Barley Coordinated Agricultural Project Work Plan FY07 (4/1/07 – 3/31/08)
Patrick Hayes
Oregon State University

1) **Describe the research, education, and outreach activities you are planning for the next year (4/1/07 – 3/29/08):** The activities described below are expanded versions of what was outlined in the work plan submitted with the initial proposal.

Research:

Mapping:

- Continue map coordinating/ liaison role with the CAP groups at Iowa State and UCR-Riverside and international cooperators at IPK, SCRI, and U. of Haifa.
- Ensure mapping of Pilot OPAs 1, 2, and is completed, data are available, and data are properly integrated with other efforts – e.g. QTL Miner and QTL Workbook.
- Complete and submit for publication a manuscript describing integration of prior data and CAP SNP data in the OWB population.

Diversity:

- Continue CAP core germplasm coordinating/ liaison role with the CAP groups at Iowa State and UCR-Riverside and international cooperators at IPK, SCRI, and U. of Haifa.
- Ensure CAP core genotyping with Pilot OPAs 1, 2, and is completed; data are available; and data are properly integrated with other efforts – e.g. QTL Miner and QTL Workbook.
- Complete and submit for publication a manuscript describing integration of North American and European germplasm genotypes with Pilot OPA 1, 2, and 3 SNPs.

Winter hardiness traits as a model for LD mapping

- Complete LD mapping of winter hardiness traits in OSU and European germplasm based on B-OPA1 and phenotype data from multiple field sites in North America, field data from Hungary, and controlled freeze test data from the Martonvasar, Hungary phytotron.
- Determine extent of genomic vs. intragenic LD in the winterhardiness-related adaptive gene clusters via analysis of B-OPA 1 SNPs in target genes and targeted sequencing of functional domains in the same genes.
    - The target genes are Vrn1, 2, and 3; the 5H CBF gene cluster; and Ppd-H1.
    - These analyses will be based on the Oregon breeding germplasm and the CAP core germplasm set.
- Prepare second year (Idaho) and European germplasm for assessment of hardiness traits at multiple field sites in North America, field assessment in Hungary, and controlled freeze testing at the Martonvasar, Hungary phytotron.

Winter malting barley as a model for MAS

- Using QTL Miner, integrated with candidate gene and QTL mapping, proceed with definition of the "six-row malting quality" and "winter hardiness" genotype footprints.
- Use these integrated footprints to design and make crosses for accumulating all favorable alleles for both composite phenotypes.
- Contribute to the global view of allelic diversity for agronomic traits in North American barley germplasm via the coordinated activities of the CAP.

Education

- Continue with the MAS M.S. thesis project underway with Juan Rey. This project involves development of winter habit barley for human nutrition.
- Continue with the undergraduate thesis project underway with Lauren Osborne. The project involves characterization of vernalization sensitivity phenotypes in segregating populations.
- Initiate new research projects as students and funding are identified - funds for graduate student training are not included in the OSU CAP budget, but there is ample room for defining a thesis project with the CAP-supported research.

Outreach

- Continue with presentations of Barley CAP goals, accomplishments, and plans.

- Domestic activities will include at least three field days and grower meetings. At this time two international presentations are scheduled: Uruguay (May) and Thailand (November).

2) List specific outcomes and deliverables that will be accomplished in the first 6 months (4/1 – 9/30). These will be used as benchmarks for your bi-annual progress report.

Research:

- Maps completed and made available.
- OWB Map manuscript submitted for review.
- Genetic diversity analyses on CAP core germplasm completed and made available.
- Analyses of OSU germplasm winter hardiness traits.
- Analyses of agronomic and quality traits with QTL Miner.
- Additional genotyping and targeted sequencing of winter hardiness-related genes.
- Conduct all field trials as scheduled for breeding lines in the Barley CAP.
- Prepare and submit DNA of all breeding lines as scheduled for the Barley CAP.
- Organize the second round of collaborative winter hardiness testing.
- Based on integration of phenotype and genotype, make crosses to accumulate all favorable alleles.

Education

- Continue with Rey M.S. thesis project and take selected lines to the field in fall, 2007.
- Complete Osborne's undergraduate thesis project.
- Recruit new undergraduate thesis research student.

Outreach

- Present CAP project at 07 field days and at Uruguay meeting.

3) List specific outcomes and deliverables that will be accomplished in the second 6 months (10/1 – 3/31). These will be used as benchmarks for the bi-annual progress report.

Research

- Ensure all mapping projects completed and made available; revise manuscript(s) as necessary; participate in preparation of final CAP mapping manuscript (led by A. Korol).
- Submit germplasm diversity manuscript(s) in collaboration with SCRI.
- Prepare manuscript describing genome-wide, localized, and intragenic LD for winter-hardiness related traits and the implications for development of winter malting barley.
- Record all phenotypes as stipulated in Barley CAP and submit data to data coordinator.

Education

- Recruit new graduate students, if external funding available, to work with CAP-related data.
- Develop and implement new undergraduate thesis research project.

Outreach

- Present CAP project at 07 grower meetings, make a presentation at the annual CAP meeting, present CAP project at Thailand meeting.

