globalrust.org)

Students!  
Take note there will be student support for attendance at Borlaug Global Rust Initiative March 2014 at Cimmyt



## Save the date!

### Dr. Norman Borlaug's 100th Birthday Celebration and Wheat Summit and BGRI 2014 Annual Meeting

March 2014

Watch [www.globalrust.org](http://www.globalrust.org) for more information

## TCAP Participating Programs (see <http://www.triticeaecap.org> for more information)

### Universities

Soil and Crop Sciences, **Colorado State University**  
 Plant Breeding, **Cornell University**  
 Plant Pathology or Agronomy, **Kansas State University**  
 Plant Sciences and Plant Pathology, **Montana State University**  
 Department of Crop Science, **North Carolina State University**  
 Plant Pathology, Plant Sciences, **North Dakota State University**  
 Environmental Natural Resources, or Horticulture & Crop Sciences, **Ohio State University**  
 Plant and Soil Sciences, **Oklahoma State University**  
 Crop and Soil Science, **Oregon State University**  
 Plant Sciences, **South Dakota State University**  
 Soil and Crop Science, **Texas A&M University**  
 Plant Sciences, **University of California, Davis**  
 Botany and Plant Sciences, **University of California, Riverside**  
 Aberdeen Research & Extension Center, **University of Idaho**  
 Plant and Soil Sciences, **University of Kentucky**  
 Plant Sciences and Landscape Arch., **University of Maryland**  
 Agronomy & Genetics, Plant Pathology, **University of Minnesota**  
 Division of Plant Sciences, **University of Missouri**  
 Agronomy and Horticulture, **University of Nebraska Lincoln**  
 Plant, Soils and Climate, **Utah State University**  
 Crop and Soil Environmental Sciences, **Virginia Tech**  
 Crop and Soil Science, **Washington State University**

### USDA-ARS

GMPRC, Manhattan, KS  
 WRRRC, Albany, CA  
 Aberdeen, ID  
 Raleigh, NC  
 BRL Fargo, ND  
 NCSL, Fargo, ND  
 Ithaca, NY  
 St. Paul, MN  
 Pullman, WA

### Collaborating Institutions with Student Projects

Chicago State University  
 Tuskegee  
 West Texas A&M  
 University of Arkansas, Pine Bluff  
 Lehman College  
 Rust College  
 Fayetteville State University



