GMPRC
Grain Marketing and Production Research Center

Research Kernels

Our Latest Research Results • December 2008

Beauveria bassiana infection of eggs of stored-product beetles

Insect pathogenic fungi have been shown to attack the larvae and adults of many pests of stored products, but whether they can infect the eggs of those insects is unknown. *Beauveria bassiana*, a fungus that is registered for insect control, was tested under maximum challenge conditions for its infectivity for four of the major beetle pests of stored grain and grain products. When ambient humidity was set at 92%, exposure to the fungus caused reduced hatch of lesser grain borers and red flour beetles, but there was no effect at lower humidities. Fungus treatment of rusty grain beetle and sawtoothed grain beetle eggs had no effect. This information helps target the appropriate vulnerable insect stages when using fungal insecticides.

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Validation of RNA interference as a tool to silence genes expressed in the epidermis and midgut of the Western corn rootworm, *Diabrotica virgifera virgifera* Leconte

The Western corn rootworm (WCR) is one of the most important insect pest species of corn throughout the U.S. Corn Belt both in terms of crop losses and synthetic insecticide use. Crop rotation and chemical control have been the primary management strategies to reduce larval damage caused by root feeding. However, WCR's ability to sequentially evolve resistance to different insecticide classes and behavioral resistance to crop rotation has made its control increasingly difficult. Due to the dearth of control strategies available for the Western Corn Rootworm and its remarkable history of adaptation it is imperative that new biopesticide targets be discovered. Since the insect midgut is a main entry point for pesticides and food toxins, novel control methods that exploit the midgut hold great potential as effective systems for the suppression of pest populations. The objective of this project was to establish RNA interference (RNAi) as a tool to identify vital genes as targets for new WCR biopesticides. Here we report RNAi-mediated knockdown of two genes, and demonstrate that gene knockdown by this method in WCR larvae provides a powerful technique for identifying potential biopesticide targets.

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Comparison of waxy versus non-waxy wheats in production of fuel ethanol: fermentation performance

Use of ethanol as a fuel additive has grown over the past few years, and this growth is expected to continue. Currently the majority of fuel ethanol in the US is produced from corn. However, as starch is the principal component of corn, other cereal grains including sorghum, wheat, millet, rice and barley are obvious ethanol feedstocks in areas where corn production is limited. While wheat markets in the US have traditionally been for milling, wheat is considered a potential energy crop in some parts of the world, such as Europe. Compared with corn, factors affecting ethanol yield for wheat are not well understood. In this study we found that non-waxy soft wheat had the highest ethanol yields (433 L/ton) than did non-waxy hard and waxy wheat. Waxy wheat had higher conversion efficiencies however. This research suggests that waxy wheat could be bred specifically for bio-fuel production.

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Improved characterization of sorghum tannins using size exclusion chromatography

Tannins are polymeric phenolic compounds that have antioxidant properties which are found in many types of plants. Some specific types of sorghum produce tannin in their grain at a level higher than that found in blueberries. The chemical composition of tannins may play a significant role on influencing their functionality. Several methods have been developed for characterization of tannins from different plants using a variety of techniques. Most of the methods are very time and resource consuming, however some provide a rapid separation of the tannin polymers using a relatively easy procedure. High performance size exclusion chromatography (HP-SEC) was used to

characterize tannins from seven sorghum cultivars grown over two years to provide detail into the molecular size distribution of the tannin polymers. Area under all of the tannin peaks was highly correlated (r = 0.95) to the tannin content of the sorghum bran fractions in high and low tannin sorghum lines.

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Methods for detecting chromosome rearrangements in *Gibberella zeae*

The fungus *Gibberella zeae* (also known as *Fusarium graminearum*) causes Fusarium head blight of wheat and barley. This species is composed of multiple lineages that are morphologically similar and that are capable of crossing with each other to varying degrees. Chromosome rearrangements between the lineages could be an important barrier to fertility. This paper describes rapid methods for detecting chromosome rearrangements in this species.

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Heat tolerance and expression of protein synthesis elongation factors, EF-Tu and EF-1α, in spring wheat

Protein elongation factors, EF-Tu and EF-1α, are proteins that play a crucial role in protein synthesis. EF-Tu and EF-1α have been also implicated in cell response to heat stress. It is not clear, however, whether EF-Tu and EF-1α are of importance to heat tolerance in spring wheat. In this study, we investigated heat tolerance and the expression of EF-Tu and EF-1α in mature plants of spring wheat cultivars Kukri and Excalibur under prolonged exposure to high temperature. In addition, we also investigated the expression of these elongation factors in young plants experiencing a short-term heat shock. Heat stress induced accumulation of EF-Tu and EF-1α in both cultivars but the accumulation was greater in the cultivar that showed better tolerance to heat stress (Excalibur). The results support the hypothesis that EF-Tu and EF-1α are of importance to wheat response to heat stress.

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Virulence analysis of Hessian Fly (*Mayetiola destructor*) populations from Texas, Oklahoma, and Kansas

The Hessian fly is a destructive insect pest of wheat. The most effective means to control Hessian fly damage is to develop and deploy wheat varieties that are resistant to the insect. The challenge for the host plant resistance strategy is the dynamic change of Hessian fly biotypes in the field. Specific resistance genes can lose effectiveness due to changes in Hessian fly biotypes. In order for the host plant resistance strategy to be continuously successful, we need to monitor which resistance genes are still effective periodically. This research investigated the effectiveness of 20 known resistance genes to field Hessian fly populations from Texas, Oklahoma, and Kansas. Five of the 20 tested genes, H13, H21, H25, H26, and Hdic, conferred high levels of resistance (> 80% of plants scored resistant) to all tested geographic populations. However, resistance levels for other genes varied depending on which Hessian fly population they were tested against. This study should provide useful information to breeders when they select resistance genes for their breeding programs and to wheat growers when they select wheat varieties for planting.

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