



Gary's Update



The barley CAP has been making good progress on several fronts. The Hordeum Toolbox can be accessed from the barley CAP website (www.barleycap.org/). It houses pedigree, genetic and phenotypic data from the 2006 and 2007 breeding lines. I encourage each of you to work with the database and provide feedback so the developers can refine the database for optimal community benefit. Graduate students are starting to progress through the project. Carol Powers, a University of Minnesota Ph.D. student, graduated in June 2009 and took a position with Dow AgroSciences in Indianapolis, Indiana. Her thesis was focused on using barley CAP data to identify loci controlling malting quality traits (see page 3 for details). Another University of Minnesota student, Jon Massman, finished his M.S. degree and has begun his Ph.D. degree program with Rex Bernardo. Jon's thesis was focused on using barley CAP data to identify loci for resistance to Fusarium head blight (see page 3 for details). The association genetics/marker assisted selection workshop will be held in St. Paul, MN on August 19-21. See article on page 1 that describes the agenda for the workshop. I encourage each of you to attend and/or send your graduate students and postdocs.

Association Genetics, MAS Workshop

Barley CAP has scheduled a second workshop on Association Genetics, Marker-Assisted Selection for August 19-21, 2009, Cargill Building, University of Minnesota, St. Paul, MN. The workshop will be presented by Kevin Smith (U Minnesota), Rex Bernardo (U Minnesota), Jean-Luc Jannink (USDA-ARS, Ithaca, NY) and Shiaoan Chao (USDA-ARS, Fargo, ND).

Registration forms are on the front page of the barley CAP website at www.barleycap.org. Registration forms are due July 15, 2009. The workshop is free for Barley CAP participants, their students and postdocs; \$100 for non Barley CAP participants. A limited number of \$500 student stipends will be provided.

Rooms have been reserved at the Radisson University Hotel, 615 Washington Ave S.E., Minneapolis, MN 55414, Phone: 612-379-8888. Please reserve your room by July 15. Here are the steps to reserving online: Go to www.radisson.com/univ_minneapolis, Click on "More Search Options" in the Room Reservation Section, Enter Dates of Stay, Then under Promotional Code enter: **CAP**, Guests will then be linked to the block. Rate is \$139 plus tax

Tentative agenda:

Session I - QTL mapping

1. Traditional approaches
 - i. Populations
 - ii. QTL detection methodologies
2. Association mapping
 - i. Population structure
 - ii. Linkage disequilibrium
 - iii. Haplotype structure
 - iv. Markers, marker density, minor allele frequency
 - v. Hands on – QTL Miner Simulator, Haploview, THT/Germinate tools

Session II - Genome-Wide Association Mapping

1. Hands on – Tassel, QTL Miner
2. Interpreting QTL mapping results
3. Identifying targets for MAS

Session III - Designing MAS Strategies

1. Review phenotypic selection in barley breeding
2. Overview MAS strategy-BC, allele enrichment, single locus, multiple loci, whole genome selection
3. Marker Platforms: SSRs, Illumina Bead Station SNP, Florescent polarization SNP detection,
4. High-throughput SNPs to markers that can be implemented in a breeding program

Barley CAP Data Analyses by USDA-ARS in Ithaca at Cornell University

by Jean-Luc Jannink

Team members

Current: Jean-Luc Jannink, Peter Bradbury, Martha Hamblin, Tom Parker, Aaron Lorenz

Recent past: Hiroyoshi (Hiro) Iwata, Jerko (“J” pronounced like a “Y”) Gunjaca

Role within Barley CAP:

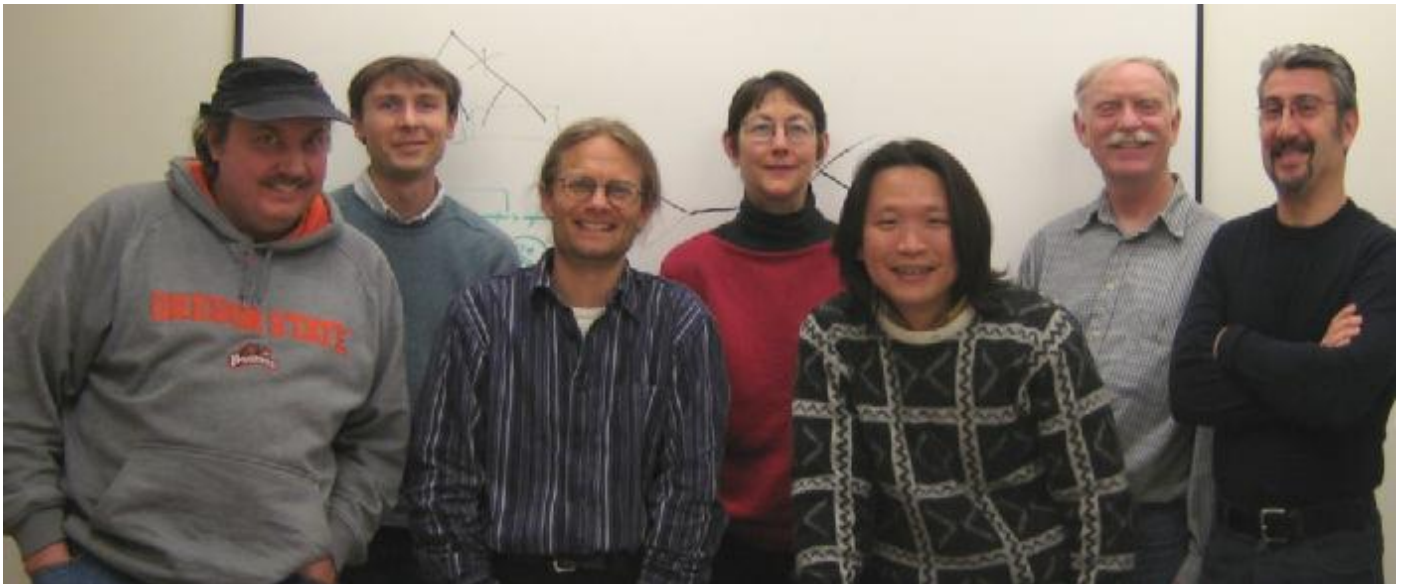
The role we play within barley CAP is to analyze the large amounts of marker and phenotypic data being generated. Because the nature and quantity of the data are new to public-sector plant breeding, we are also required to develop new methods to analyze the data and use it for crop improvement. Some of the questions we are exploring are:

1. Using current association analysis methods, what power does Barley CAP data give us to detect QTL for traits with a range of heritabilities and complexities?
2. How best can lines from different breeding programs be pooled to detect QTL?
3. What new methods of association analysis might increase QTL detection power?

4. Are there efficient methods to deal with missing marker data or with markers that were typed only in some data but not others?

5. How best can we use the Barley CAP resource of marker data and phenotypes to predict the performance of new barley lines and to improve our field evaluations of lines? That is, how can we translate Barley CAP research into accelerated gain from selection within our breeding programs?

Because much of our work relies only on genotypic data, we have been able to make progress on research analysis with results from Tim Close’s and Shiaoman Chao’s labs. We have published a paper on genomic selection in barley based on the Barley CAP Core genotypes. The take-home message is that we believe that the marker density we have available through the CAP will be sufficient to implement selection on SNP data alone, thereby increasing the speed of the barley breeding cycle dramatically. A review article, also inspired by our work on barley CAP data, discusses the theory behind genomic selection and emphasizes the need for further empirical work such as being done by the Barley CAP.



Shown from left to right: Tom Parker, Aaron Lorenz, Jean-Luc Jannink, Martha Hamblin, Hiro Iwata, Peter Bradbury, and Jerko Gunjaca

Students Complete Barley CAP Supported Research Projects

Carol Powers, a graduate student in Kevin Smith's lab at the University of Minnesota, successfully defended her dissertation in May. Carol began working as part of the Barley CAP team in the fall of 2005. Her thesis is entitled "Patterns of linkage disequilibrium and association mapping of malt quality traits in a barley breeding program." In it she describes her work investigating the effect of breeding history on patterns of linkage disequilibrium in a six-rowed breeding program. She also conducted association mapping studies for malting quality traits using breeding lines from a single breeding program. Carol has accepted a Senior Biologist position at Dow AgroSciences working on sunflower and canola genetics and breeding which she will begin in July.

