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Research Kernels

Our Latest Research Results • September 2007

Toxicity and efficacy of selected organophosphate and pyrethroid insecticides and new acaricides to stored product mites

Mites can often infest stored products and can cause physical damage and allergic reactions in humans. There are several different pest species, but the knowledge concerning their susceptibility to pesticides is often conflicting. We evaluated several common insecticides used to control insects in stored products, and also a miticide for mite control by exposing three different stored-product mite species to diets treated with a range of concentrations. One species was clearly tolerant to all of the tested pesticides, while some of the newer pesticides did give some control of the other two species, but at very high concentrations. Results show the difficulty of mite control and emphasize the need for development of pesticides that have specific activity against stored-product mites.

Contact: Franklin Arthur, Telephone 785-776-2783, frank.arthur@ars.usda.gov

Characterization of recombinant chitinase-like proteins of Drosophila melanogaster and Tribolium castaneum

Chitin is the main component of insect exoskeleton, conferring both rigidity and flexibility, and protecting the insect from injury, predation, infection and desiccation. Chitin is also the major component of a membrane that coats the lining of the midgut, protecting it from abrasion and self-digestion. Until recently, very little has been known about the enzymes that are needed for digestion and reutilization of the old cuticle during the insect molting cycle. We isolated a variety of different types of chitinases from the fruit fly and the red flour beetle, and found that they had a range of different activities in the degradation of chitin. Each of these enzymes appears to have a slightly different function, but most or all are vital for insect survival. Each of these newly-discovered genes can become a target in screening assays for new biopesticides that disrupt molting and related physiological processes.

Contact: Richard Beeman, Telephone 785-776-2710, richard.beeman@ars.usda.gov

Interspecific relationships among stored grain beetles

Insects reduce the quality of stored grain and other stored products in the U.S. and throughout the world. Many laboratory studies have described interspecific relationships of stored grain insects, but little is known about such relationships under field conditions. Using data collected from a total of 1,118 wheat samples in Kansas grain elevators, the interspecific relationships between the three most common insect pests of stored wheat were studied. We found that these three beetle species significantly affected each other. The rusty grain beetle was more evenly distributed than the lesser grain borer, and high numbers of either the rusty grain beetle or the red flour beetle may have adversely affected the numbers of lesser grain borer; this may have been due to cannibalism. The findings from this study will be used to improve existing models of insect population dynamics in stored grain, which will lead to improved insect pest management programs for stored grain.

Contact: Paul Flinn, Telephone 785-776-2707, Email: paul.flinn@ars.usda.gov

Analysis of transcriptome data in the red flour beetle, Tribolium castaneum

Although the genome sequence is now available for the red flour beetle, deciphering actual genes (i.e., annotation) remains a challenging task. We have analyzed DNA transcripts from different red flour beetle tissues to help with the genome annotation. From more than 61,000 transcripts, we were able to match about 39% of genes that had been predicted from an automated gene prediction program. However, about 13% of the transcripts were not within predicted genes, indicating that many real genes were missed by the automated program. Our analysis suggests that there are approximately 7,500 genes in the red flour beetle genome. These data provide evidence of the power of high throughput sequencing of DNA transcripts in refining genomic data. Knowledge of red flour beetle genes should enable improved methods of controlling these and other insect pests.

Contact: Brenda Oppert, Telephone: 785-776-2780, Email: brenda.oppert@ars.usda.gov

Molecular mapping of the leaf rust resistance gene Lr17a in Wheat

Leaf rust is one of the most significant diseases that affects wheat. Application of chemical fungicides are often not economical and thus, disease must be combated using genetics. Effective resistance genes are found in germplasm sources and are bred into new varieties. However, it is sometimes difficult and labor intensive to determine whether a wheat cultivar has a particular gene or not. Thus, molecular tools are derived to help follow certain genes in populations. In this work, molecular markers have been found that can be used to identify the resistance gene Lr17a, in wheat. This gene is in numerous cultivars. Now that markers have been found, breeders can accurately determine if the gene is present in their lines, without the need for screening with the pathogen.

Contact: John Fellers, Telephone 785-532-2367, Email: john.fellers@ars.usda.gov

Using temporally limited wind data in the Wind Erosion Prediction System

The Wind Erosion Prediction System (WEPS) requires hourly wind data but these are not always available. Therefore, a procedure was developed to stochastically generate wind speed and direction from temporally limited wind data. For three locations, two statistical datasets were created to be used with the WEPS stochastic wind generator, based on 1) the full dataset with 24 observations per day and 2) a subset of 4 observations per day: at 2, 8, 14, and 20 hours local time. Erosive wind power densities, calculated from both datasets, agreed well with each other. The same was true for prevailing wind erosion direction and WEPS-simulated soil loss. In spite of temporally limited wind data, it is possible to use WEPS to estimate wind erosion hazard and relative effectiveness of various conservation practices.

Contact: Edward Skidmore, Telephone 785-537-5530, Email: edward.skidmore@ars.usda.gov

Cookies and tortillas from pre-cooked high-fiber wheat flour obtained by extrusion

Obesity is a major concern in the U.S. and globally, and the problem is reaching epidemic proportions. Consumption of dietary fiber has been recommended as a safe and practical approach for reduction of serum cholesterol and coronary artery disease. Extrusion cooking is widely used to modify functional properties, such as paste viscosity, water solubility and water absorption of cereal flours and starches. The purpose of this project was to examine the feasibility of utilizing extrusion technology for producing pre-cooked whole-wheat flours with increased functionality for baked products like cookies and tortillas at the same time having a reduced glycemic index. Significant differences in functional, rheological properties, and quality parameters of extruded wheat flour cookies and tortillas were observed. As the percent fiber content was increased, the quality parameters deteriorated for both non-extruded and extruded wheat flour cookies. No significant difference was observed in the rollability of non-extruded wheat flour tortillas whereas a significant difference was observed in extensibility values for extruded wheat flour tortillas.

Contact: Michael Tilley, Telephone 785-776-2759, Email: michael.tilley@ars.usda.gov

Pre-cooked, Sorghum-based Pasta Utilizing Extrusion Processing

Sorghum food products are safe foods for people that have celiac disease and cannot eat wheat, rye, barley, and possibly oats. Flour from a white sorghum, which is neutral in taste and appearance, was used as the base ingredient to produce pre-cooked, gluten-free pasta. The objectives of this study were to obtain the optimum combination of ingredients and processing on the quality and sensory characteristics. Results from the lab-scale study showed that pasta dried with the addition of humidity improved its appearance. Addition of monoglycerides to the formulation significantly improved the cooking quality of the pasta. Results of sensory studies using regular consumer (i.e. non-celiac) panelists showed that sorghum pasta fell in the middle of the acceptability range and would therefore provide an alternative market for white sorghum flours.

Contact: Scott Bean, Telephone 785-776-2757, Email: scott.bean@ars.usda.gov

USDA-ARS
GRAIN MARKETING
AND PRODUCTION
RESEARCH CENTER

1515 College Ave.
Manhattan, KS 66502

1-800-627-0388
gmprcinfo@gmprc.ksu.edu
ars.usda.gov/npa/gmprc

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