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Research Kernels

Our Latest Research Results - February 2011

Effects of Flameless Catalytic Infrared Radiation on *Sitophilus oryzae* (L.) life stages

Authors: M. Khamis, B. Subramanyam, H. Dogan, P.W. Flinn, J.A. Gwirtz
Submitted to: Journal of Stored Products Research
The rice weevil causes a great deal of damage to stored wheat in the USA because the immature stages develop inside the kernel and are difficult to control. There are few insecticides that are registered for control of this pest, which increases the chances that insecticide resistance will develop. A catalytic heater using propane gas can be used to produce infrared heat that can kill insects that are inside wheat kernels. In collaboration with scientists at Kansas State University, we conducted experiments to determine the effectiveness of infrared radiation to kill different stages of the rice weevil inside wheat kernels. The grain temperatures attained were influenced by wheat quantity, distance from the emitter, and exposure time. Complete mortality of all stages of the rice weevil was achieved at 8.0 cm (3 inches) from the emitter using 113.5 grams (4 ounces) of wheat during a 60-second exposure. Eggs were least susceptible to the treatment, followed by adults inside kernels, larvae, and adults outside of kernels. These results show that flameless catalytic infrared technology may be a viable option for disinfestation of stored wheat in the future.
Contact Paul Flinn, telephone 785-776-2707, email paul.flinn@ars.usda.gov

Susceptibility of *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) Life Stages to Flameless Catalytic Infrared Radiation

Authors: M. Khamis, B. Subramanyam, P.W. Flinn, H. Dogan, J.A. Gwirtz
Submitted to: Journal of Economic Entomology
The red flour beetle is a common pest of stored wheat. Few new insecticides are being developed for stored-grain insect control, which increases the chances that insecticide resistance will develop. A catalytic heater using propane gas can be used to produce heat that can kill insects in grain. In collaboration with scientists at Kansas State University, we conducted experiments to determine the effectiveness of infrared radiation to kill different stages of the red flour beetle in stored wheat. Grain temperature was a function of exposure time, distance from the heat source, and amount of grain. All life stages of the red flour beetle were killed after a 60 second exposure at a distance of 8.0 cm (3 inches) from the emitter using 113.5 g (4 ounces) of wheat. The mean grain temperatures ranged from 107 to 111°C (225 to 232°F). Pupae were the least susceptible stage, followed by eggs, adults, and larvae. These results indicate that flameless catalytic infra-red technology may be a possible option for controlling insects in stored grain in the future.
Contact Paul Flinn, telephone 785-776-2707, email paul.flinn@ars.usda.gov

Effects of Rearing Density, Age, Sex, and Food Deprivation on Flight Initiation of the Red Flour Beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae)

Authors: J. Perez-Mendoza, J.F. Campbell, J.E. Throne
Submitted to: Journal of Economic Entomology
The red flour beetle is one of the major pests in stored grain and in grain processing facilities throughout the world. Traps are used to monitor their movement to aid in making pest management decisions, but we don't fully understand the factors that cause their movement. We found that the rates at which red flour beetles initiate flight did not differ with age or sex, presence or absence of food, or duration of starvation. Adults were less likely to fly when individuals of the opposite sex were present. Presence of the same sex or mixed sexes and the actual numbers of individuals present did not affect tendency to fly. Older beetles (7- to 20-d old) initiated flight more quickly than younger beetles (1- to 4-d old). No young beetles flew during the first 24 hours of flight tests. Time to flight did not differ with rearing density, sex, presence or absence of food, or duration of starvation. These results will help to develop better methods for interpreting trap catches from pest monitoring programs.
Contact James Throne, telephone 785-776-2796, email james.throne@ars.usda.gov

Efficacy of Pyriproxyfen for Control of Stored-Product Psocids (Psocoptera) on Concrete Surfaces

