

Barley Coordinated Agricultural Project Work Plan FY06 (3/1/06 – 2/29/07)
Paul Schwarz, North Dakota State University

1) Describe the research, education, and outreach activities you are planning for the next year (3/1/06 – 2/29/07)

Research Our objective is to screen germplasm for lipoxygenase and β -glucanase activity. Beta-glucanase, does not develop until seed germination. The enzyme is quite heat liable, and less than 10% of the activity developed during seed germination remains in the kilned malt. Breakdown of cell wall β -glucans during germination is a major component of malt modification. As such, it is more meaningful to determine the activity of β -glucanase in green malt (not kilned) vs. kilned malt. However, the value for kilned malt (when compared to green malt) may provide a direct indication as to heat stability of the enzyme, which is of interest to some brewers. Beta-glucanase will be determined both on green- and kilned malts. Two assays may be readily adaptable to high throughput analyses. These are a gel diffusion method using staining with Congo Red, and a colorimetric method using a dyed cross-linked β -glucan substrate. Field replicated material is preferred to laboratory replication of the assays.

Lipoxygenase (LOX) assay is much more difficult to adapt to high throughput screening. Total LOX can be measured by following the formation of conjugated diene at 234 nm (linoleic substrate), or by the consumption of O₂. However, this is not real informative, as there are two LOX isozymes. LOX-1 and LOX-2, form mainly the 9-hydroperoxide and 13-hydroperoxides of linoleic acid, respectively. The 9-LOOH is believed to be more important in beer staling as it leads to the formation of *t*-2-nonenal (papery/stale flavor marker). It might be best to monitor the 9-LOOH:13-LOOH ratio by GC. LOX involves a lot of lipid chemistry that is not easily adapted to high throughput. Additional difficulties are that the enzyme appears to be partially inactivated by freeze-drying (green malt), and the LOOH reaction products are extremely unstable. The major effort of this portion of the project will be evaluation of assay techniques. If improvements can not be made, analysis of only a limited subset (to no samples) will be possible.

Education We will have one PhD student that will be working on these malting quality traits.

Outreach: no activities planned.

List specific outcomes and deliverables that will be accomplished in the first 6 months (3/1 – 8/31). These will be used as benchmarks for your bi-annual progress report.

- Determine the impact of freeze drying on for malt β -glucanase activity.
- Evaluate utility of gel diffusion assay for malt β -glucanase screening
- Adapt malt β -glucanase assay, using dyed-cross-linked β -glucan substrate, to high throughput screening.
- Develop high throughput 10g malting procedure.
- Evaluation of lipoxygenase assay methods
 - Determine relationship between conjugated measurement by UV spectrophotometry and LOOH measurement by GC.
 - Determine stability of LOOH reaction products.
 - Evaluate SPME for extraction of LOOH products from LOX digests.
- Make decision on utility of LOX measurement for Barley CAP
- Work with Kevin Smith to determine most appropriate materials (populations) for β -glucanase and lipoxygenase analysis

2) List specific outcomes and deliverables that will be accomplished in the second 6 months (9/1 – 2/29). These will be used as benchmarks for the bi-annual progress report.

- Malting of field- replicated materials (10 g malts) for β -glucanase analysis. Up to 1000 samples can be malted and analyzed.
 - Freeze-dry green malts.
- Initiate and partially complete β -glucanase analysis of samples from FY06 trials.

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Outreach. A barley information specialist (BIS) is to be hired with Barley CAP funding, and equal matching funds from both NDSU-IBMS and AMBA. It is anticipated that this individual will be available in May 2006. The BIS will be responsible for the development of a national outreach and education program on barley production and end-use quality. Outreach and educational components of the Barley CAP project are to be clearly incorporated, and approximately 30-35% of BIS efforts will be directly devoted to Barley CAP work. The target audiences for these programs include US barley growers and commodity organizations, cooperative extension specialists, the US malting and brewing industry, as well as interested consumers. The specialist is expected to work closely with representatives of the target audience/stakeholders in the collection, development and dissemination of information. All information /programs will be collected at a single site, but available in multiple formats to best meet the needs of various audiences. The specialist will also be available to make presentations at local to national meetings, or to assist others with presentation materials.

