



Gary's Update



The barley CAP has been busy over the past couple of months. The Hordeum Toolbox (THT) is live on the web and phenotype and genotype data can be downloaded. THT can be accessed at

<http://thehordeumtoolbox.org> or at the barley CAP website at <http://barleycap.org>. The barley CAP also hosted two organizational meetings. One meeting was focused on assessing the status of THT and determining future needs (page 4). The other meeting focused on developing a nation-wide strategy for marker-assisted selection (page 5). The barley CAP also hosted a workshop on marker-assisted selection, association genetics and genomic selection. Thirty-seven participants attended the workshop and by all accounts the workshop was a success. See page 2 of this newsletter for a more detailed description of the workshop. The barley CAP annual meeting will be on January 7, 2010 at the Hacienda Hotel in San Diego, CA. On this page is a tentative agenda for the meeting and hotel information. The barley CAP will host a data analysis meeting at the Hacienda Hotel in San Diego, CA on January 8, 2010. This meeting is designed to help barley CAP participants with analysis issues and problems. See page 5 for details of the analysis meeting.

Make your reservations for the La Hacienda Hotel by December 6 to get the special price of \$139. Call the hotel directly at (619) 298-4707. They are holding 40 rooms for our group. The annual meeting is scheduled for January 7 with a workshop on data analysis on January 8, 2010.

Barley CAP Annual Meeting

January 7, 2010

La Hacienda Hotel, San Diego, CA

Tentative Agenda

8:00-8:30 am	Continental breakfast
8:30-8:50 am	CAP overview, renewal proposal <i>Gary Muehlbauer, U Minnesota</i>
8:50-9:30 am	Extension and education <i>Peggy Lemaux, U California, Berkeley</i> <i>Brian Steffenson and Sue White, U Minnesota</i>
9:30-9:50 am	Data collection and curation <i>Jennifer Kling, Oregon State U</i>
9:50-10:10 am	THT <i>David Matthews, GrainGenes</i>
10:10-10:30 am	Break
10:30-10:50 am	SNP mapping, SNP-BAC deconvolution, AFRI proposal <i>Timothy Close, U California, Riverside</i>
10:50-11:10 am	UMN breeding and AFRI proposal <i>Kevin Smith, U Minnesota</i>
11:10-11:30 am	OSU breeding and AFRI proposal <i>Patrick Hayes, Oregon State U</i>
11:30-11:50 pm	TBA <i>Shuyu Liu, Virginia Tech</i>
11:50-1:20 pm	Lunch on your own
1:20-1:40 pm	Identifying dormancy QTL <i>Paul Werner, Graduate student, NDSU</i>
1:40-2:00 pm	Association mapping stem rust Ug99 resistance <i>Hao Zhou, Graduate Student, U Minnesota</i>
2:00-2:20 pm	TBA <i>Aaron Lorenz, USDA-ARS, Ithaca, NY</i>
2:20-2:30 pm	Nation-wide MAS strategy (SNP platforms) <i>Gary Muehlbauer</i>
2:30-2:45 pm	Six-row malting barley SNP platform <i>Kevin Smith, Rich Horsley</i>
2:45-3:00 pm	Western two-row SNP platform <i>Tom Blake</i>
3:00-3:15 pm	Winter barley SNP platform <i>Pat Hayes, Marla Hall</i>
3:15-3:35 pm	Break
3:35-3:50 pm	Genomic selection platform <i>Pat Hayes, Kevin Smith</i>
3:50-4:30	Group discussion of CAP II renewal proposal
4:30-5:00 pm	Summary from advisory boards

Barley CAP Association Genetics, Marker-Assisted Selection Workshop 2009

by Kevin Smith

Barley CAP held a 3-day workshop on Association Genetics and Marker-Assisted Selection, August 19-21, 2009, at the University of Minnesota, St. Paul. Thirty-seven people participated in the workshop including faculty, USDA scientists, industry scientists, graduate students, technicians, and post docs.

