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Research Kernels

Our Latest Research Results - July 2011

Influence of Sanitation on Temperatures Attained and Mortality of *Tribolium castaneum* Life Stages in a Pilot Flour Mill Subjected to Heat Treatments

Authors: M. Brijwani, B. Subramanyam, P.W. Flinn, M.R. Langemeier, M. Hartzer
Submitted to: Journal of Economic Entomology

The red flour beetle is one of the most common and serious insect pests of flour mills. The phase out of the fumigant methyl bromide in the United States in 2005 because of its adverse effects on stratospheric ozone has generated renewed interest in heat treatments to disinfest flour mills. It is well known that grain and grain products are poor conductors of heat, based on temperatures measured during facility heat treatments. However, data are lacking on the influence of sanitation, such as removal of flour residues, on response of stored-product insects to heat treatments. In collaboration with scientists at Kansas State University, experiments were conducted to investigate the influence of sanitation on mortality of different stages of the red flour beetle exposed to 24-hour (h) heat treatments using forced-air gas heaters. Two sanitation levels, a dusting of wheat flour and 2-cm deep flour, were created in 25 plastic bioassay boxes, each holding eggs, young larvae, old larvae, pupae, and adult red flour beetles. The maximum temperature in the bioassay boxes and in the mill was lower on the first floor than on other floors. Mortality on the first floor ranged from 56 to 99%, and 93 to 100% on the other floors. Adults were the least susceptible stage. Mortality in bioassay boxes with 2-cm deep flour was generally lower than those with a dusting of flour. The cost of the heat treatments in the study ranged from $75.30 to $111.87 per 1,000 cubic feet. These results show that an effective heat treatment can be conducted within 24 h, provided the mill is cleaned to remove flour residues and temperatures reach 50°C and are held above 50°C for at least 12 h.

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Impact of Varying Levels of Sanitation on Mortality of *Tribolium castaneum* Eggs and Adults during Heat Treatment of a Pilot Flour Mill

Authors: M. Brijwani, B. Subramanyam, P.W. Flinn
Submitted to: Journal of Economic Entomology

The red flour beetle is the most common and economically damaging insect pest in flour mills. The phase-out of the fumigant methyl bromide in the United States in 2005, because of its adverse effects on stratospheric ozone, has generated renewed interest in using heat treatments for insect control in flour mills. Based on temperatures measured during facility heat treatments, it has been shown that flour is a poor conductor of heat and data are lacking on the mortality of insects in flour residues during heat treatments. In collaboration with scientists at Kansas State University, experiments were conducted to investigate the influence of residual flour depth on mortality of red flour beetle eggs and adults during two separate 24-h heat treatments of a flour mill. Red flour beetle eggs or adults were placed inside plastic rings containing various amounts of wheat flour ranging from 0.4 to 6 inches to simulate different residual flour levels that may exist in a flour mill. The protective effects of flour residue on insect mortality during the heat treatment were much greater for adults than for eggs. Flour depths of 1 inch or greater had less than 10% adult mortality, whereas the egg stage had 70% mortality at 1 and 2 inches and 40% mortality at 4 inches. This study showed that flour residues in mills can reduce the effectiveness of heat treatments.

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Anatomical Localization and Stereoisomeric Composition of *Tribolium castaneum* Aggregation Pheromones

Authors: R.W. Beeman, J.F. Campbell, Y. Park, M.J. Aikins, K. Mori, K. Akasaka, S. Tamogami, T.W. Phillips
Submitted to: Naturwissenschaften

Pheromone lures are important tools for both monitoring and control of pest insect populations. Although the commercially produced pheromone "Tribolure" has long been used for monitoring of populations of flour beetles, no one has ever determined either the site of production in the insect body or the natural blend of components in the attractant actually produced by the insect, and there is evidence that the commercial blend is not optimized for maximum attractive potency. In this work, we showed that the natural pheromone is produced in the outer layer of the abdomen, and we determined the composition of the natural blend of the pheromone. We also demonstrated that this natural blend is significantly more attractive than commercial Tribolure. These results could lead to significant improvements in flour beetle detection in mills and warehouses.

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Residual Efficacy of Pyrethrin + Methoprene Aerosol against Larvae of *Tribolium castaneum* and *Tribolium confusum* (Coleoptera: Tenebrionidae)

Authors: A. Sutton, F. Arthur, K. Zhu, J. Campbell, L. Murray

Submitted to: Journal of Stored Products Research

Combinations of the insecticide pyrethrin combined with the insect growth regulator methoprene (Diacon II®) are used as aerosol insecticides to control the red flour beetle and the confused flour beetle in flour mills. However, there is little information on how long the residues from an aerosol application will give control of either of these two important pest species. We placed wheat flour or packaging materials inside a flour mill and exposed them to commercial aerosol formulations containing either 1% or 3% pyrethrin with the same amount of methoprene. Then, for each of two weeks for 16 weeks, we put larvae of the red flour beetle and confused flour beetle on the flour and packaging materials. Control was determined by whether or not the larvae could reach the adult stage. Both commercial formulations gave complete control of red flour beetles on all surfaces for 16 weeks, but on all surfaces the residues were less active against the confused flour beetle, and more of the larvae were able to reach the adult stage compared to the red flour beetle. Increasing the pyrethrin concentration from 1% to 3% did lead to a reduction in the number of confused flour beetle adults, indicating there may be an interaction between the pyrethrin and methoprene components of the formulation. The formulation with 1% pyrethrin will control the red four beetle, while the 3% pyrethrin formulation is needed to control the confused flour beetle.

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Evaluation of Waxy Grain Sorghum for Ethanol Production

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Submitted to: Cereal Chemistry

Grain sorghum is a starch-rich cereal that can be grown economically in the semi-arid regions of the world, unlike wheat, corn, and rice. Currently, feedstock for fuel ethanol production is about 95% corn and 4% sorghum which accounts for 35% total sorghum production in the United States. This means that sorghum could make a larger contribution to the nation's fuel ethanol requirements. One of the aims for this study was to investigate whether ethanol yield and fermentation efficiency were influenced by the ratio of amylose and amylopectin of waxy grain sorghums. We found that using waxy sorghums for ethanol production resulted in energy consumption during the cooking process and shorter fermentation times. We also found that the residue left after fermentation of waxy sorghums had higher protein but lower starch content, which may have unique uses to the animal feed industry.

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Genetic Diversity and Population Structure of Elite Foxtail Millet [*Setaria italica* (L.) P. Beauv.] Germplasm in China

Authors: Z. Liu, G. Bai, D. Zhang, C. Zhu, X. Xia, R. Cheng, Z. Shi

Submitted to: Crop Science

As climate changes, drought will be one of the major constraints for crop production worldwide. Foxtail millet [*Setaria italica*] has excellent drought tolerance and has become one of the important cereal crops in China and several other countries that have severe water deficiency. To facilitate effective use of limited genetic resources in breeding programs, genetic diversity and population structure of foxtail millet were investigated in a collection of 128 lines selected from 3356 germplasm lines using molecular markers. The collection was from three major ecological areas of China: northern, northwestern, and northeast China. A high level of genetic diversity across the panel was identified among the collection. The collection is structured into six groups. Lines in Group 2 have unique geographic origins and pedigrees and are different from other groups. Thus crosses of accessions in this group to accessions from other five groups are more likely to generate elite combinations for developing both conventional and hybrid cultivars.

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