Benefits and Risks of Producing Roundup® Ready Sprin& Wheat in the Pacific Northwest

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Weed control is a primary concern for wheat producers in the Pacific Northwest (PNW) due to yield and crop quality losses associated with weed competition. The ability to control weeds through the use of herbicide resistant varieties is appealing to many producers, particularly for direct seed wheat production. Roundup Ready® (RR) wheat will permit “in crop” weed control while maintaining the intrinsic environmental and economic benefits associated with direct seed management. The first adapted spring wheat varieties suitable for commercial production are projected to be available in 2005. In spite of their imminent availability, questions concerning whether RR wheat production will become a reality have arisen. The effectiveness of the RR system as a weed control measure is not in question. However, the asexual gene introgression technique that was originally used to introduce the herbicide resistance gene into wheat is “unnatural,” which has generated concerns, primarily about food safety and the possible escape of transgenes into the environment. Controversies such as these lead to bans on the importation of transgenic crops into Europe and several Asian countries. Since more than 85% of the wheat produced in the PNW is exported to Pacific Rim countries, consumer acceptance, or lack thereof, is likely to determine the fate of RR wheat production in the region. Inability to segregate transgenic from non-transgenic wheat may prohibit RR wheat production if export customers are unwilling to buy transgenic crops. Furthermore, risks associated with incorporating RR wheat into production systems have not been investigated to date.

Agroecological changes resulting from over-the-top herbicide application may impact the productivity of RR wheat. Grain yield advantages resulting from improved weed control may be lost due to increased soilborne pathogen activity on dying weeds within a RR wheat crop. A study to proactively determine the risks of incorporating RR wheat into direct seed production systems was recently initiated at WSU. Near isogenic lines (NILs), with and without glyphosate tolerance, of two cultivars (Bobwhite and Westbred 926) were evaluated under direct seed conditions in three agroclimatic zones in eastern Washington in 2002 and 2003. A mixture of spring barley and sterilized oat seed inoculated with Rhizoctonia solani/oryzae or Gaeumannomyces graminis var. tritici (GGT) were direct seeded into the field plots prior to planting the NILs to simulate greenbridge volunteer. A no greenbridge control also was included. NILs from three treatments (RoundUp, Buctril/Harmony Extra, and a no spray, hand weeded control) were evaluated for disease severity as well as agronomic performance. All NILs were evaluated with the Buctril/Harmony Extra and no spray treatments, but only the glyphosate tolerant varieties were treated with glyphosate.

Regardless of disease treatment, location or year, glyphosate treated RR spring wheat, produced as much or more grain than NILs treated with Buctril/Harmony Extra or the no spray control, suggesting that greenbridge transmission of Rhizoctonia and GGT due to RoundUp application may not occur at high enough levels to suppress yields of RR varieties. An interesting herbicide-pathogen interaction was noted in field trials that were heavily infested with stripe rust. Bobwhite NILs that had not been treated with RoundUp had a more severe incidence of stripe rust than RoundUp treated NILs. Bobwhite NILs sprayed with Buctril/Harmony Extra or in the no spray control, suggested that greenbridge transmission of Rhizoctonia and GGT due to RoundUp application may not occur at high enough levels to suppress yields of RR varieties. An interesting herbicide-pathogen interaction was noted in field trials that were heavily infested with stripe rust. Bobwhite NILs that had not been treated with RoundUp had a more severe incidence of stripe rust than RoundUp treated NILs. Bobwhite NILs sprayed with Buctril/Harmony Extra or in the no spray control displayed severe stripe rust susceptibility symptoms and matured 2 to 3 weeks earlier than NILs treated with RoundUp. Buctril/Harmony Extra treated RR Bobwhite produced significantly less grain than the RR Bobwhite treated with RoundUp, regardless of root disease treatment. Visual differences in stripe rust severity were not apparent until 21 days after herbicide application. Results suggest that glyphosate within a RR wheat plant may remain active for extended time periods, thereby hindering the colonization of leaf tissue by foliar pathogens. If true, residual “in plant” glyphosate activity also may be responsible for increased grain yields detected for RoundUp treated RR NILs across locations, regardless of disease treatment. Contrary to prediction, preliminary results indicate that a synergistic disease suppression response occurs when glyphosate is applied to Roundup Ready wheat. Additional studies have been initiated to elucidate the effects of RoundUp application on the transmission of soilborne pathogens to herbicide resistant wheat.