Barley Coordinated Agricultural Project Annual Progress Report
FY06 (4/1/06 – 3/31/07)
Patrick Hayes, Oregon State University

1) Describe the research, education, and outreach activities you completed in FY06 (4/1/06 – 3/31/07)

Research

- We identified the OSU 96 CAP breeding lines for 2006 per the requirements outlined in the CAP Participants Guide. These lines were planted, observed, and harvested. Data were obtained from Corvallis, Pendleton, Pullman, Filer, and Parma. The Aberdeen site was lost due to hail damage. The CAP common checks are Strider and 88ab536. Data were collected on heading date, height, lodging, yield, plump grain, and test weight. Samples were submitted for malting quality analysis at the CCRU and to the CAP participants for Beta glucan (Wise), food quality (Baik), and lipoxygenase (Schwarz). Barley stripe rust disease severity (%) and scald (1 – 9 rating) were recorded at Corvallis, Oregon. All data collected from the above trials were entered into CAP spreadsheet format for submission to Jennifer Kling.
- We organized and obtained data on the first phase of a vernalization sensitivity trial in cooperation with the Virginia and Idaho programs (288 entries). The spring nursery was planted in March, 2006 and seed was planted in October, 2006. Data were collected on heading date and growth habit in the spring-planted nursery and the same will be done for the fall-planted nursery.
- The process of increasing and maintaining winter habit lines was modified due to the lack of adaptation of winter material to Ft. Collins spring-sown conditions (e.g. the seed increase and DNA source nurseries maintained by Blake Cooper, BARI). Instead, we used our own purification head rows and submitted single head samples to Kevin Smith for DNA extraction.
- We have analyzed data from the allele re-sequencing project and decided, based on the P-OPA1 data published on the European germplasm, to add additional genes to our re-sequencing list prior to preparing a manuscript.
- We developed a CAP core set of 102 accessions for Pilot OPA-1, Pilot-OPA 2 and Pilot-OPA 3 screening. Six of these accessions were already in the germplasm array selected by IPK/SCRI/UCR. Therefore, we solicited accessions from CAP participants to generate a set of 96. We grew these 96 accessions at OSU; extracted DNA from each accession and sent DNA to Tim Close for Illumina genotyping. We also sent DNA from the same extraction event to Triticarte for DArT genotyping. We archived one head of each of the 96 accessions. We provided seed of the 96 lines to Shioman Chao for Pilot-OPA 1 genotyping: she obtained seed of the remaining 6 lines from the originators.
- We are compiling the data from Pilot-OPA 1, 2, and 3 and DArT genotyping of this CAP core set (in cooperation with Tim Close); we will share these data with CAP participants pre-publication; and we will analyze these data and prepare a manuscript in collaboration with Robbie Waugh at the SCRI.
- We are analyzing the DaRT, Pilot-OPA2 data, and will analyze the Pilot-OPA3 data when it is available. The Pilot-OPA2 data for the OWB mapping population were received from Tim Close. Maps, data, and diversity analysis results were posted at the CAP website, pending the unveiling of THT.
- Based on discussions and email with UCR, SCRI, and IPK we have a general outline of responsibility for map construction and report writing. OSU will focus on the OWBs; the SCRI on SM; and the IPK on MB. UCR will be responsible for data generation, quality control, and compilation. Publication credit will be given to all participants. There are many opportunities for research and publication with these data sets. We are keen to share the data and collaborate.
- This plan is outlined in a statement posted at the CAP website, Research Progress link.
- We are performing the coordinating and organizing functions detailed in the CAP management plan.

Education

- A Ph.D. student (Juan Rey) started his thesis research on marker assisted selection (MAS) for winterhardiness and human nutrition traits. He has conducted his first MAS cycle of selection.
- A Research Associate (Dr. Peter Szucs) is working with the allele sequence data and map construction. He has completed maps of the OWB population for P-OPA 1, P-OPA 2, and DArT.
- CAP Project results were integrated into Introductory Plan Genetics (CSS430).

Outreach

- Presented information on the Barley CAP at the August 2006 ITMI meeting.
- Prepared presentation for the Eucarpia Cereals Section in November 2006.
- Barley CAP was described at three Oregon Field Days in Corvallis, Pendleton and Moro.
- Prepared feature on Oregon CAP for CAP Newsletter.
- Barley CAP featured in the February 16, 2007 edition of the Capital Press.
- Published commentary on LD mapping, with specific mention of CAP, in PNAS.

2) List specific outcomes and deliverables accomplished in FY 06 (4/1 – 3/31). These will be used as benchmarks for your annual progress report.

- Sent breeder seed to Cooper but based on lack of adaptation, proceeded to use our own seed source instead
- Sent seed for DNA extraction to Smith
- Harvested 2006 yield trials and spring-planted vernalization trial
- Planted 2007 yield trials and fall-planted vernalization experiement
- Field Days attended and presented CAP information
- Data formatted and submitted to Jennifer Kling
- Additional re-sequencing underway to flesh out manuscript
- Developed CAP core germplasm set, extracted DNA and sent to UCR and Triticarte; produced archived seed samples
- Obtained Pilot-OPA 2 data and completed diversity analysis and map construction
- Data, maps, and diversity dendrogram posted at CAP website/ Research Update link
- Assisted in planning data sharing and manuscript publication process