Education: If possible the BIS will be selected to have a BS or MS in the agricultural or biological sciences, with a background in genetics and or cereal grains , and strong interest in education. Ideally, this opportunity can be treated as a Fellowship.

Research: non-applicable to this project

2) List specific outcomes and deliverables that will be accomplished in the first 6 months (3/1 – 8/31). These will be used as benchmarks for your bi-annual progress report.

- Develop appropriate liaisons within Barley CAP, and stakeholder groups (grower, extension, industry). This group is to provide feedback and advice to the BIS.
 - BIS travel will be needed to develop these liaisons.
- Collection of existing barley outreach materials related to production and quality.
- Develop appropriate technical support structure (ITS), and initiate development of website to house barley outreach materials.
- Begin development of new educational programs (various formats) focusing on barley production and quality.

3) List specific outcomes and deliverables that will be accomplished in the second 6 months (9/1 – 2/29). These will be used as benchmarks for the bi-annual progress report.

- Incorporate Barley CAP materials into new outreach materials on barley variety development, barley production, and malting and brewing quality.
- Preparation of CAP outreach materials to meet needs identified by target audiences (PowerPoint, Poster, Brochure, etc). Specific needs will be identified by close liaison with stakeholder groups.
- Develop 2007 meeting/presentation opportunities and schedule with barley grower organizations and state extension personnel. BIS will be available for these meetings

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Research: non-applicable to this project

Education: Ms Karen Hertsgaard, who was selected as the Barley Information Specialist, has a M.S. in Agronomy and a strong background in extension and outreach work.

Outreach. Our primary activities since April 2006 have involved the search and hiring process for a Barley Information Specialist (BIS), and the coordination of a barley grower survey. The BIS position was approved and advertised in June, Interviews were completed by September. Ms Karen Hertsgaard accepted the position and will begin in November 2006. This position is supported with Barley CAP funding, and equal matching funds from both NDSU-IBMS and the North Dakota Barley Council. The BIS will be responsible for the development of a national outreach and education program on barley production and end-use quality. Outreach and educational components of the Barley CAP project are to be clearly incorporated, and approximately 30-35% of BIS efforts will be directly devoted to Barley CAP work. The target audiences for these programs include US barley growers and commodity organizations, cooperative extension specialists, the US malting and brewing industry, as well as interested consumers.

At a June meeting of the Institute of Barley and Malt Sciences (IBMS) in St Paul, the Board of Directors indicated that a survey of barley growers would be valuable in assessing both reasons for declining barley acreage, and the specific educational/outreach programs that might best assist growers. Barley CAP representatives, Kevin Smith and Gary Muehlbauer, were in attendance. A survey has been developed in coordination with the IBMS Board of Directors, AMBA, Idaho Barley Commission, Montana Wheat and Barley Committee, the North Dakota Barley Council, USDA ND Agricultural Statistics Service, and Barley CAP. The initial objective was to complete the survey of approximately 500 growers in Montana, Idaho and North Dakota by telephone. It now appears the survey will have to be conducted by mail, but perhaps can incorporate a wider number of barley production regions. It is our intention to have the survey completed by January 1, 2006.

The Barley CAP program was presented (by Dr Lynn Dahleen) to an audience of maltsters and brewers at the NCI/ASBC Malt Quality Evaluation Short Course which I coordinate. Rich Horsley, Kevin Smith and I have begun work on an article on barley breeding and genetics for *New Brewer*. This publication will potentially reach thousands of stakeholders in the home-brewing and craft-brewing markets.

List specific outcomes and deliverables accomplished in the first half of FY06 (4/1 – 9/30).

- Developed a position description for the Barley Information Specialist (BIS), and completed the advertisement, interview and hiring process. Ms Karen Hertsgaard will begin as the BIS on November 3, 2006.
- Developed a barley grower survey questionnaire.
- Coordinated presentation of Barley CAP materials at the NCI/ASBC Malt Quality Evaluation Short Course which was held in Fargo, August 29-September 1.
- Initiated an article on barley breeding and genetics for *New Brewer* magazine