The instructors who led the intense 3-day workshop demonstrating the latest technology in Association Mapping and Marker-Assisted Selection included Kevin Smith (U Minnesota), Jean-Luc Jannink (USDA-ARS, Cornell), Shaioman Chao (USDA-ARS, North Dakota) and Rex Bernardo (U Minnesota), Peter Bradbury (Cornell University), David Marshall (Scottish Crop Research Institute).

Over half the participants were affiliated with the Barley CAP. Some participants from the Wheat and Rice CAPs also attended. The participants had a wide range of experience with the topics covered in the workshop. Some were relatively unfamiliar with mapping/MAS. Others had extensive experience and background in some areas. The mixture made for great interaction with lots of opportunity to draw on their experiences.

Barley CAP awarded five scholarships for graduate students to attend the workshop.

Participants were all asked to bring a lap top computer and were given guest access to the University of Minnesota server to enable them to participate fully with hands-on work using each program. This years version of the workshop emphasized using the software TASSEL for association mapping. Peter Bradbury joined the group of instructors and helped guide participants through a hands-on association mapping session. In addition, Dave Marshall from SCRI demonstrated two new Java applications, FlapJack and CurlyWhirly, which were designed to visualize genotype and phenotype data. Response from the participants was positive. Many seem to appreciate the expanded time available for hands-on data analysis during the workshop.

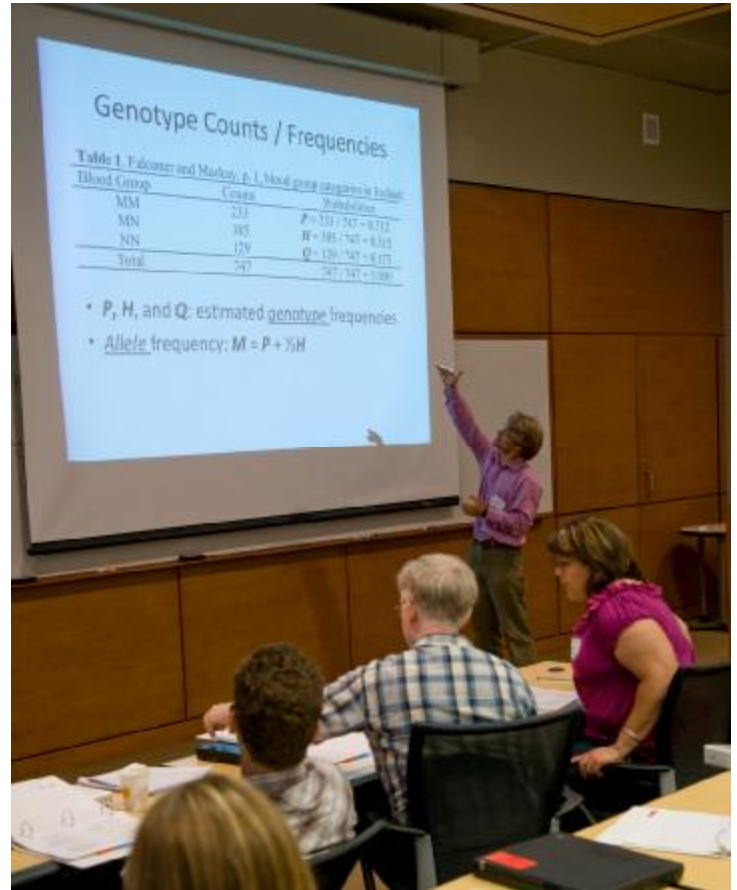
A report on the 2008 workshop can be viewed in the barley CAP update for June 2008 at www.barleycap.org (click on News, then June 2008). Sue White is working on an assessment of the outcomes from the workshop for 2008 and 2009. The instructors are discussing ways to continue this workshop beyond the Barley CAP funding period.



Workshop participants focus intently on Kevin Smith's presentation at the barley cap MAS workshop.



Kevin Smith answers a question from one of the workshop participants.



