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GRAIN MARKETING AND PRODUCTION RESEARCH CENTER

Research Kernels

Our Latest Research Results • February 2009

Hessian fly (Mayetiola destructor) interactions with barley, rice, and wheat seedlings

The Hessian fly is one of the most destructive insects of wheat world-wide. The insect is also suspected to damage barley on the west coast of the US. This research showed that Hessian fly populations collected from wheat fields can survive on barley seedlings, but with high mortality and slow development. We also found that most barley lines responded to Hessian fly attacks with a combination of resistance and tolerance. The evidence we have gathered so far indicates that Hessian fly populations from wheat fields may not be able to cause serious damage to barley, but further research is needed. Wen also found that rice, a nonhost of the Hessian fly, is resistant to the insect with a mechanism that differs from resistance mediated by major genes in wheat.

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The complete sequence of Triticum mosaic virus, a new wheat infecting virus of the Great Plains

Plant viruses are an important constraint on wheat production in the Great Plains. One of the most significant is Wheat streak mosaic virus (WSMV). Until recently, high resistance to WSMV was not available, however, a variety, RonL, was released with high resistance. In the spring of 2006, a plot of RonL was found to have WSMV like symptoms. Initially, it was thought that the virus symptoms were due to a variant of the WSMV virus or High Plains virus. Using diagnostic techniques, it was found that the symptoms were due to a new, uncharacterized virus. A coat protein covers most plant viruses, and the amino acid sequence of the new virus' coat protein was different from any other virus characterized. Thus, the virus was given the name Triticum mosaic virus (TriMV). In the associated report, the complete sequence of the RNA of the virus is reported and compared to other wheat-infecting viruses. There is strong evidence that the virus belongs to the Potyvirus family but the evidence also shows that it is distantly related to WSMV. Future work will look at collections from across the Great Plains to determine whether TriMV is a new introduction, or has been present, but just undetected.

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Non-additive expression of homoeologous genes is established upon polyploidization in hexaploid wheat

The wheat family contains species that are diploid (2 copies of each gene), tetraploid (four copies of each gene), and hexaploid (six copies of each gene). Hexaploid bread wheat is thought to originate from a natural cross that occurred thousands of years ago between diploid and tetraploid wheat relatives. An interesting question in the evolution of hexaploid bread wheat is how the multiple copies of genes interact with each other and possibly adapt over time to optimize growth of the hexaploid plant. Gene expression level was measured for thousands of genes in a diploid wheat (goatgrass), a tetraploid wheat (durum), and a new hexaploid wheat that was derived by crossing the diploid and the tetraploid. About 16% of the genes were altered in expression in the new hexaploid compared to the wild relatives. These results may help identify gene interactions that are important in hexaploid bread wheat.

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Diverse origins of aluminum-resistant sources in wheat

In acidic soils, a large amount of free aluminum (Al) may be released into soil solution. This affects wheat root growth and subsequently reduces nutrient and water uptake essential for plant growth. Use of Al-resistant cultivars can significantly reduce risks associated with acidic soils. In this study, 57 wheat accessions were classified into four groups: US-Fultz, Polyssu, Mexican, and Chinese, based on their DNA markers and pedigree. The results indicate that Al resistance in the four groups may have three independent origins. Fultz was developed in the USA as a major ancestor to soft red winter wheat, Polyssu originated in Brazil as a major source of Al resistance used in most genetic studies worldwide, and the Chinese group originated in China. Al resistance in US cultivars is mainly from Fultz, not from Polyssu. Further characterization of Al resistance in the three different sources could reveal multiple Al-resistant mechanisms in wheat.

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Primary particle size distribution of eroded material affected by degree of aggregate slaking and seal development

Soil erosion is an undesirable phenomenon from both agricultural and environmental points of view. The smaller soil particles in the eroded material are the major contributor to off-site contamination. These small soil particles contain pesticides, nutrients, etc. Many of the processes which contribute to soil eroding from a site are dependent not only upon the physical soil properties (texture) but also time dependent conditions such as the rate of wetting by rainfall events. The objective of this study was to determine whether the particle size distribution (PSD) of an eroding soil changes with rainfall amount and intensity and whether the changes in the PSD are affected by soil texture and the rate of wetting. The tests were conducted under various simulated rainfall amounts and intensities on two types of soils and the resulting PSD's of the eroding soil were accurately measured with a laser particle analyzer. It was found that generally soil loss resulting from fast wetted soils were greater than from slow wetted samples. The smallest soil particles (clay) usually were higher in concentration relative to the original soil's clay concentration early in the erosion experiments. With increasing rainfall duration, the concentration of clay enrichment decreased. The magnitude of this decrease in concentration and the final clay enrichment depended on both the wetting rate and the soil texture. The information obtained from this study should assist in improving water erosion models by better understanding these physical effects on eroding soil surfaces.

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Population growth and development of the psocid *Liposcelis brunnea* Motschulsky (Psocoptera: Liposcelididae) at constant temperatures and relative humidities

Psocids, or booklice, are emerging pests of stored grain and processed stored products, but we know little about their biology and control. We determined that a little studied species, *Liposcelis brunnea*, will not develop at a relative humidity of 43% or below or above 95 degrees, while populations increased from 72 to 90 degrees and 55 to 75% relative humidity. Population growth was higher at 63% than at 75% relative humidity. The ability of *L. brunnea* to multiply rather rapidly at 55% RH may allow it to thrive under conditions of low relative humidity where other *Liposcelis* species may not. These data give us a better understanding of *L. brunnea* population dynamics and can be used to help develop effective management strategies for this psocid.

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Efficacy of spinosad in partially treated wheat against five stored-product insect species

In bulk grains, much of the insect infestation occurs in the top layer of the grain mass. We evaluated the effectiveness of a new biological insecticide (spinosad) as a surface treatment in wheat to control insect pests. Spinosad was applied to the upper one half, one fourth, or one eighth layer of the wheat or the entire grain mass in a vial, and adult insects were either added to the vials before or after the wheat. When lesser grain borers were added to the vials after the wheat, all died except in the one-eighth layer treatment. In contrast, when lesser grain borers were placed in the vials before the wheat, all died only when all of the wheat was treated. Mortality of the rice weevil was lower but there was evidence of upward movement into the treated layers. Mortality of the psocids *Liposcelis paeta* and *L. bostrychophila* was <50% when the entire quantity of wheat in the vials was treated, in contrast to 100% mortality of the psocid *Lepinotus reticulatus*. However, for all psocid species, overall mortality decreased with decreasing depth of the treated layer. The results of this laboratory study show that while spinosad has some effectiveness as a partial treatment to wheat, efficacy will depend on the target species, the depth of the treated layer, and the upward or downward mobility of the insect species.

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