Genetic dissection of wheat–necrotrophic fungus interactions: breeder beware !

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Tan spot and Stagonospora nodorum blotch (SNB) are both devastating foliar diseases of wheat caused by the necrotrophic pathogens *Pyrenophora tritici-repentis* and *Stagonospora nodorum*, respectively. Both pathogens produce numerous host-selective toxins (HSTs) that interact with dominant host genes in an inverse gene-for-gene manner to cause disease. However, broad-spectrum, race-nonspecific QTLs conferring resistance to tan spot also have been identified and are current targets for marker-assisted selection (MAS). For SNB, we have developed molecular markers closely linked to five *S. nodorum* HST sensitivity genes. We have used MAS to introgress the race nonspecific tan spot resistance QTLs and to eliminate the *S. nodorum* toxin sensitivity genes from the wheat cultivar Alsen while retaining the *Fhb1* locus. In related, but more basic, research, we are working to characterize these host-toxin interactions at the molecular level. The HST known as ToxA is produced by both *P. tritici-repentis* and *S. nodorum*, and sensitivity to ToxA is governed by the *Tsn1* gene in wheat. The cloning of *Tsn1* revealed that it contains numerous resistance gene signatures, and further characterization of the *Tsn*–ToxA interaction indicates that the mechanisms are much the same as in classic R gene–Avr gene interactions, except that the end result is susceptibility as opposed to resistance. The difference in outcome likely is due to the biology of the pathogen, i.e., necrotrophs have acquired mechanisms to exploit the resistance mechanisms acquired by plants to combat biotrophic pathogens. Therefore, it is possible that breeding for resistance to a biotrophic pathogen could result in the acquisition of susceptibility to a necrotrophic pathogen, or visa versa.

SESSION V: VIRUSES

The status of wheat viruses in the Great Plains.

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Wheat is an economically important crop in the Great Plains of North America. Several viruses infect wheat in this region, causing yield losses ranging from trace to 100% in the most severely affected fields. The major virus infecting wheat in the Great Plains is wheat streak mosaic virus (WSMV). However, in 2006, *Triticum* mosaic virus (TriMV) was discovered in Kansas and was recently (2008) confirmed in Colorado, Nebraska, Oklahoma, South Dakota, Texas, and Wyoming. Both WSMV and TriMV are transmitted by the wheat curl mite (WCM). Co-infection of wheat by both viruses has been confirmed under field conditions, and synergism in symptom expression has been demonstrated in controlled environment studies. Therefore, the potential exists for greater yield loss from co-infection of wheat by WSMV and TriMV. In addition, preliminary work has shown that cultivars with resistance to WSMV appear to be susceptible to TriMV, implying that recent progress in the development of WSMV-resistant cultivars is potentially threatened by the presence of TriMV. Another virus also transmitted by the WCM, and which has been shown to co-infect wheat with WSMV, is wheat mosaic virus (WMoV, formerly High Plains virus). Other viruses of wheat in the Great Plains include wheat soilborne mosaic virus, wheat spindle streak mosaic virus, barley yellow dwarf virus, and cereal yellow dwarf virus. The current status of these viruses in the Great Plains and their implications on wheat production in the region will be discussed.