Susceptibility of Perennial Small Grains to Soilborne wheat mosaic virus and Wheat spindle streak mosaic virus

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Perennial small grains offer the potential for sustainable production of forage and grain on marginal and erodable lands (3). Breeding of high-yielding, winter-hardy, perennial small grains is underway (3). A potential threat to perennial small grain production is infection by the soilborne viruses, Soilborne wheat mosaic virus (SBWMV) and Wheat spindle streak mosaic virus (WSSMV). Growers and breeders are aware of the susceptibility to and yield effects of soilborne viruses on annual small grains. By contrast, the susceptibility and impact of these viruses on perennial small grains are unknown and uncharacterized, including any added effects from viral carryover from one year to the next. Because chemical, cultural, and biological controls have not proven effective against soilborne viruses in annual small grains, the planting of resistant cultivars is the main control tactic and the same is likely to be true for perennial small grains.

Both SBWMV (the type member of the genus Furovirus) and WSSMV (a member of the genus Byomovirus [family Potyviridae]) are presumed to be transmitted by the obligately parasitic, soilborne protozoan Polymyxa graminis. The most reliable means of assessing susceptibility to the two soilborne viruses is by growing plants from seed in infested soil. We conducted preliminary experiments to assess whether eight of the most promising, yet diverse, perennial wheat and rye breeding lines were susceptible to SBWMV and WSSMV, either individually or when co-inoculated. The lines included were: AT3425 [putatively Triticum aestivum × Thinopyrum ponticum (1)], BFPMC1 (Thinopyrum intermedium), Permontra, PI-368149, PI-368150 (T. turgidum × S. montanum), Spitzer, TA12252, and Varimontra. We planted two seeds into one-inch balls of moistened soil collected from infested fields in Trumansburg, NY (for SBWMV); Ithaca, NY (for WSSMV); or a mixture of the two soils for co-inoculation. Two dozen soil balls per genotype per soil inoculum were planted into microplots of previously noninfested soil confined by fiberglass barriers at Tailby field, Ithaca, NY in early October, 2001. Plants were inspected for virus-like symptoms in May, September, and October 2002. Percent incidence was not calculated due to the small sample sizes and uncertainty regarding the efficacy of our inoculation protocol. Every genotype except Spitzer was considered to be at least moderately susceptible to one or both viruses based on the observation of typical disease symptoms in some inoculated plants. Viral symptoms were not observed in Spitzer and randomly sampled leaves from two plants did not test positive for either virus based on ELISA results.

ELISA was used to confirm visual symptoms observed in May 2002. Sap from individual, symptomatic leaves was extracted using a rolling leaf press, diluted in 0.5 ml phosphate-buffered saline, and tested for viral coat proteins using established ELISA protocols for SBWMV (Agdia, Elkhart, IN) and for WSSMV (2). Samples with five times and three times, respectively, the absorbance of the average of the negative controls (symptomless wheat leaves from a greenhouse) were scored as testing positive for the respective virus. For SBWMV, results of ELISA tests confirmed infection of AT3425, PI-368149
(Triticum turgidum × S. montanum), TA12252 (S. montanum), and Varimontra (reselection of Permontra). For WSSMV, results of ELISA tests confirmed infection of AT3425 and Permontra (Secale cereale × S. montanum). ELISA results also confirmed the co-infection of AT3425, BFPMC1 (Thinopyrum intermedium), Permontra, PI-368149, PI-368150 (T. turgidum × S. montanum), TA12252, and Varimontra by SBWMV and WSSMV. None of the singly inoculated plants were co-infected. Strikingly, co-inoculation resulted in increased infection by both viruses as observed previously in the annual wheat cultivar Newton (4). No symptoms were observed during autumn 2002, even though autumn temperatures were similar to those that were conducive for symptom development in the spring. No plants, whether infected by virus or not, survived the following winter for reasons unknown, though winter hardiness of perennial genotypes continues to be a challenge for crop improvement. Our results suggest that perennial small grains are at risk for infection by soilborne viruses and that resistant cultivars may be needed for management of these diseases. Ideally, breeders should screen perennial small grain lines for resistance to soilborne viruses in the early stages of selection.

Literature Cited