

PI: Paul Murphy**PI's E-mail: Paul_Murphy@ncsu.edu****Project ID: FY14-SW-001****ARS Agreement #: New Agreement (Expiring Agreement # 59-0206-9-083)****Research Category: VDHR-SWW****Duration of Award: 1 Year****Project Title: Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm.****PROJECT 1 ABSTRACT**

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The objectives of this project are 1) increased acreage planted to varieties with improved FHB resistance and low DON, 2) Increased efficiency of Coordinated Project breeding programs to develop FHB resistant varieties, and 3) Develop new breeding technologies to further enhance short term and long term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm. The Southern Uniform Scab Nursery provides public and private sector breeders with multi-environment evaluations of FHB resistance in advanced generation breeding lines compared with the resistant check varieties Ernie, Bess and Jamestown. Four Recombinant Inbred populations are in different stages of research designed to identify QTL associated with FHB resistance in NC-Neuse, Bess, Tribute, Catbird. The populations have undergone DArT, SSR and SNP analyses, and phenotypic data will be collected and analyzed during this grant cycle. Based on efforts in progress, by fall 2014 and fall 2015, doubled haploid lines developed from the following crosses will be distributed to interested cooperators: NC09-22206 / Jamestown, NC08-23323 / V08W294, GA04570-10E46 / NC8170-4-3, GA04570-10E46 / Jamestown, GA04570-10E46 / NC08-20986, Shirley / NC8170-4-3, Shirley / NC08-20986, Jamestown / NC08-20768, NC8170-4-3 / NC08-140, NC8170-4-3 / NC-Cape Fear, NC8170-4-3 / NC08-21273, and NC8170-4-3 / NC09-20768. In each of these crosses, either one or both, parents express moderate resistance to FHB. Selections made by cooperators in from NC-developed DH lines distributed in fall 2012 and 2013 will be evaluated in 2014-15 and likely 2015-16. In the NC program, 1170, 75, 20, 8 and 2 DH lines will be entered in Head Row Increase, Observation, Preliminary, Advanced, and Official Variety Trials in fall 2013. As a member of SUNGRAINS (Southeastern University Grains), I partner closely in a collaborative cultivar development program by public small grain programs in NC, GA, FL, LA, AR and TX. Over 75 percent of our variety development populations result from crosses between one or more parents exhibiting partial to high levels of resistance to FHB. Typical FHB sources include in-house advanced generation lines containing *Fhb1*, Qhhs.ifa-5A, FHB 5A (Ernie), 2DL, 3BSc, 2B and 'Frontana' 3A and 5A alleles. More emphasis is being placed on parents with 'native' resistance, particularly lines from the MO, IL, VA, MD, GA and NC programs with better yield potential, adaptation and end use quality. Approximately 550 F₂ and F₃ bulks (combined) will be advanced in both seasons utilizing mass selection. Approximately 30,000 headrows in the F₄, F₅ and F₆ generations (combined) will be advanced each season using the pedigree method. Our current misted/inoculated nursery contains 3200 headrows. Evaluations of Preliminary and Advanced tests are conducted in the misted nursery annually. In addition to the Uniform Southern FHB Nursery, we will evaluate the seven state Gulf-Atlantic Nursery in our misted/inoculated nursery. We will evaluate important released varieties (60 plus) entered in the annual NC Official Variety Testing (OVT) program. Results from the OVT will be posted on the NC Small Grains Production website. Our approach is enrichment of targeted populations of three-way F₁'s, and F₂ bulks using marker assisted selection combined with extensive phenotypic evaluation in later generations when heritabilities are greater. In 2014-15 and 2015-16, we will select among 3-way F₁'s and enhance F₂ populations through identification of plants containing the QTL mentioned above, and additional QTL being identified in ongoing studies with NC-Neuse, Jamestown, and Bess.

PI: Paul Murphy**PI's E-mail: Paul_Murphy@ncsu.edu****Project ID: FY14-SW-004****ARS Agreement #: New Agreement (Expiring Agreement # 59-0206-9-083)****Research Category: VDHR-SWW****Duration of Award: 1 Year****Project Title: Developing Doubled Haploids to Expedite Variety Development in SRWW.****PROJECT 2 ABSTRACT**

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One of the main objectives of the VDHR research area is to increase the efficiency of coordinated project breeding programs in developing and releasing FHB-resistant varieties. Doubled haploids (DH) shorten variety development time in fall-sown small grains by approximately four years. We plan to expand the use of this technique for the whole Southern Winter Wheat region by the coordinated development of four breeding populations through DH production followed by collaborative phenotyping across the region once the DH lines are developed and seed is being increased for testing. This proposal fits into the overall Coordinated Project because it will quickly provide inbred breeding lines having several diverse FHB resistance genes (exotic and native) to five breeding programs for testing in the Southern Winter Wheat (SWW) region. We plan to use the doubled haploid facility at Heartland Plant Innovations for DH production. Approximately 200 DH lines will be developed for three of the populations and 400 lines will be developed for a fourth population. Three of the populations will utilize University of Maryland parents containing three QTL for FHB resistance (*Fhb1*, *FHB5AS*, and *FHB2DL*). The second parents in the crosses are high yielding, broadly adapted lines with excellent agronomic and end use characteristics but with low levels of FHB resistance. One cross will utilize the cross LA05102C-8-8 / LA12285 which is segregating for native FHB resistance. Over all three populations of DH lines developed from crosses to the MD parents, 400 will contain *Fhb1*, the most effective QTL for resistance. Two hundred will contain *Fhb1* plus one of the remaining two QTL and 100 of the DH lines will contain all three QTL. The VA and NC programs opted to share a single population of 400 DH lines, in order to increase the frequencies of lines with multiple QTL. Haploid plants will be evaluated for the presence of the three QTL, and those haploids containing *Fhb1* alone, and *Fhb1* plus one or two of the other QTL will undergo chromosome doubling. Current turn-around time for developing DH by Plant Innovations is 12 months from the receipt of the seed. Seed will need to be increased for testing because only 7-10 seeds/DH are guaranteed from the initial development of DH lines. The estimated cost will be \$18 per haploid, \$1 for tissue collection, \$6 for marker analyses at three QTL, and \$12 for chromosome doubling. For a population of 200 haploids, that entails \$3,600 for haploid production, \$200 for tissue collection, \$1,200 for marker analysis and \$1,200 for chromosome doubling of 100 selected haploids. The total per population with an MD parent is \$6,200. The total for the LA cross, which will not undergo marker selection of haploid plants will be \$6,000. This pre-proposal was developed through the cooperation of all the breeding programs in the Southern region and will be a source of outstanding SRWW lines selected for FHB resistance that will be available and shared with other wheat breeders. This pre-proposal has great potential to deliver high-impact FHB resistant varieties in a short period of time.