

## Our Latest Research Results - September 2010

### Utilization of a Web-Based Model for Aeration Management in Stored Rough Rice

**Authors:** F.H. Arthur, Y. Yang, L.T. Wilson

**Submitted to:** Journal of Economic Entomology

Expert systems utilizing population models and bin-cooling models are available for management of stored wheat and stored corn but not for stored rice. We developed a web-based system for management of the lesser grain borer and the rice weevil, two major economic pests of stored rough rice. This model was used to predict population growth of both species in unaerated rice and rice cooled at different airflow rates using aeration (blowing outside ambient air through the bin to cool the grain), for rice stored in Beaumont, TX. Predicted population growth of both species in aerated rice was about 98% less than in unaerated rice, regardless of starting grain temperatures or aeration airflow rate. This web-based system could help management programs for stored rice by increased use of aeration and potentially less usage of fumigants for insect control.

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### Phenolics in the Bran of Waxy Wheat and Triticale Lines

**Authors:** R.S. Jonnala, S. Irmak, F. MacRitchie, S. Bean

**Submitted to:** Cereal Chemistry

There is increasing interest in the phenolic compounds of cereal grains due to their anti-oxidant capacity and potential human health benefits. For example, increased consumption of phenolic compounds has been correlated with a reduced risk of cardiovascular diseases and certain types of cancers. Wheat is one of the most cultivated cereal grains in the world and a major food staple. Substantial research has been conducted on the phenolic compounds in wheat, however, little research has been done on waxy wheat and triticale lines. In addition, little research has been conducted to study how genetic changes to wheat such as occur in the breeding of waxy wheat impacts bioactive compounds such as phenolics. Ferulic acid was found to be the major phenolic compound in the waxy wheat lines and complete waxy lines had great total phenolic compounds than double null lines, which in turn had greater total phenolic compounds than single waxy null lines.

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### Divergent Host Plant Adaptation Drives the Evolution of Sexual Isolation in the Grasshopper *Hesperotettix viridis* (Orthoptera: Acrididae) in the Absence of Reinforcement

**Authors:** T. Grace, S.M. Wisely, S.J. Brown, F.E. Dowell, A. Joern

**Submitted to:** Biological Journal of the Linnean Society, London

The beginning stages of lineage divergence can be difficult to detect, as correlations between altered genotypic and phenotypic attributes are often weak early in the process. Shifts in host plant use and divergence in mating signals can lead to sexual isolation and ultimately speciation. To understand the process, it is important to recognize the initial barriers that reduced contact between populations, the evolutionary factors leading to adaptation if it occurs, and the contributions of such factors and traits to better understand lineage divergence. Genetic studies of the grasshopper *Hesperotettix viridis* suggest that selection contributes to genetic differentiation in response to host use. Here we used near infrared spectroscopy to examine the host preferences, degree of differentiation in mate choice, and divergence in cuticular morphology. Significant host-based preference of individuals from two host plant groups was detected. No-choice mate selection experiments reveal preference for individuals collected from the same host species independent of location, and little mating observed between individuals from different host species.

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### Fusarium Head Blight Symptoms and Mycotoxin Levels in Single Kernels of Infected Wheat Spikes

**Authors:** K.H.S. Peiris, M.O. Pumphrey, Y. Dong, F.E. Dowell

**Submitted to:** Cereal Chemistry

The study of how the Fusarium head blight (FHB) disease spreads and manifests disease symptoms and mycotoxins in infected grains in spikelets along the spikes among wheat varieties is important to understand the FHB resistance of different wheat varieties. Two wheat varieties with different FHB resistance levels (Susceptible and moderately resistant to FHB) were grown in a greenhouse and a floret in a central spikelet of spikes were artificially inoculated with spores of *Fusarium graminearum*, the predominant fungus causing

the FHB in wheat. The FHB symptoms of the kernels were assessed and levels of two mycotoxins, deoxynivalenol and 15-O-acetyl-deoxynivalenol, were measured after harvesting the fully mature spikes. The two varieties behaved differently in terms of the distribution of FHB symptoms and mycotoxin levels. The moderately resistant variety had comparatively lower mycotoxin levels in infected kernels than that of the kernels of the susceptible variety. Moreover, in the susceptible variety mycotoxins were detected in kernels in spikelets above and below the inoculated spikelet, while in the moderately resistance variety mycotoxins were found mostly in the kernels in spikelets below the inoculated spikelet. This study also revealed the presence of both symptomatic kernels with non-detectable levels of mycotoxins and asymptomatic kernels with significant mycotoxin levels in FHB infected wheat spikes. Similar single kernel analysis of FHB symptoms and mycotoxin levels in kernels along spikes may provide plant breeders more information about the FHB resistance of the germplasm being tested and consequently enhance the efficiency of FHB resistance breeding programs.

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### **Cloning, Expression, and Characterization of a Cellulase from *Tribolium castaneum* (Coleoptera: Tenebrionidae)**

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**Submitted to:** Insect Biochemistry and Molecular Biology

Cellulases are enzymes that can break down plant material. Although insect cellulases were thought to be the products of microbes living inside the insects, we now know that insects also can make their own cellulase enzymes. In studying the genome sequences of the red flour beetle, we found a gene that encoded what appeared to be a cellulase. We used molecular procedures to clone the gene and express the protein. We find that the enzyme has characteristics of a particular group of enzymes called endoglucanases and has highest activity at extremely high pH. Since processing plant materials at high pH may be more efficient, this beetle enzyme may have applications for biofuel refineries. In addition, we are investigating whether this enzyme may be exploited to control beetle damage to stored products.

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### **Polyacrylamide Effects on Aggregate and Structure Stability of Soils with Different Clay Mineralogy**

**Authors:** A.I. Mamedov, L.E. Wagner, C.H. Huang, L.D. Norton, G.J. Levy

**Submitted to:** Soil Science Society of America Journal

Environmentally friendly anionic polyacrylamide (PAM) is used to prevent runoff and erosion to help sustain soil quality and prevent surface water pollution. However PAM application studies have yielded conflicting results. Little research has been done on the degree of effectiveness on different soil types and application methods. We studied the effectiveness of PAM application on aggregate and structure stability for 16 soils collected from arid and humid zones. Soils having a loam or clay texture were evaluated having different clay mineralogy. All these soils are widely distributed in the U.S. Soil aggregate structure stability was estimated from the sensitivity of aggregates to slaking. For the non-treated soils, their aggregate structure stability, hence a soil's draining ability were in the order of smectitic < illitic soils < kaolinitic. Addition of PAM increased the soil moisture content of the aggregates at saturation, which increased their drainable pores, leading to an increase in the stability of the aggregates compared with the untreated ones. The aggregate and structure stability of the PAM treated soils were close to each other. Therefore, the effectiveness of PAM in improving aggregate stability in these soils followed in the order of smectitic > illitic > kaolinitic clay mineralogy. Thus, the weaker aggregates were more strongly affected by the addition of PAM. In conclusion, this study showed that the effectiveness of PAM for increasing aggregate stability depended on soil clay mineralogy (i.e. clay activity = cation exchange capacity/clay content) and to soil conditions affecting PAM adsorption (salts, pH and cations). These data are readily available from USDA-NRCS soil surveys and should be considered before the use of PAM to obtain maximal effectiveness from its use in arid and humid regions. Moreover additional experiments on effect of wetting-drying cycles, PAM concentration and cation composition on soil aggregates and structural stability will contribute to better utilization of PAM under field conditions.

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