

Washington Grain Commission

Wheat and Barley Research Annual Progress Reports and Final Reports

Project #: 3019 3674

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

Title: Evaluation of WSU wheat breeding lines for management of Hessian fly and development of DNA markers for resistance breeding

Cooperators: Mike Pumphrey, Arash Rashed

Executive summary:

Hessian fly (HF) infestations continue to cause significant annual yield losses in spring wheat production areas of Washington and neighboring regions of Oregon and Idaho. Hessian fly is in many ways a silent problem. Moderate infestations are not visually striking, and their occurrence is somewhat variable over space and time. Factors such as weather patterns, crop rotation, variety selection, and tillage or conservation practices can impact HF pressure. Infestation may also be a significant barrier to increased conservation tillage practices in Washington. Advanced breeding lines, new sources of resistance genes *H13*, *H26*, and two unknown resistance sources, along with winter wheat varieties were screened for Hessian fly resistance in 2021. Backcross populations were developed with four new sources of resistance, and progeny advanced to select homozygous resistant lines. Winter wheat populations and varieties were screened to introgress HF resistance into winter wheat. This project supported the screening of all new entries in WSU Variety Testing Program spring wheat trials and winter wheat variety trials. NEW DNA markers that allow diagnostic tracking of the previously unknown spring wheat resistance source that is in most spring wheat varieties were validated and fully implemented in 2021.

Impact:

Spring wheat production has averaged ~30 million bushels in WA in recent years. A conservative state-wide Hessian fly loss estimate of 2% translates to over \$4,000,000 per year; yield loss due to HF in moderately to heavily infested areas often exceeds 25% and may be 100% in localized areas. In addition to protecting from \$45-\$104 per acre via HF resistance, improved variety development can translate to \$Millions/year in WA spring wheat farm gate value. Our recent emphasis on winter wheat is due to infestations increasingly observed in winter wheat in the region. While not as severe as spring wheat infestations, we believe the value of Hessian fly resistance in winter wheat is underestimated and increasing.

Our most recently released soft white spring wheat varieties Seahawk, Tekoa, and Ryan, new club release WA8325 (Roger) and hard red spring wheat varieties Hale, Net Cl+, Glee, Alum, and Chet are resistant to Hessian fly because of selection activities carried out by this collaborative project. Given their broad acreage in Washington State, this represents a major economic impact to Washington farmers.

Outputs and Outcomes: attached

WGC project number: 3674
WGC project title: Evaluation of WSU wheat breeding lines for management of Hessian fly and development of DNA markers for resistance breeding
Project PI(s): Pumphrey
Project initiation date: 2021
Project year: 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
Screen WSU Spring breeding populations and advanced breeding lines for resistance to Hessian fly in the laboratory	Information on resistance of elite breeding lines on an annual basis	Over 300 spring wheat lines, 31 winter wheat varieties, numerous breeding populations, and new entries into the WSU Wheat Variety Testing Program were screened in 2021. Data has been shared with Extension personnel, through the Variety Selection Tool, WSCIA Buyer's guide, etc.	Annually	Progress was presented by M. Pumphrey at field days, plot tours, at Wheat Research Reviews for individual states. Presentations continue to be made to the Washington Wheat Commission and WAWG conferences upon invitation. Progress was reported in Wheat Life magazine.
Continue to incorporate "new" Hessian fly resistance genes into breeding lines	Improved germplasm with useful sources of Hessian fly resistance	Several backcrosses have been made to known (H13, H26) and unknown resistance gene donors, using susceptible elite line "Dayn" as the initial recipient parent. BC4-derived Dayn-Hessian fly resistant introgression lines were evaluated for the second year in yield plots and for grain quality in 2021, and elite performers used in routine breeding crosses in fall 2021. Also, JD and Melba were used to introduce four new resistance sources through backcrossing with phenotypic selection. Diagnostic DNA markers for the resistance present in Seahawk, Kelse, and some other spring wheat varieties were fully validated in 2021.	Annually	