Milestone Matrix of the VDHR-Southern Soft Winter Wheat CP

Variety Development Objectives for Year 1 (5/1/2016-4/30/2017) and Year 2 (5/1/2017-4/30/2018)

1. Increase acreage planted to varieties exhibiting improved FHB resistance.
2. Increase efficiency of individual breeding programs' to develop and release FHB resistant varieties.
3. Develop new breeding technologies and germplasm to further enhance short-term and long-term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm.

Variety Development Milestones

State(s)	#	Description	Target and Date	Outputs/Linkages
AR, LA, GA, NC, VA	1a	Complete biparental, 3-way and 4-ways crosses to improve FHB resistance in adapted SRWW	Yr1: Complete 2100 crosses by 5/2017 Yr2: Complete 2100 crosses by 5/2018	Generate 100,000+ recombinant lines for future evaluation and selection of pure lines
All	1b	Evaluate and advance multiple segregating breeding populations and select desirable pure lines. Emphasize the development of germplasm that incorporates FHB QTL, such as *Fhb1*, 2DL, 3BSc, 4B, 5AS, Jamestown QTL_*1B* and *QTL_6A*, Bess *Qfhb.nc-2B.1* and *Qfhb.nc-3B.2* and Neuse *QTL_1A; QTL_6A* along with other hexaploid sources into adapted SRWW backgrounds. More reliance on 'native' resistance and adapted lines containing QTL listed above	Yr1: Evaluate and select among more than 3,500-7,000 F2-F5 breeding populations and more than 100,000 progeny rows by 5/2017 Yr2: Evaluate and select among more than 3,500 - 7000 F2-F5 breeding populations and more than 100,000 progeny rows by 5/2018	Generate a diverse set of 100,000+ SRWW with known, and unknown, FHB QTL. Disseminate most promising lines to SRWW breeders for evaluation with a goal to release as varieties and germplasms.
AR, LA, GA, NC, VA	1c	Evaluate **new** advanced generation breeding lines developed within programs for FHB resistance. Continue evaluating lines that are	Yr1: Obtain data on more than 2400 new breeding lines by 7/2017. Process data and select lines to retest by 9/2017	Identify new recombinant lines with enhanced FHB resistance and agronomic potential. Germplasm information compiled into database.

State(s)	#	Description	Target and Date	Outputs/Linkages
		advanced within each program each year. Note: this is not cooperative, multi-state testing	Yr2: Obtain data on more than 2400 new breeding lines by 7/2017. Process data and select lines to retest by 9/2017	
AR, LA, GA, NC, VA	1d	Increase seed of breeding lines with improved FHB resistance for potential commercial release. Report increases to CP coordinator	Yr1: Harvest increase seed and report by 10/2017 Yr2: : Harvest increase seed and report by 10/2018	Facilitate commercial production of FHB resistant cultivars and disseminate information to seed companies, Extension services, milling industry, and growers
AR, LA, GA, NC, VA	1e	Release of cultivars with improved FHB resistance. Report releases to CP coordinator.	Yr1: Release by 10/2017 Yr2: Release by 10/2018	Provide the wheat community with wheat cultivars with improved FHB resistance. Goal is to release four new varieties with high levels of FHB resistance in the region during the two year cycle
All	2a	Marker-assisted selection will be used in all programs to increase efficiency to meet their specific needs and breeding strategies including MAS enrichment of F_1s from multiparent crosses, early generation F_2 or F_3 plant or family selections, MAS-BC and background parent selection. Apply information from ongoing studies on mapping FHB and DON resistance in Neuse (NC), Jamestown (VA), and Tribute (VA).	Yr1: Harvest tissue and obtain marker data from USDA Genotyping Center for over 2,300 lines by 5/2017. Yr2: Harvest tissue and obtain marker data from USDA Genotyping Center 2,300 lines by 5/2018. Additional genotyping to be done in-house.	Frequency of FHB resistance QTL in variety development populations will be increased with MAS. Will enhance parental selection for crossing programs also.
All	2b	Deploy double haploid technology to accelerate development of FHB resistant lines and mapping populations. Combination of contracts with Heartland Plant	Yr1: Up to 500 DH lines distributed by NC State program 9/2017. Send F1 seed to HPI to produce 1,350 new DH lines. Seed from DH lines distributed for evaluation in 9/2017 from HPI	Speed the development of cultivars and breeding lines that combine FHB resistance from native and exotic sources in adapted SRWW backgrounds.