Jean-Luc Jannink presented information on genotype counts and frequencies.



Participants at the Barley CAP Association Genetics, Marker-Assisted Selection.

Report on THT meeting

The barley CAP held a meeting in St. Paul, MN, on August 18, 2009, to discuss the progress and the next steps in the development of The Hordeum Toolbox (THT) database. Sixteen participants attended the all day meeting.

Julie Dickerson (Iowa State University) is the barley CAP co-PI that has been developing THT. Julie joined the group on the phone and gave a nice overview of the capabilities and the data currently housed in THT. Overall, the group was impressed by the progress on the development of THT.

THT houses genetic maps, pedigree information, and phenotype and genotype data from the barley CAP. It is straightforward to obtain genotype and phenotype data. In addition, the SNP markers are linked to PLEXdb and the rice genome sequence. THT is live on the web and can be accessed at www.hordeumtoolbox.org/ or can be accessed through the barley CAP website (<http://www.barleycap.org>).

Jennifer Kling (Oregon State University) provided an overview of the pedigree and phenotype data curation process and the current status of these activities. Currently, she is almost finished curating all submitted phenotype data.

Jean-Luc Jannink (USDA-ARS, Ithaca, NY) and Kevin Smith (University of Minnesota) led discussions on the linkages and new functions that

should be developed with THT. These proposed linkages included TASSEL, HAPLOVIEW, FLAPJACK, CURLY-WHIRLY, and STRUDEL.

From this meeting a list of action items to improve THT was prepared. For long-term sustainability of THT, the database will be moved to GrainGenes. Currently, THT is being transitioned to GrainGenes with the expected completion by the end of November.

Barley CAP Student is Finalist in Paper Competition

Sindu Nair, Washington State University, was one of the six finalists in the "Best student research paper competition" at the American Association of Cereal Chemists International (AACCI) annual meeting held in Baltimore, MD in September 2009. The title of Sindu's oral presentation was "'Structural differences in diverse barley lines for SKCS hardness index'".

The links for this competition are as follows: www.aaccnet.org/divisions/student/caryopsis/May2009.asp#3

www.aaccnet.org/membership/srpaper.asp

The competition highlights the best research conducted and presented by students, while offering students an opportunity to interact with the AACC International community.

Patrick Hayes Full Barley Crew at Oregon State University



Patrick Hayes reports that, "Everyone pictured has at one point been part of our project and has contributed in some way to the CAP."

Barley Breeder Meeting Report

by Gary Muehlbauer

The barley CAP held a meeting in St. Paul, MN on September 21, 2009, with the overall objective to develop a nation-wide strategy for marker-assisted selection (MAS) in barley that leverages the efforts of the barley CAP. Seven barley breeders (Pat Hayes, Kevin Smith, Tom Blake, Blake Cooper, David Hole, Marla Hall, and Rich Horsley), Shioaman Chao, and Gary Muehlbauer participated in the meeting. The meeting started with Muehlbauer summarizing the current progress of the barley CAP. In particular, data acquisition and the status of The Hordeum Toolbox (THT) were described. Currently, genotype and phenotype data from the 2006 and 2007 breeding lines are in THT. Genotype data for the 2008 lines has been obtained, curated and ready for upload to THT.

Muehlbauer also summarized the recent USDA-CSREES-AFRI funded grants that were leveraged from barley CAP efforts. Tim Close (University of California, Riverside) obtained funding to use a combination of strategies to sequence 95% of the genes and over 2,000 BAC clones. Pat Hayes described his AFRI grant, which includes continuing his breeding and genetics work on winterhardiness. Kevin Smith described his AFRI-funded proposal that is focused on testing the power of genomic selection. Smith also described a pilot study he is planning to conduct, in collaboration with Rich Horsley and Blake Cooper, on genomic selection for *Fusarium* head blight resistance.

Each of the breeders in attendance then summarized their breeding program with the main focus being the breeding approach used, traits of interest, and how marker-assisted selection (MAS) was being and could be employed in the future.

