



Research Kernels

Our Latest Research Results • April 2008

Send Us Your Comments

We always welcome feedback and suggestions, but this month marks the one year anniversary of the revised Research Kernels (RK). RK was reformatted and is now being distributed primarily as an electronic newsletter, saving time and money. We also increased the frequency from quarterly to monthly. So, what do you think? Any suggestions for other changes? Please write us at: gmprcinfo@ars.usda.gov. Also, we're beginning a quarterly electronic newsletter "GMPRC Update" that will focus on the people, products, impact and activities at GMPRC. Look for the first issue in the next few months.

Characterization and mapping of cryptic alien introgression from *Aegilops geniculata* with new leaf rust and stripe rust resistance genes *Lr57* and *Yr40* in wheat

Leaf rust and stripe rust are important foliar diseases of wheat worldwide. Leaf rust and stripe rust resistant introgression lines were developed by crossing common wheat with the wild wheat relative, *Aegilops geniculata*. These lines were characterized in a collaboration between Punjab Agricultural University, the KSU Wheat Genetics and Genomic Resources Center, and USDA-ARS. Introgression lines showed similar and complete resistance to the most prevalent pathotypes of leaf rust and stripe rust in Kansas (USA) and Punjab (India). Some alien introgression lines had very small translocation segments that were not visible by microscopic examination. These cryptic alien introgression lines contained new resistance genes for leaf rust and stripe rust that were designated *Lr57* and *Yr40*, respectively. This is the first documentation of a successful transfer and characterization of cryptic alien introgression from *Ae. geniculata* conferring resistance to both leaf rust and stripe rust in wheat.

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Cryptic wheat–*Aegilops triuncialis* translocation with leaf rust resistance gene *Lr58*

Resistance to wheat leaf rust was transferred from the wild wheat relative, *Aegilops triuncialis*, into hexaploid bread wheat. The line was characterized in a collaboration between Punjab Agricultural University, the KSU Wheat Genetics and Genomic Resources Center, and USDA-ARS. The translocation line was resistant to the most prevalent races of leaf rust in India and Kansas. Genetic mapping showed that the resistance was inherited as a single dominant gene. The unique source and map location of the introgression on chromosome 2B indicated that the leaf rust resistance gene is new and was designated *Lr58*. Molecular markers were developed to select for presence of this gene in wheat breeding programs.

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Assessing fermentation quality of grain sorghum for fuel ethanol production using Rapid Visco Analyzer

The use of sorghum as a feedstock for the ethanol industry is increasing. Rapid methods for predicting the fermentation quality of sorghum are needed to enhance the production of ethanol from sorghum. The Rapid Visco Analyzer (RVA) was used to characterize the pasting properties of 68 sorghum grains with a standard 23-min temperature profile and relate these properties to ethanol fermentation. The results showed a strong linear relationship between ethanol yield and final viscosity, as well as setback. Ethanol yield increased as final viscosity decreased. Based on these results, a modified RVA procedure (10 min) was developed to simulate the liquefaction step in dry-grind ethanol production. The modified RVA procedure is applicable not only for characterization of mashing properties, but also for optimization of alpha-amylase doses for starch liquefaction. Thus, the modified RVA method developed in this work is useful for predicting the fermentation properties of sorghum.

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Differential heat shock tolerance and expression of heat shock proteins in two stored-product psocids

Psocids, or booklice, are emerging pests of stored products, such as in grain storages and flour mills. Heat treatments are increasingly used to control insects in flour mills, and there is no information on efficacy of heat for controlling psocids. We tested susceptibility of two species of psocids, *Liposcelis entomophila* and *Lepinotus reticulatus*, to heat, and we determined whether heat shock proteins, which are proteins which protect other proteins in the bodies of animals during stress, play a role in tolerance to heat in these two species. *Liposcelis entomophila* was over 2-fold more heat tolerant than *L. reticulatus*. We found heat shock proteins only in *Liposcelis entomophila*, which might explain its greater tolerance to heat treatment and its more common occurrence in warmer parts of the world. Our results indicate that heat treatments should be efficacious for control of both of these psocid species.

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Resistance to *Bacillus thuringiensis* endotoxins in the European corn borer (*Ostrinia nubilalis*)

Transgenic corn expressing *Bacillus thuringiensis* (Bt) toxins has been planted to control the European corn borer. Over the past 20 years, research has been ongoing to understand Bt resistance in corn borer populations. Overall, the data suggest that in some corn borer larvae, resistance is linked to alterations in digestive enzymes. However, these larvae are unable to survive on transgenic corn. These results demonstrate that the current transgenic corn varieties expressing Bt toxins are effective in controlling susceptible and resistant populations of corn borers.

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Control of *Rhizopertha dominica* (F.) in rough rice through a combination of diatomaceous earth and varietal resistance

Different varieties of grain crops, including rough rice, vary in their susceptibility to stored-product insect pests. We conducted a test by exposing adult lesser grain borers, a major insect pest of stored grains, on susceptible and resistant varieties of rough rice treated with increasing rates diatomaceous earth (DE). The production of offspring from these exposed adults was assessed as a measure of control. As the rate of DE

increased to the maximum rate specified on the insecticide label, few offspring were produced on 3 of 4 resistant varieties. In contrast, more offspring were produced on the 4 susceptible varieties. There was also a corresponding increase in the percentage of insect-damaged kernels in the susceptible varieties compared to the resistant varieties. Results show that combining natural varietal resistance with a reduced-risk insecticide such as DE could limit lesser grain borer populations and result in less damage to the commodity.

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Effect of frying conditions and yeast fermentation on the acrylamide content in You-Tiao, a traditional Chinese fried twisted dough-roll

In early 2002, the National Food Administration of Sweden reported the presence of high amounts of acrylamide in heat-treated grain and potato-based foods. This finding resulted in worldwide interest, because acrylamide is a potent neurotoxin and has been classified as a probable carcinogen. The highest concentrations of acrylamide are found in fried potato-based products such as French fries and potato chips. Acrylamide is formed through the Maillard reaction when certain sugars are heated in the presence of the amino acid asparagine, both of which are relatively abundant in potatoes and wheat. Factors such as cooking temperature and cooking time affect production of acrylamide. You-tiao is a traditional Chinese fried twisted dough-roll, usually eaten at breakfast. It is inexpensive and enjoyed by all segments of the population. The dough is similar to bread dough that is fermented but it is fried at high temperatures rather than baked. This study determined how the processing conditions affected acrylamide content in you-tiao.

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