Jon Massman, finished his M.S. degree with Kevin Smith and has begun his Ph.D. degree program with Rex Bernardo. Jon's thesis was focused on using barley CAP data to identify loci for resistance to Fusarium head blight

At Oregon State University Kale Haggard successfully defended his M.S. thesis. Yada Chutimanitsakun is expecting to finish in December of 2009. Scott Fisk and Natalie Graham are new M.S. students.

Patrick D. O'Boyle graduated with a Ph.D. in Plant Breeding and Genetics from Carl Griffey's program at Virginia Tech in May 2009. The title of his dissertation was: "Genetic Characterization and Linkage Mapping of Barley Net Blotch Resistance Genes." Pat is now working at Beta Seeds breeding sugar beets.



Gary Muehlbauer Traveled to Japan to Share Barley CAP

Gary Muehlbauer attended the International Triticeae Symposium in Kyoto, Japan and gave a talk on the barley CAP. Approximately 100 people attended the symposium from around the world. Topics that were covered ranged from cytogenetics, systematics, evolution, domestication, biodiversity and breeding and genomics.



Institute of Barley and Malt Sciences Coordinate Barley Workshops

By Karen Hertsgaard

Four workshops coordinated by the Institute of Barley and Malt Sciences (IBMS) were held in January 2009, in Dickinson, ND on the 12th, Sidney, MT on the 14th, Minot, ND on the 15th and Conrad, MT on the 22nd. Close to 200 producers, extension and university research and industry personnel attended the workshops, titled *Barley Production and Management for Profit*.

Helping plan these workshops were members of the Montana and North Dakota Extension Teams including Mark Black (Great Falls, MT), Jeff Farkell (Brady, MT), Kurt Froelich (Dickinson, ND), Herb Karst (Sunburst, MT), Ben Larson (Sidney, MT), Kent McVay (Huntley, MT), Mike Rose (Minot, ND), and Dan Picard, Grant Jackson and Tom Robinson (all of Conrad, MT).

The IBMS Extension Teams which represent Montana, Idaho and North Dakota and surrounding states, were formed in October 2007 with the mission of enhancing communication efforts between barley stakeholders. The teams consist of fifty-five individuals representing barley producers, crop consultants, industry, extension education and university research personnel. The barley CAP supported the initial meeting of Extension Team Leaders in 2008.

Presentations and presenters at the 2009 *Barley Production and Management for Profit* workshops:

Barley Economics for 2009 - Dwight Aakre, Extension Farm Management Specialist in Agribusiness and Applied Economics at North Dakota State University (NDSU)

Barley Disease Management - Roger Ashley, NDSU Area Extension Specialist/Cropping Systems, Dickinson Research Extension Center

Food Barley - Dan Biggerstaff, Vice President of Strategic Planning, WestBred, LLC, Bozeman, MT

Barley Variety Development, Barley CAP and Barley for Rural Development Updates - Tom Blake, Professor of Plant Science/Barley Breeder, Montana State University (MSU), Bozeman, MT

Barley Insurance Update - Stanley Bruce, RMA, Billings, MT

Update and Historic Trends in Pricing and Production - Steven Edwardson, Executive Director of the North Dakota Barley Council

Irrigation Water Management of Malting

Barley Robert Evans, Agricultural Research Lab Research Leader, USDA-ARS Northern Plains, Sidney, MT

Fertilizer Considerations - Dave Franzen, Extension Soil Scientist, NDSU

Biofuels and Crop Insurance Update - Cole Gustafson, Extension Agribusiness and Applied Economics Bioproducts Specialist, NDSU

American Malting Barley Association, Inc. Update - Scott Heisel, Vice President and Technical Director of the American Malting Barley Association

Barley Variety Update - Richard Horsley, Professor of Plant Sciences/Barley Breeder, NDSU