## TCAP Terminology

- **Association mapping** is a technique used to identify marker-trait associations in lines that are not derived from a single cross.
- **Bacterial Artificial Chromosomes (BAC)** are pieces of DNA that can be used as vectors for a variety of purposes. For example, genomic DNA from barley is cut into smaller pieces and inserted into BACs, creating a complete library of the Barley DNA. BACs can be amplified creating a source for DNA sequencing. Since BAC libraries are created with random pieces of the Barley DNA, there will be overlap between BACs, thus providing a complete sequence that has a physical relationship and can be anchored.
- **Canopy Spectral Reflectance (CSR)** is a new phenotyping tool TCAP is exploring. It is based on the observation that plants under stress reflect different colors of light. Measuring the light reflected might be a way to predict plant performance.
- **Canopy Temperature Depression (CTD)** plants need CO<sub>2</sub> for photosynthesis and acquire it through window-like structures in leaves simultaneously releasing O<sub>2</sub> and H<sub>2</sub>O. When a plant is water stressed, the windows in the leaves through which this gas exchange occurs must close, reducing photosynthesis and thereby reducing yield. When the windows are open not only can photosynthesis occur, but also as H<sub>2</sub>O is released the temperature around the plant decreases due to evaporation. CTD can act as a proxy for measuring the plants ability to continue to photosynthesize under drought stress.
- **Copy Number Variation (CNV)** are differences in DNA between individuals that occurs when a large number of building blocks called nucleotides are either duplicated or deleted. CNVs generally range in size from thousands of base pairs to millions of base pairs. In contrast, SNPs are another DNA difference that only involves single base changes. The number of CNVs reported here in Barley of 15% is in a similar range as what has been reported in humans.
- **Deoxyribonucleic acid (DNA)** is the genetic material for most organisms. An organism's complete set of DNA is called its **genome**.
- A **gene** is the instructions for a specific structure in the organism. For an organism to survive certain instructions (genes) are required. However, the details or order of the instructions may vary from organism to organism and it is these differences that we are looking for to improve wheat and barley.
- **Genomics** is the study of the **genome**. The genome is a complete set of instructions for the organism. You can think about it like an instruction manual for that organism.
- **Genomic selection** is when markers spread throughout the genome are used to predict the performance of individuals to facilitate breeding.
- **Genotyping** is when the genetic makeup of an organism is characterized. The genotype controls the way an organism looks, which is called the **phenotype**. In our instruction manual analogy, determining the genotype would be like reading the instruction manual, while determining the **phenotype** is like testing the product created after following the instructions.
- **Germplasm** is a collection of genetic resources, which in wheat and barley is usually a collection of seed.
- **KASP™ Markers** are a cost efficient method of SNP genotyping developed by KBioscience. KASP stands for Kompetitive Allele Specific PCR. Advantages of KASP over other systems: may be less expense, greater flexibility, and higher conversion rate
- A **marker** is a difference in the DNA that acts like a bookmark indicating the position of a certain set of instructions. It can be a difference in the instructions (**gene**) itself but it can also be a difference in a neighboring part of the DNA.
- Making **Marker/trait associations** is identifying good bookmarks for the instructions that are important. Once marker/trait associations are made, markers can be used to make selections.
- **Marker Assisted Selection** is a technique that uses DNA markers to identify individuals carrying certain genes to facilitate breeding.
- **National Small Grain Core Collection**, NSGC collection is an important germplasm resource for the TCAP. TCAP participants will be evaluating and distributing an extensive collection of seeds representing material from around the world. TCAP is searching this material for unique **genes** that will be used to improve wheat and barley.
- **Nested Association Mapping** is a hybrid technique that uses attributes of both bi-parental mapping and association mapping.
- **Nitrogen use efficiency (NUE)**, Nitrogen is required by plants for growth and enters plants from soil through roots. Farmers replenish nitrogen using fertilizers and have found maximizing nitrogen can increase yields; however, nitrogen can be costly not only for farmers but also to the environment. An important goal of the TCAP is to improve the NUE of wheat and barley, both saving money and the environment.
- **Nucleotides** are the building blocks of DNA and can be thought of as the letters making up the instruction book. The instruction book for wheat is composed of 16 billion letters or nucleotides (= **16GB**). It is the order of the building blocks that store the genetic information.
- **Principle Coordinate Analysis (PCoA)** is a method to explore and visualize dissimilarities in data. For example, on page 3 each accession is plotted by how different the genotyping data is from every other accession, creating scatter plots with more similar accessions closer together. The scatter plots are two dimensional, while the data can have multiple dimensions. To better view the information the plots can be rotated to obtain multidimensional views.
- **Quantitative Trait** is a trait that can be measured and is controlled by many different locations in the genome. The different locations controlling a specific quantitative trait are called **QTL (Quantitative Trait Loci)**. In our analogy of the instruction manual, several different instructions (QTLs) together control a trait. Most traits important to stakeholders are quantitative (e.g. yield and quality).
- **QTL Mapping** is a technique used to make marker/trait associations using a **bi-parental mapping** population from a cross between two lines that are different for a trait of interest.
- **Sequencing** is reading the order of the **nucleotides**. Some of the new technology we are exploring are methods that look for differences by determining the sequence, for example **gene capture** and **genotyping by sequencing**.
- **Single nucleotide polymorphism (SNPs)** is the difference in one building block (nucleotide) in the DNA sequence. In our analogy it is like changing "TAG" to "GAG" in our instruction manual. An advantage of **SNPs** is more potential differences and so more markers at a higher resolution, making it easier to make marker/trait associations.
- **Water Use Efficiency (WUE)**, Water is the limiting resource in much of the world today and is likely to continue to be in the future due to climate change and loss of arable land. An important goal of the TCAP is to improve WUE of wheat and barley, providing resistance to drought and new varieties for low moisture areas.