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Research Kernels

Our Latest Research Results - January 2012

Influence of Environmental and Physical Factors on *Tribolium castaneum* (Coleoptera: Tenebrionidae) Trap Captures in a Flour Mill

Authors: A.A. Semeao, J.F. Campbell, R.J. Whitworth, P.E. Sloderbeck
Submitted to: Journal of Economic Entomology
Pheromone traps that capture walking insects are widely used for monitoring of stored-product insect pests inside processing facilities, but variation in the local environment where traps are placed might impact the probability of capturing insects at that location. If specific factors associated with locations of greater insect activity could be identified, then they could be used to identify the optimal locations within a facility to place traps. The red flour beetle is a major pest of flour mills and is monitored using Dome® traps placed on the floor. Evaluating long-term patterns in red flour beetle captures revealed that while over short periods of time beetles were more likely to be found in certain areas of the mill, over longer periods of time areas of greater insect activity moved around the mill resulting in long-term averages that were more uniform among trap locations. Although the characteristics of individual trap locations were found to be highly variable, only warmer temperatures, higher flour dust accumulation, and proximity of milling equipment were associated with traps with high levels of beetle capture. Results indicate that while the environment appeared to have some influence over pattern in beetle captures it was limited, probably because broader patterns of change in distribution within the mill over time, perhaps related to season or increase in total abundance, were more important.
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Using a Population Growth Model to Simulate Response of *Plodia interpunctella* Hübner Populations to Timing and Frequency of Insecticide Treatments

Authors: E.A. Fontenot, F.H. Arthur, J.R. Nechols, J.E. Throne
Submitted to: Journal of Stored Products Research
Insecticides are used to suppress populations of insects in stored commodities, but it is difficult to determine long-term impact of different insecticide application strategies on insect population growth. We developed a computer model that simulates population growth of the Indianmeal moth, a major pest of stored grains and dried fruits, and we used the model to simulate the impact of timing and frequency of applications of different types of insecticides on long-term growth of Indianmeal moth populations. The most effective strategy tested for controlling Indianmeal moth populations was the use of biweekly applications of insecticide. The results will help pest managers in the food industry make sound management decisions.
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Analysis of the *Tribolium homeotic* Complex: Insights into Mechanisms Constraining Insect Hox Clusters

Authors: T.D. Shippy, M. Ronshaugen, J. Cande, J. He, R.W. Beeman, M. Levine, S.J. Brown, R.E. Denell
Submitted to: Development, Genes and Evolution
Development of the insect embryo is a complex process with many critical steps, disruption of any one of which would lead to the death of the embryo prior to egg-hatch. Although most of the genes required for embryonic survival have been identified, the ways they cooperate to orchestrate normal development are still unclear. This knowledge would enable better design of gene knockout strategies for pest control that target specific regions of vital genes. In this work we show that a large group of development genes in the embryo are grouped into a large cluster on one beetle chromosome, and that this clustering is necessary for their proper functioning, even though each gene in the cluster affects the development of a different region of the embyro. This work refines our ability to design selective toxins for incorporation into resistant crop varieties.
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Attraction of Walking *Tribolium castaneum* Adults to Traps

Author: J.F. Campbell
Submitted to: Environmental Entomology
The red flour beetle is a major pest of food processing facilities, and its activity can be monitored using traps baited with pheromone and food odor attractants. How well these attractants work under real world conditions has not been previously evaluated, although anecdotal reports from users suggest that beetles are not highly responsive. Using a new experimental protocol that simulates how beetles interact with traps in commercial food facilities, it was demonstrated that beetle response was strongest to traps baited with pheromone and food attractant, or with pheromone alone, when air flowed

from the trap toward the beetle. The beetle's positive response to pheromone and food attractant baited traps extended out to a distance of 35 inches, the maximum distance tested. However, under still air conditions beetles did not respond to any of the tested attractants. Within food processing facilities, traps are often placed in sheltered locations with limited air movement, with the result that traps may have limited attractiveness to red flour beetles. Understanding the role of air movement on the response of this important pest could improve the interpretation of monitoring programs and guide the optimal placement of traps within a facility.
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Detection of Fungal Damaged Popcorn using Covariance Features

Authors: O. Yorulmaz, T.C. Pearson, A.E. Cetin
Submitted to: Computers and Electronics in Agriculture
Popcorn is especially vulnerable to fungal infections at harvest time because drying of this grain must be gradual, otherwise it will not pop. One type of fungal infection is called "blue-eye" since it causes a small blue-gray blemish on the germ of the kernel. These infected kernels can have a very undesirable off taste, resulting in lower consumer acceptance of this snack food. The blemish associated with blue-eye damaged popcorn is so small that current commercially available sorting machines are not able to detect and remove these infected seeds. In this study, image processing techniques were developed to detect blue-eye damaged popcorn with accuracies over 95%. While these techniques are fairly advanced, they can be implemented on high speed sorting machines to detect and remove blue-eye damaged popcorn. Furthermore, the technique is adaptable to detecting blemishes on other commodities, such as wheat, beans, and corn, such as those caused by insect damage and other species of fungi.
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Detection of Hidden Stored Grain Insects in Brown Rice using a Conductive Roller Mill

Authors: D.L. Brabec, T.C. Pearson, P.W. Flinn
Submitted to: Cereal Foods World
A small mill was designed to facilitate detection of rice and wheat kernels infested by hidden stored grain insects. These insects bore into kernels as tiny larvae and live their entire pre-adult life inside the kernels, with no visible indication that they are there. When they reach adulthood, they emerge from the kernel and can lay thousands more eggs which can lead to loss of grain and poor quality. Given that the immature insects are hidden inside the kernels, there is no good method to detect infested kernels. The modified mill was shown to have high accuracy in detecting infested kernels. This will allow better monitoring for these pests and allow better quality control of incoming and outgoing product, leading to better overall grain quality.
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3-D and Quasi-2-D Discrete Element Modeling of Grain Commingling in a Bucket Elevator Boot System

Authors: J.M. Boac, M. Casada, R.G. Maghirang, J.P. Harner III
Submitted to: Transactions of the ASABE
Unwanted grain commingling reduces grain purity, which impair the effectiveness of new quality-based grain handling systems. Experimental studies of commingling are expensive and time consuming so this study developed experimentally validated models that can reduce the time and expense of studying grain commingling. Grain commingling in a pilot-scale bucket elevator boot was modeled in (1) three-dimensional (3-D) discrete element method (DEM) simulations and (2) in two-dimensional (2-D) DEM simulations, which provides faster simulations. Grain commingling in the pilot-scale boot was measured in experiments using red and clear soybeans. Predicted results from both 3-D and 2-D models followed the trends of the experimental data, with a tendency to under predict commingling early in the process. Since the models predicted the cumulative commingling well over the whole run, they were considered effective for evaluating commingling in the boot. The 2-D model reduced simulation run time by approximately 70% compared to the 3-D model of the pilot-scale boot. Results of this study will be used to accurately predict impurity levels and improve grain handling, which can help farmers and grain handlers reduce costs and maintain grain purity during transport and export of grains.
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