The second part of the meeting focused on genotyping and Shioaman Chao provided an update of the current marker expertise and capacity of the USDA-ARS (Fargo, ND) genotyping laboratory. The genotyping laboratory has expertise with SSR, FP and SNP markers and has primarily used SSR markers for MAS. Chao provided a summary of the costs associated with each of the marker technologies. Chao also presented the case for purchasing the Illumina Bead Express platform for genotyping for breeding programs. This platform has several advantages in that it would use the current primer design for the BOPA1 and BOPA2 SNPs, and it is flexible with regards to the number of SNPs that can be assayed. The consensus of the group was that the Illumina Bead Express was the preferred platform.

Kevin Smith led a discussion of the approaches to identify targets for MAS and to implement MAS. The group agreed that the barley CAP had done an excellent job collecting phenotype and genotype data but had been lacking in conducting association analysis to identify marker-trait associations. This is partly due to the lack of association analysis experience by many members of the barley CAP. The summer workshops have gone a long way in helping students, postdocs and PIs with the appropriate background to begin to conduct association analysis but further hands-on help is required. For example, Rich Horsley described how one of his graduate students used multiple different approaches to conduct association genetic analysis to detect QTL. Thus, conducting and sharing analysis was targeted as an important activity. The group decided that analysis meetings consisting of graduate students, postdocs and PIs accompanied by expert(s) would help solve this problem. Peter Bradbury and Jean-Luc Jannink have been contacted and have agreed to host an analysis meeting in San Diego, CA on January 8, 2010.

The overall MAS strategy is to develop SNP platforms for the six-rowed malting quality barley programs, the two-rowed western barleys, and the winter barley programs, and a SNP platform for genomic selection. To help facilitate the development of the SNP platforms and target traits appropriate for traditional MAS and genomic selection, breeders were assigned specific SNP platforms to develop. Kevin Smith and Rich Horsley were assigned the Midwestern six-row malting 48 SNP platform; Tom Blake was assigned the Western two-row platform; and Pat Hayes and Carl Griffey were assigned the Winter two- and six-row 48 SNP platform. Pat Hayes and Kevin Smith agreed to develop a 384 SNP platform for genomic selection within their programs. At the barley CAP annual meeting on January 7, 2010, each of these platforms will be described.

Data Analysis Meeting Scheduled

There will be a data analysis meeting on January 8 at the Hacienda Hotel in San Diego, CA. This is the day following the Barley CAP annual meeting. The purpose of the meeting is for barley CAP participants to conduct analysis of barley CAP datasets. Peter Bradbury (USDA-ARS, Ithaca, NY) and Jean-Luc Jannink (USDA-ARS, Ithaca, NY) will attend to answer questions and help with analysis approaches.

Barley CAP Germplasm Evaluated for Resistance to Africa Stem Rust in Kenya

by Brian Steffenson

The emergence of the highly virulent stem rust race TTKS (aka isolate Ug99) in East Africa has rendered barley vulnerable to attack. Race TTKS is virulent on over 80% of the world's barley varieties and is spreading rapidly. From its initial discovery in Uganda in 1999, race TTKS has spread to Kenya, Ethiopia, Sudan, Yemen, and Iran. It may only be a matter of time before it spreads to major barley producing areas in other parts of the Middle East, Asia, and beyond.

To assess whether there might be variation for reaction to race TTKS under field conditions, the 2008 and 2009 Barley CAP accessions (spring breeding programs only) were planted at the Kenya Agricultural Research Institute (KARI) in Njoro, Kenya. Stem rust infection was uniform and severe across the nursery allowing for the easy separation of resistant and susceptible lines. While more than 90% of the 2008 and 2009 entries were susceptible to stem rust (with severities ranging from 20-60% and susceptible infection types), a few exhibited high levels of resistance (severities of 1-5% with moderately resistant infection types). Most of the spring barley programs had a few lines with at least partial



Brian Steffenson and Kumarse Nazari (from ICARDA) evaluating Barley CAP lines for resistance to African stem rust.

resistance to stem rust. The Utah State and Washington State breeding programs showed the greatest level of diversity for stem rust reaction. Data collected at Njoro will be subjected to association mapping analyses to identify the chromosomal positions of the resistance loci. Since TTKS resistance was identified in several agronomically advanced breeding lines, it should be possible to develop a stem rust resistant malting barley cultivar for producers within a shorter time period. The Barley CAP project thanks Peter Njau of KARI and Sylvester Ndeda of Kenya Malting for supporting this research.



