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Project ID: FY10-BA-001 **FY09 ARS Agreement #: 59-0206-9-084**

Research Category: **BAR-CP** **Duration of Award: 1 Year**

Project Title: Development of Winter Barley Cultivars with Enhanced Resistance to FHB and DON.

PROJECT 1 ABSTRACT

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FHB epidemics were widespread in Virginia in 1998 and devastated much of the crop in 2003 and 2009 in Virginia and the southeastern U.S. Current FHB resistance sources in our breeding program consist of spring barley lines. These lines are not adapted to our environment and lack resistance to other prevalent diseases and, therefore, need to be crossed and top or back crossed using a marker assisted breeding strategy to transfer FHB resistance into adapted winter barley backgrounds. Given the renewed interest in barley exports and new demands (30 million bushels per year) for winter barley for use in ethanol production, our program now has increased demands for developing and providing growers and end users with superior cultivars having high yields, desirable quality, and especially FHB resistance. High DON (15-18 ppm) levels in the 2009 barley crop resulting in high DON levels (>7.5 ppm) in the protein meal byproduct of ethanol production render this normally valuable component unacceptable for use in food or feed products. Because the byproduct dried distillers grain with soluble (DDGS) from ethanol production is rapidly becoming a significant source of nutrient-rich food and feed products, FHB resistant varieties having low DON are critical to ensure that barley DDGS have low DON.

Approaches: Prior testing of our winter barley genotypes in inoculated, mist-irrigated scab nurseries indicates that a number of lines possess native resistance to FHB and DON. Among 29 lines in the 2009 hulless barley state test, 22 had FHB indices lower than the overall test mean (4.7%), while the susceptible check had an index value of 35%. Among 22 lines in the 2009 hulled state test, 13 had lower index values than test mean 6.6%, while the most susceptible lines had index values higher than 20%. The newly released hulless cultivar EVE had an FHB index of 1.25% and a DON concentration less than 1 ppm in this severe scab epidemic year. Resistance in Virginia barley germplasm needs to be validated and characterized in comparison to other reported sources.

Single and top crosses between superior hulled and hulless winter barley parents with parents having FHB resistance have and will be produced each year in our program. F_1's will be advanced in the greenhouse or field each year. Sources of FHB resistance used in our program include Chevron, Fredrickson, Atahulpa, Tibetan, and elite genotypes from the University of Minnesota including MN-Brite, M122, FEG4-66, FEG43-46, and FEG43-47. To date, we have developed more than 50 populations from crosses made between outstanding hulled and hulless winter barley cultivars and elite lines from the breeding program with other lines possessing known FHB resistance introduced from various sources (Minnesota, USDA world collections and CIMMYT in Mexico). FHB segregating breeding populations in the F_2 and higher generations are evaluated each year in an inoculated, mist-irrigated scab nursery and/or in larger blocks at Blacksburg and Warsaw, VA. Heads selected from F_3 and higher generation populations comprised of FHB resistance parents having known and validated FHB QTL will be screened with molecular markers in our lab and evaluated in headrow nurseries to identify desirable FHB resistant pure lines. Next season (2010-2011), heads from approximately 25 hulled and hulless FHB populations in the F_4 and higher generations will be harvested, threshed individually, planted, and evaluated to derive pure lines with FHB resistance. Selected lines will be evaluated in observation yield trials at two locations. Superior lines will be evaluated and advanced sequentially in replicated preliminary, advance, state, and regional trials as well as in scab nursery tests. Elite high yielding lines having improved resistance to FHB and DON will be released as cultivars for use in feed, fuel, and food production. Meanwhile, marker assisted backcrossing is also being used in the breeding program to transfer the hulless trait into our high yielding hulled winter barley cultivar Thoroughbred and subsequently, FHB resistance will be integrated by crossing with a FHB resistant hulless cultivar. Barley cultivars having improved FHB resistance will be released to replace current cultivars.