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Research Kernels

Our Latest Research Results • August 2007

Comparison of Three NIR Spectrophotometers for Infestation Detection in Wild Blueberries Using Multivariate Calibration Models

There is an increased consumer interest in fresh and processed blueberry products because of their potential health benefits, in particular as a good source of antioxidants. The blueberry maggot fly is the most important pest of commercially grown lowbush and highbush blueberries in eastern North America and can infest a significant amount of the blueberry crop. Domestic and international markets for fresh, canned, and frozen fruit have a "near zero to zero" tolerance for infested fruit. There is a potential to change the way in which this fly is managed on-farm by developing technologies that rely upon detection of the fly within the fruit at the processing plant using optical detection systems such as near-infrared spectroscopy (NIRS). We studied the application of three NIRS instruments for detecting internal larvae and showed infested blueberries could be detected with accuracies up to 80%. This technology could be used to detect infested blueberries online and lead to an automated means of detecting and removing defective berries. This technology will help the blueberry industry meet the needs of domestic and foreign markets and thus lead to expanded markets for their product.

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Susceptibility of sorghum to *Rhyzopertha dominica* F. and their effects on the physicochemical properties of sorghum kernel and flour

Sorghum is receiving increased attention as a food grain in the United States, especially for persons suffering from celiac disease, and storage of food grade sorghum could increase as this market develops. Rhyzopertha dominica (F.), the lesser grain borer, is a major economic insect pest of many stored grains, including sorghum, but there is little published data regarding the attractiveness of sorghum as a food source for R. dominica. The objectives of this study were to determine the attractiveness of sorghum as a food source for R. dominica, and to quantify the damage to sorghum quality parameters caused by different levels of R. dominica infestation. The results showed that R. dominica will readily feed on sorghum, and the infestation of R. dominica not only affects the physical properties of the sorghum kernels but also affects the chemical composition during storage. We found that initial population of bugs, culture temperature, and their relation affected the number of progeny and feeding damage. As the initial population increased, the number of progeny, percentage of insect-damaged kernels, and feeding damage increased. R. dominica infestation caused decrease in sorghum protein content and kernel hardness, and increase in starch pasting viscosity.

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Protein digestion in red oak borer larvae, *Enaphalodes rufulus* (Haldeman)(Coleoptera: Cerambycidae)

Red oak borer larvae have caused damage and threatened the survival of oak trees in the Ozark Mountains. To try to identify new control methods, we studied the digestive proteinases in larvae from trees that were transferred to artificial diet, or those that were reared in tree sections on phloem. Biochemical tests indicated that red oak borer larvae use serine proteinases to digest protein. Inhibitors of one type of serine proteinase, trypsin, were very effective in reducing total proteolytic activity from gut samples. Therefore, we suggest that use of trypsin inhibitors may be an effective way to reduce red oak borer damage to trees, either by increasing the inherent expression of trypsin inhibitors in trees, or by transgenic technologies that use genes encoding trypsin inhibitors.

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Chloroplast EF-Tu and thermal aggregation of Rubisco activase

A plant protein, known as chloroplast EF-Tu, has been implicated in heat tolerance in maize. This protein has been found to protect heat-labile proteins, such as citrate synthase and malate dehydrogenase, from heat-induced damage (thermal aggregation). In this study, we investigated the effect of wheat EF-Tu on thermal aggregation of a photosynthetic enzyme, Rubisco activase. Additionally, we investigated the effect of maize EF-Tu on activase aggregation. Activase was chosen because it displays an exceptional sensitivity to thermal aggregation and constrains photosynthesis at high temperature. Both wheat and maize EF-Tu protected Rubisco activase from thermal aggregation. This is the first report on protective activity of wheat EF-Tu and the first evidence for thermal protection of a photosynthetic enzyme by this chloroplast protein. The results are consistent with the hypothesis that chloroplast EF-Tu plays a functional role in heat tolerance by protecting heat-labile proteins from heat-induced damage.

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Insecticidal effect of spinosad dust, in combination with diatomaceous earth, against two stored-grain beetle species

Spinosad is a biological pesticide that has been evaluated for control of stored-grain beetles, but the dust formulation has not been extensively tested. We conducted tests by evaluating Spinosad dust applied alone and in combination with the natural inert dust diatomaceous earth (DE) on wheat and corn, with the rice weevil and the confused flour beetle as the target pests. Spinosad alone was more effective on wheat and corn for control of the rice weevil, and adding the DE increased rice weevil mortality on corn. The confused flour beetle was more difficult to kill on both commodities compared to the rice weevil, but adding the DE gave increased mortality of this species as well. Applying spinosad in combination with DE may be necessary to give effective control of beetle pests of stored wheat and other stored products.

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Aerosol distribution and efficacy in a commercial food warehouse

There is little published information regarding the effectiveness of insecticidal aerosols in commercial facilities, and results of laboratory trials may not always be an indication of effectiveness in field applications. Tests were done by exposing adult red flour beetles and confused flour beetles, along with pupae and larvae, to pyrethrin insecticide inside a commercial warehouse. In addition, larvae of the beetles and eggs of the Indianmeal moth were also exposed to the insect growth regulator methoprene. Although the aerosol system effectively distributed the insecticide throughout the test facility, the red flour beetle was more susceptible than the confused flour beetle to the pyrethrin insecticide. Methoprene was effective against larvae of both beetle species, but eggs of the Indianmeal moth were difficult to kill. Results show that the effectiveness of aerosols will depend on several related factors, including how well the application system distributes the insecticide, the toxicity of that insecticide, differences in susceptibility between target insect species, and variation in susceptibility of individual life stages.

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Characterization and expression of the beta-N-acetylglucosaminidase gene family of *Tribolium castaneum*

The chitin-containing insect exoskeleton ("skin") represents both a unique physiological adaptation and a promising target for biopesticide disruption. Each time an insect sheds its old skin, the chitin is digested into smaller components, and these components are recycled to manufacture the next skin. We have identified four insect genes called "NAGs" that are essential for the final stage of chitin degradation into the smallest component parts. Each of the four NAG genes has a slightly different function in chitin degradation, presenting 4 new targets for pest control intervention. Continued identification of the individual genes required for processes unique to insects will expand our options for selective biopesticide design.

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