Variation for reaction to African stem rust in two lines from the Washington State barley breeding program.

Calendar

- Oct/Nov 2009** European Cooperative Programme for Plant Genetic Resources. The Barley Working Group will hold a workshop on pre-breeding for climate change in Alnarp, Sweden. Dates to be defined (www.ecpgr.cgiar.org/Workgroups/barley/barley.htm)
- Nov. 1-5, 2009** ASA-CSSA-SSSA Annual Meeting at the David L. Lawrence Convention Center, Pittsburgh, PA
- Nov 1-4, 2009** 6th Canadian Workshop on Fusarium Head Blight. **Location:** Ottawa, ON Canada. **Contact Email:** organizer@cwfhb.org. **Website:** www.cwfhb.org.
- Dec 1-2, 2009.** 2nd International Phytophthora capsici Conference. **Location:** Islamorada Fl (Florida Keys). **Contact Name:** Pam Roberts (pdr@ufl.edu)/Alex Csinos (csinos@uga.edu). **Contact Email:** pdr@ufl.edu. **Website:** conferences.dce.ufl.edu/pcap/reg.aspx.
- Dec 7-9, 2009.** 2009 National Fusarium Head Blight Forum. **Location:** Orlando, Florida, USA. **Contact Name:** Sue Canty, USWSI-NFO. **Contact Email:** scabusa@scabusa.org. **Website:** scabusa.org/forum09.html.
- January 7, 2010** Barley CAP annual meeting, La Hacienda Hotel, San Diego, CA. Make reservations at the hotel by December 6. Ask for Barley CAP: (619) 298-4707.
- January 8, 2010** Barley CAP Data Analysis meeting, La Hacienda Hotel, San Diego, CA.
- January 9-13, 2010** International Plant and Animal Genome Conference, San Diego, CA, (www.intl-pag.org)
- Feb 28-Mar 03, 2010.** Global Biosecurity 2010: safeguarding agriculture and the environment. Brisbane Convention and Exhibition Centre, Australia. www.globalbiosecurity2010.com.
- Jun 6-11, 2010.** 12th World Congress of the International Association for Plant Biotechnology. St. Louis, Missouri, USA. www.IAPB2010.org.
- June 15-20, 2010** Brewing Summit 2010, Rhode Island Convention Center, Providence, RI (<http://www.mbaa.com/meeting/Summit2010.htm>)
- July 6-10, 2010** 2nd Pan American Congress on Plants and Bioenergy, Sao Paulo, Brazil (www.aspb.org/meetings/PCPB2010.pdf)
- July 25-28, 2010** The 6th Canadian Barley Symposium, hosted by the University of Saskatchewan, Saskatoon, SK, Canada website is <http://www.canbar6.usask.ca/index.php>
- July 31-Aug 4, 2010** Joint Annual Meetings of the American Society of Plant Biologists and the Canadian Society of Plant Physiologists, Montreal, Canada (www.aspb.org/meetings/)
- August 7-11, 2010** American Phytopathological Society Meeting, Nashville, TN, meeting.apsnet.org/.

BarleyCAP

The Barley Coordinated Agricultural Project (CAP), funded by the Agriculture and Food Research Initiative (AFRI) of the USDA Cooperative State Research, Education and Extension Service (CSREES), involves government and public- and private-sector laboratories. The project links laboratory and field research with education and outreach. It uses modern tools of genomics to facilitate classical plant breeding efforts to develop superior barley varieties.

