GMPRC
Grain Marketing and Production Research Center

Research Kernels

Our Latest Research Results • October 2008

Non-destructive prediction of protein, starch, and moisture for individual maize kernels using near infrared reflectance spectroscopy

Starch, protein, and moisture are major constituents of the maize kernels and comprise approximately 80% of the kernel mass. To select kernels with desirable composition traits for breeding, geneticists and breeders need seed composition information. Standard lab methods are destructive which prohibits planting selected seeds that have the desired compositions. A non-destructive, near-infrared reflectance (NIR) spectroscopic instrument was used in this research to classify individual maize kernels. The NIR instrument was used to determine starch, protein, and moisture content of individual maize seeds. The NIR instrument collects both seed weight and spectral data at a rate of 4-6 s/kernel and NIR spectra alone at up to 10 kernels/s. These results give significant improvements over previous single-kernel NIR systems. The calibrations reported here make the NIR instrument a valuable and practical tool for high throughput measurement of the major chemical constituents in single maize kernels.

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Should grain elevator managers adopt Integrated Pest Management?

The reduced number of insecticides available for controlling insect pests of stored grain combined with demands for pest-free food poses a challenge for managers of stored grain facilities. Integrated pest management (IPM) provides the potential for better insect management in stored grain, as well as increased worker safety and reduced environmental impact. Many country elevators continue to use calendar-based fumigation instead of IPM. To determine if this choice is economically justified, we used a simulation model to compare the total costs for sampling-based IPM and calendar-based fumigation for a typical country elevator in the U.S. Central and Southern Plains. The simulation studies showed that if insect immigration rate was the same for all bins, then country elevators storing hard red winter wheat will likely find it more economical to use calendar-based fumigation than to adopt a sampling-based IPM approach. However, if we assumed that insect immigration rate varies among bins, then a sampling-based IPM approach was the better alternative. A sampling-based IPM program can save the elevators money and decrease environmental impact because, instead of fumigating all of the bins at a facility, they only need to fumigate bins that are infested.

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Effects on wetting by spray on concentrated flow erosion and intake rate

Rapid wetting of dry soil by irrigation or rain water may cause breakdown of soil aggregates. If soil is wet before furrow irrigation, this condition may reduce aggregate slaking and may decrease concentrated flow erosion. Soil could be wetted by spray (like rain) or by flow (like furrow irrigation) with different intensity. We studied the effects of spray wetting intensity and furrow flow type (interrupted vs. continuous flow) on soil cumulative intake and cumulative soil loss of silt loam and clay soils. For the silt loam soil, spray wetting generally had no effect on cumulative intake and concentrated flow erosion. In this soil, the interrupted or continuous flow yielded comparable cumulative intake. In the clay, there was a critical spray intensity for aggregate disintegration. Below the critical intensity, spray wetting did not cause aggregate slaking and high concentrated flow erosion. When the spray intensity was higher than critical, spray wetting did not diminish concentrated flow erosion. Thus, in the clay soil, interrupted flow increased cumulative intake in comparison to continuous flow. The opposite response of the silt loam and clay soils to interrupted flow can be explained by differences in aggregate stability, which affects consolidation. Under stable soil aggregates, interrupted flow increased cumulative intake in comparison to continuous flow due to the elevated hydraulic gradient in the interrupted flow. But when surface aggregates were disintegrated, the complete consolidation of the soil surface by interrupted flow balances the favorable impact of the increased hydraulic gradient. Thus, cumulative intake under interrupted and continuous flow

remained similar. The study describes soil stability conditions under which spray wetting before furrow irrigation could affect furrow erosion. In soils with an inherent aggregate and structural stability (clay soil), spray wetting may diminish concentrated flow erosion. In soils with a less stable structure (silt loam), spray wetting before concentrated flow does not affect concentrated flow erosion. The results can help in the adjustment of existing models and development of new models for the estimation of soil erosion with changes in irrigation practices and soil conditions.

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A protein from the salivary glands of the pea aphid, *Acyrthosiphon pisum*, is essential in feeding on a host plant

Insects, especially those with sucking mouthparts, inject proteins and other substances into host tissues to facilitate feeding. This research, for the first time, has demonstrated that a salivary protein is essential for an insect to survive on host plants. Without this protein (through so-called gene silencing), the insect can survive on an artificial diet, but not on a host plant. The essentiality of this protein for the insect to live on a host plant indicates a possibility to convert a host plant into a nonhost by artificially expressed double-stranded RNA of the insect gene in plants.

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Insecticidal effect of diatomaceous earth against three species of stored-product psocids on corn, rice, and wheat

Psocids, or booklice, are emerging pests of stored grain and processed stored products, but we know little about their biology and control. We evaluated the effectiveness of three insecticidal diatomaceous earth (DE) formulations that are registered for control of stored-product insects, Dryacide, Protect-It, and Insecto, against three psocid species, *Liposcelis entomophila*, *Lepinotus reticulatus*, and *Liposcelis decolor* on wheat, rice and corn in the laboratory. *Liposcelis decolor* was relatively tolerant of all DEs. Susceptibility of *Liposcelis entomophila* and *Lepinotus reticulatus* varied with grain and DE formulation. Mortality of *L. entomophila*, *L. reticulatus*, and *L. decolor* was only 63, 71, and 42%, respectively, after 14 days, and offspring production after 30 days reached 54, 42, and 76 individuals per 10 grams of grain. Our results indicate that DE's, when used alone, will not provide effective control of psocids.

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Molecular techniques for detection of confused flour beetle infestations in stored products

The confused flour beetle is a pest of stored products, and it infests a wide range of food products, from flour and cereals to spices. The insect reduces food quality and is responsible for large economic losses every year. Although a number of methods for detection of stored-product pests are common and widely used, they are time consuming and expensive. Therefore, establishing molecular methods of detection of stored-product pests could provide a useful alternative method. We attempted to establish methods of detection of the confused flour beetle based on molecular biology techniques of standard and real-time PCR. The PCR method proved to be reliable and sensitive for detection, and the method is a possible supplemental detection method for quantitative assessment of infestation level.

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