Principles of Feeding Barley to Cattle - Breanne Ilse, Animal Scientist, Carrington Research Extension Center, NDSU

Fertilizer Practices for Irrigated and Dryland Barley and Seeding Rate Studies - Grant Jackson, Professor of Agronomy, Western Triangle Ag Research Center, MSU, Conrad, MT

Barley in Rotation and Variety Selection Tools for Producers - Kent McVay, Extension Cropping Systems Specialist, MSU, Southern Ag Research Center, Huntley, MT

Considerations in Contract Design - Frayne Olson, Extension Agribusiness and Applied Economics Crops Economist/Marketing Specialist, NDSU

Barley CAP Updates - Joel Ransom, Department of Plant Sciences Extension Cereal Crops Agronomist, NDSU

IBMS Updates and Malting Barley Quality Affects Beer Quality - Paul Schwarz, Professor of Plant Sciences/Malt and Barley Quality and IBMS Director, NDSU

A Farmer's Perspective - Ernie Taft, Montana Barley Producer

Insect Problems in Barley - Kevin Wanner, Extension Entomologist, MSU, Bozeman, MT

Malting Barley: Opportunities and Challenges - William Wilson, Distinguished Professor of Agribusiness and Applied Economics, Extension Entomologist

Evaluations of all four events were quite favorable and plans are being made for more meetings in 2010. Most presentations from the meetings are posted on the IBMS Website at <http://www.ag.ndsu.edu/ibms>

In addition to the Barley CAP sponsors include the AMBA, Inc.; Anheuser Busch, Inc.; CENTROL Crop

Consulting; Malteurop North America, Inc.; MillerCoors; MSU Extension; the Montana Wheat and Barley Committee; the North Dakota Barley Council; the North Dakota Grain Growers Association; NDSU Extension Service; and USDA-CSREES Barley for Rural Development.



Joel Ransom presenting barley CAP Update



Meeting of producers, extension and university researchers, and industry personnel at Conrad, MT.

Small Grains Field Day in Warsaw, VA

by Wynse Brooks

There were nearly 75 participants at May 21, 2009, small grains field day held at Warsaw, Virginia. We highlighted the barley CAP in our presentations. Meanwhile, we are presently in the field trying to get the grains harvested, while the weather permits.



Wynse Brooks discusses barley cap research at field day



Field day participants



Graduate and undergraduate students at field day

Calendar

- July 18-22, 2009** Joint Annual Meetings of the American Society of Plant Biologists and the Phycological Society of America, Hawaii Convention Center, Honolulu, Hawaii
- August 1-5, 2009** American Phytopathological Society Meeting, Portland, Oregon, Oregon Convention Center
- August 19-21, 2009** Barley CAP Association Genetics, Marker-Assisted Selection Workshop, University of Minnesota, St. Paul, MN (www.barleycap.org)
- Aug 31-Sept 4, 2009** 19th International Triticeae Mapping Initiative meeting, Clermont-Ferrand, France (colloque.inra.fr/itmi2009/itmi)
- Sept 13-15, 2009** Australian Barley Technical Symposium, Sunshine Coast, Queensland, Australia (www.abts.com.au/)
- Oct 1-4, 2009** Master Brewers Association of Americas (MBAA) Annual Convention, La Quinta, CA (meeting.mbaa.com/)
- Oct 13 - 16, 2009** 12th International Cereal Rusts and Powdery Mildews Conference, Antalya, Turkey. Organizer [Mahinur Akkaya](http://www.icrPMC2009.org/) (www.icrPMC2009.org/)
- Oct 25-30, 2009** 9th International Plant Molecular Biology Congress, St. Louis, Missouri (www.ipmb2009.org/)
- 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
- January , 2010** Barley CAP annual meeting, La Hacienda Hotel, San Diego, CA. Reservations: (619) 298-4707.
- January 9-13, 2010** International Plant and Animal Genome Conference, San Diego, CA (www.intl-pag.org)

**BarleyCAP**

The Barley Coordinated Agricultural Project (CAP), funded by the National Research Initiative (NRI) 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.