Authors: C. Athanassiou, F.H. Arthur, N. Kavallieratos, J.E. Throne
Submitted to: Journal of Economic Entomology
Psocids (insects which are also called booklice) are pests of stored grains and grain products in most of the world, and they have natural tolerance to some of the insecticides used for control of stored-product insects. Thus, there is a need to develop alternative treatments for their control. We evaluated the insecticide pyriproxyfen, which is a newly registered insect growth regulator with low mammalian toxicity, for control of

three stored-product psocid pests on concrete surfaces, which are typical of flooring in flour mills and warehouses. Exposure to pyriproxyfen reduced the numbers of all three species of psocids. The presence of food, either treated or not with pyriproxyfen, generally did not affect effectiveness of the insecticide. However, numbers of progeny generally were lower when psocids were placed on the concrete surface before it was treated with pyriproxyfen compared to being placed on the concrete surface after treatment. Few adults of any species were found in the pyriproxyfen treatments. The results indicate that pyriproxyfen is effective for control of the psocids *Liposcelis bostrychophila*, *L. decolor*, and *L. paeta* on concrete, although complete control was rarely achieved, and this warrants further long-term study to determine if pyriproxyfen can completely eliminate psocid populations over time.
Contact James Throne, telephone 785-776-2796, email james.throne@ars.usda.gov

Effect of Methoprene on the Progeny Production of *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae)

Authors: L.K.W. Wijayaratne, P.G. Fields, F.H. Arthur
Submitted to: Pest Management Science
Insect growth regulators (IGRs) affect growth and development of immature insects, and may also produce sub-lethal effects such as a reduction in number of eggs laid by adults. In this test, larvae and adults of the red flour beetle, a major pest of stored products, were exposed on wheat treated with the IGR methoprene. Exposure of adults produced little effect on subsequent reproduction of those adults. However, male larvae that were exposed to the treated wheat were more susceptible than female larvae with generally lower adult emergence in exposed male larvae compared to exposed female larvae. In addition, males that survived to the adult stage and were paired with unexposed females generally produced fewer offspring than unexposed males paired with unexposed females. Results show that sub-lethal effects caused by an IGR could contribute to overall population reductions from insecticidal treatments.
Contact Frank Arthur, telephone 785-776-2783, email frank.arthur@ars.usda.gov

Diverse Microbes in the Gut of Hessian Fly Larvae

Authors: R. Bansal, S. Hulbert, J.C Reese, R.J. Whitworth, J.J. Stuart, M.S. Chen
Submitted to: Applied and Environmental Microbiology
The gut of animals including insects hosts various microbes. Gut microbes perform a wide range of functions useful to the host, such as synthesizing vitamins and essential amino acids, preventing growth of harmful pathogens, and utilizing energy substrates that cannot be used directly by the host itself. Gut microbes in plant-feeding insects also play a role in insect-plant interactions. The Hessian fly is a very important insect pest of wheat. In this study, we analyzed the composition of microbes in the Hessian fly larval gut. We found that the Hessian fly larval gut hosts diverse bacteria and Archaea. The composition of microbes changes in different instar and pupae of the insect. The research provides a foundation for future research on the roles of gut microbes in Hessian fly biology and its interaction with wheat.
Contact Ming-Shun Chen, telephone 785-532-4719, email ming-shun.chen@ars.usda.gov

Hessian Fly - Associated Bacteria: Transmission, Essentiality, and Composition

Authors: R. Bansal, S. Hulbert, B. Schemerhorn, J.C. Reese, J.R. Witworth, J.J. Stuart, M.S.Chen
Submitted to: Journal of Applied Microbiology
Hessian fly is an important insect pest on wheat that causes stunting of seedlings and lodging of adult plants. In this study, we analyzed for the first time bacteria associated with different developmental stages of the Hessian fly. Diverse bacteria were found in Hessian fly larvae, pupae, and adults. Most of the bacteria were transferred to the next generation through eggs (maternal transmission). Elimination of bacteria from the insect through antibiotics resulted in high mortality of larvae, suggesting that symbiotic bacteria were essential for the insect to survive on wheat seedlings. Similar bacteria were also found in Hessian fly-infested wheat, suggesting that Hessian fly larvae transmit bacteria into plant tissue, and that these transmitted bacteria may play a role in the wheat-Hessian fly interaction. This research provides a foundation for future research on the role of bacteria in Hessian fly biology and virulence.
Contact Ming-Shun Chen, telephone 785-532-4719, email ming-shun.chen@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research

1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/npa/cgahr