

**Washington Grain Commission  
Wheat and Barley Research Annual Progress Report**

**Project #: 5389**

**Progress Report Year:**   1   of   3   (maximum of 3 year funding cycle)

**Title:** Developing Washington Wheat with Stable Falling Numbers (FN) through resistance to preharvest sprouting and LMA.

**Project PIs:** Camille M. Steber, Michael O. Pumphrey, Arron H. Carter

**Cooperators:** Kimberly Garland Campbell, Ryan Higginbotham, Deven See, Craig Morris

**Executive summary:** The goal of this project is to breed for stable Falling Numbers (FN) in Washington wheat through selection for genetic resistance to preharvest sprouting and late maturity alpha-amylase (LMA). The previous project identified existing cultivars with sprouting and LMA problems through evaluation of the WSU cereal variety trials, and made this information available through a website enabling growers to examine FN relative to yield data from 2013 and 2014 (<http://steberlab.org/project7599.php>). The current project will enable breeders to select for resistance to LMA and PHS by developing and using phenotypic screens and molecular markers.

**Objective 1. Screen spring and winter wheat cultivars, breeding, and mapping lines for preharvest sprouting tolerance using the spike wetting test and the Falling Number test.**

Falling Number was determined for the 2014 WSU Cereal Variety Trials, and locations showing low FN were identified for the winter and spring wheat variety trial locations in 2015.

**Objective 2. Improve screening for LMA susceptibility to prevent release of susceptible spring and winter varieties.**

LMA is not a wide-spread problem in older northwest wheat cultivars, but LMA susceptibility is an emerging problem in our breeding programs. Greenhouse LMA testing is slow and requires considerable growth chamber space for cold treatment of whole wheat plants. LMA experiments were performed with a more efficient “cut spike” protocol for field-grown wheat. Screening detected LMA-susceptible winter breeding lines. No LMA susceptibility was detected in Avocet with and without the Yr5 and Yr15. Field cut spike experiments detected known LMA susceptible lines, but appeared to over-predict the number of LMA susceptible lines. Field cut spike assays will enable us to perform the large scale screening needed for association mapping, but will need to be confirmed by other methods.

**Objective 3. Identify molecular markers linked to sprouting and LMA resistance and susceptibility genes by association mapping.**

Association mapping identified molecular markers linked to preharvest sprouting susceptibility/tolerance in winter wheat. Mapping was performed using both spike wetting tests and FN on the same mapping population. Spike wetting tests did not detect many of the sprouting tolerance loci detected by FN. This suggests that if we want to breed for stable FN we will need to continue running FN assays instead of relying on the less labor-intensive spike-wetting tests. Thus, the project will continue using FN data for breeding and mapping lines grown at locations subject either to sprouting or LMA events.

**Impact:** Wheat in all market classes is dramatically discounted for low falling numbers (below 300s). Moreover, a consistent problem with low FN could damage the reputation of Washington wheat in foreign markets. LMA screening will prevent the release of LMA susceptible cultivars that may lower the overall FN of grain from this region.

**WGC project number:** 5389  
**WGC project title:** Developing Washington Wheat with Stable Hagberg Falling Numbers  
**Project PI(s):** C. Steber, M. O. Pumphrey, A.H. Carter  
**Project initiation date:** 07/01/15  
**Project year:** year 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
1. Screen spring and winter wheat cultivars, breeding, and mapping lines for preharvest sprouting tolerance using the spike wetting test and the Falling Number test.	Knowledge about the susceptibility of spring and winter wheat cultivars and breeding lines to preharvest sprouting based on the spike-wetting test and on FN (2015, 2016, 2017). Selection of breeding lines with higher resistance to preharvest sprouting compared to current varieties.	Year 1. Completed FN testing for the 2014 variety trials (see <a href="http://steberlog.org/project/7599">steberlog.org/project/7599</a> ). Conducted spike wetting tests of winter wheat breeding lines from the 2015 field season. Identified locations with low FN problems in 2015 by FN testing of known susceptible spring and winter wheat lines. Winter wheat checks had low FN in Mayview and Pullman. Spring wheat checks had low FN in Almira, Endicott, Farmington, Horse Heaven, Lamont, Lind, Pullman, and Reardan. FN will be performed on variety trials at these locations.	Year 1, 2, and 3. Spike-wetting tests and FN testing of breeding lines, association mapping lines, and affected variety trial locations.	Results will be communicated through talks at the Wheat Research Review, annual Wheat Life articles, abstracts submitted to the Lind and Spillman Field Days, and through the project website: <a href="http://steberlab.org/project7599.php">steberlab.org/project7599.php</a> .
2. Improve screening for LMA susceptibility to prevent release of susceptible spring and winter varieties.	Knowledge about the susceptibility of spring and winter wheat varieties and breeding lines to LMA. Breeding of LMA resistant wheat.	Year 1. Compared the field cut-spike LMA testing with greenhouse LMA tests. The field cut spike assay detects known LMA susceptible lines, but may score mistake soem LMA resistant lines for susceptible lines. Based on FN and LMA testing data, winter LMA suspects include, Jasper, SY-Ovation, Bruehl, WA8202, 4J071246-1C, and Rosalyn. Spring wheat LMA suspects include Alturus, ARS504174, WB6341, IDO851, IDO854, Nick, UI-Stone, and WA8124.	Year 1. Perform LMA testing using both the established greenhouse and new field-based technique. Determine if the field technique gives the similar results to greenhouse. Year 2 and 3. LMA testing of breeding lines and spring association panel.	Results will be communicated through talks at the Wheat Research Review, annual Wheat Life articles, abstracts submitted to the Lind and Spillman Field Days.
3. Identify molecular markers linked to preharvest sprouting resistance and susceptibility genes by association mapping	Molecular markers for use in early selection for increased preharvest sprouting tolerance.	Year 1. Molecular markers linked to preharvest sprouting tolerance were identified based on Falling Number and spike wetting test data. The genes/loci identified by Falling Number were not identical to those identified by spike wetting test. This suggests that we need to continue to emphasize FN data when making selections in the breeding programs.	Year 1. Perform association mapping to identify loci linked with PHS tolerance. Year 2 and 3. Perform field LMA tests in preparation for association mapping. Year 3 perform LMA association mapping.	Results will be communicated through talks at the Wheat Research Review, annual Wheat Life articles, abstracts submitted to the Lind and Spillman Field Days.