GMPRC
Grain Marketing and Production Research Center

Research Kernels

Our Latest Research Results • January 2009

Estimating the saltation and suspension components from field wind erosion

During wind erosion on fields, the saltation (hopping) aggregates abrade the surface and create additional dust-size aggregates. Accurate estimates of the saltation and dust leaving fields are needed to determine the near-field sediment deposition and off-site dust impacts, as well as to improve wind erosion models. In this study, improved methodology to estimate dust and saltation fractions leaving fields was developed as follows: First, the eroded sediment trapped in passive samplers spaced vertically above the soil surface was sieved with precision sieves. Next, mathematical equations were fitted to the sieved data to determine the proportions of saltation and dust leaving fields. From analysis of 9 field studies in 4 states, the improved methodology showed estimated saltation decreased by 21% and dust increased by 42% compared with estimates using prior methodology reported in the literature.

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The *Tribolium castaneum* larval gut transcriptome and proteome: A resource for the study of the coleopteran gut

Beetle storage pests are among the most damaging and difficult to control. Now that we have the sequenced genome of the red flour beetle, *Tribolium castaneum,* we can begin to develop sophisticated techniques to study the beetle gut, the primary interface of the insect with its environment. Genetic sequences of the flour beetle were used to develop microarrays to identify those genes expressed in the larval gut. We also used another advanced technique called “proteomics” to identify proteins that are found in the beetle gut. These studies have provided a database for novel biopesticides to screen and incorporate into integrated pest management strategies to control beetle pests.

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Size distribution and rate of dust generated during grain elevator handling

Dust generated during grain handling can pose a safety and health hazard and is an air pollutant. Fifty percent of the 245 reported grain dust explosions in the United States from 1986-2005 were in grain elevators. Due to the high organic content and small size of the particles, high concentrations of grain dust pose an explosion hazard. The size of the particles affects the minimum explosive concentration and the force of the explosions. In addition, prolonged exposure to grain dust can harm grain-handling workers’ health with smaller dust particles being carried deeper into the human respiratory system. To characterize the dust generated during handling of wheat and shelled corn dust samples were collected from the lower and upper ducts upstream of the cyclone dust collectors in the research elevator of the USDA Grain Marketing and Production Research Center. In the tests at an average grain flow rate of 54.4 t/h, the corn and wheat differed significantly in the dust size distribution and the rate of total dust generated. Shelled corn produced significantly smaller dust particles, and a greater proportion of small particles, than wheat. The corn produced more than twice as much total dust — 185 g/t of corn handled — than did wheat. These results improve our understanding of the health concerns of these grain dusts related to particle size and will be valuable for feed and grain handlers and grain elevator operators for evaluating and improving their handling and sanitation procedures to reduce their safety and health hazards and air pollution problems.

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Prediction of maize seed attributes using a rapid single kernel near infrared instrument

Non-destructive measurements of seed attributes would significantly enhance breeder selection of seeds with specific traits and potentially improve hybrid development. A single-kernel near infrared reflectance (NIR) instrument was tested for rapidly measuring maize seed attributes. At a throughput of five kernels/s, the instrument enables plant breeders to quickly select individual seeds that

possess specific desired traits. Accuracy of the instrument was tested on 87 maize samples representing a wide variability in the essential amino acids, tryptophan and lysine, crude protein, oil and sugar content. Results showed crude protein and kernel mass were measured well. Tryptophan, lysine and oil measurements were less accurate but have good potential for sorting individual seeds into high, medium and low values. Sugar content was not measured accurately. The instrument has good potential to augment breeder development of nutritionally enhanced maize hybrids.

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Selecting and sorting waxy wheat kernels using near-infrared spectroscopy

Amylose-free, or waxy, wheat has functional end-use advantages over amylose-bearing wheat, and these advantages can provide for additional marketing opportunities. For example, waxy wheat flour has a high water-binding capacity, products made from waxy flour can exhibit a longer shelf-life, products extruded from waxy flour can be enhanced, and ethanol conversion from waxy wheat is enhanced. However, when developing waxy wheat, as few as 1 in 64 kernels may express the waxy trait. Therefore, the ability to select waxy seed from early generation segregating populations would provide breeding materials enriched in the number of seeds with this trait. Also, if an advanced waxy breeding line requires purification for the waxy trait prior to release, there is presently no efficient or cost-effective way to accomplish this, especially since large seed samples are typically involved. We showed that an automated single-kernel near-infrared (SKNIR) sorting system could be used to select waxy kernels from segregating breeding lines or to purify advance breeding lines for the waxy trait. This rapid and non-destructive SKNIR technology offers significant benefits to breeding program and is much faster than utilizing molecular markers or staining techniques.

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Quantitative trait loci for resistance to pre-harvest sprouting in U.S. hard white winter wheat

Pre-harvesting sprouting (PHS) refers to seed germination in a matured wheat head before harvest due to a long period wet weather. Sprouted wheat usually has poor flour quality. Using DNA marker technology, three genetic factors, called quantitative trait loci (QTL), that control delayed seed germination were identified from US white wheat cultivar Rio Blanco. One major QTL, QPhs. pseru-3A, was identified in the distal region of wheat chromosome 3AS and was responsible for 41.0% PHS resistance based on three greenhouse experiments. This QTL was identified in two mapping populations with Rio Blanco as the PHS-resistant parent. Two other QTL were located on chromosome 2B and showed a minor effect on PHS resistance. These QTLs were tagged with several DNA markers. Because Rio Blanco is a popular parent used in many hard winter wheat breeding programs, DNA markers linked to the QTLs have potential for use in marker-assisted selection of wheat cultivars with improved PHS resistance.

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