State(s)	#	Description	Target and Date	Outputs/Linkages
		Innovations (HPI) and NC State in-house DH production. Genotype data for resistance QTL will be used to pyramid resistance genes and select best parents and progeny (for F1 topcrosses) to send for DHs.	contracts. Yr2: Send F1 seed to HPI to produce 1,350 new DH lines. Seed from DH lines distributed for evaluation in 9/2018 from HPI contracts. Up to 500 more DH lines distributed from NC State program.	
VA	2c	Assess FHB resistance of lines in the multi-state NUWWSN. Evaluate other agronomic traits and resistance to other diseases as they occur.	Yr1: Obtain data on more than 50 lines and send to coordinator by 9/2017 Yr2: Obtain data on more than 50 lines and send to coordinator by 9/2018	Assess FHB of lines for potential release. Germplasm information compiled into to database and germplasm made available to all breeders
VA	2d	Assess FHB resistance of lines in the multi-state PNUWWSN. Evaluate other agronomic traits and resistance to other diseases as they occur.	Yr1: Obtain data on 60 lines and send to coordinator by 9/2017 Yr2: Obtain data on 60 lines and send to coordinator by 9/2018	Assess FHB of lines for potential release. Germplasm information compiled into to database and germplasm made available to all breeders
All USDA Quality Lab	2e	Assess FHB resistance of lines in the multi-state SUWWSN. Evaluate other traits such as quality, and resistance to other diseases as they occur. Includes obtaining haplotype data.	Yr1: Obtain data on up to 70 lines and send to cooperators by 9/2017 Yr2: Obtain data on up to 70 lines and send to cooperators by 9/2018	Assess FHB resistance and other quality and agronomic traits of lines for potential release. Genotype data provided on up to 35 loci. Germplasm information compiled into a database and germplasm made available to all breeders
AR, LA, GA, NC, VA	2f	Assess FHB resistance of cultivars entered in the State Evaluation Trials of commercially available cultivars. Disseminate information to growers via Extension.	Yr1: Collect data on approximately 500 entries and disseminate by 9/2017 Yr2: Collect data on approximately 500 entries and disseminate by 9/2018	Assess FHB of lines for commercially available cultivars. Data will be compiled into a database that will be used in various Extension outreach media (reports, websites, presentations, etc).
All	2g	Assess FHB resistance of advanced generation lines in cooperative nurseries: Uniform Southern Yield,	Yr1: Obtain data on up to 150 lines and send to cooperators by 9/2017 Yr2: Obtain data on up to 150 lines	Assess FHB of lines for potential release. Germplasm information compiled into a database and

State(s)	#	Description	Target and Date	Outputs/Linkages
		GAWN, SUNWHEAT.	and send to cooperators by 9/2018	germplasm made available to all breeders
NC	2h	Coordinate the SUWWSNs of up to 70 SRWW genotypes and checks. Disseminate preliminary and final reports in a timely fashion	Yr1: Preliminary report by 8/2017, Final report by 11/2017. Yr2: Preliminary report by 8/2018, Final report by 11/2018.	Data sent to all breeders, summarized in Forum proceedings, posted on USWBSI website, placed in database.
LA	2i	Collaborate in male sterile recurrent population development for pyramiding FHB resistance	Yr1: Grow populations in breeding programs and make selections. Yr2: Grow populations in breeding programs and make initial selections	Improved germplasm developed through recurrent selection
All	3a	Evaluate training populations to develop genomic selection (GS) models that can be applied across VDHR-SWW breeding programs. Perform association mapping (AM) to identify novel QTL and confirm previously identified QTL.	Yr1: Collect phenotypic data on training populations by 9/2017. Preliminary AM and GS analysis. Yr2: Collect phenotypic data on training populations by 9/2018. Finalize AM and GS analysis.	Genomic selection models that can be applied to VDHR-SWW breeding programs. Integration of GS models across the AR, NC and VA programs. Confirmation of previously identified QTL and potential identification of novel resistance loci. Results can be used to develop new populations via DH production with high levels of predicted resistance.