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Research Kernels

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Detection of Fungus-Infected Corn Kernels using Near-Infrared Reflectance Spectroscopy and Color Imaging

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Submitted to: Transactions of the ASABE

Mold contamination of grain products can lead to significant economic losses because of health and production issues related to mycotoxins. Corn, in particular has significant problems because of its widespread use for human and animal feed. Detection and measurement of fungal-infected corn kernels would be advantageous to minimize or eliminate consumer risk, and for breeders in identifying hybrids resistant to mold growth. Near infrared reflectance spectroscopy (NIRS) and color imaging methods were studied to detect the type and extent of mold infection, on single corn kernels, for eight common mold species. NIRS was able to accurately identify 98% of uninfected kernels compared to 89% for color imaging. Certain mold species were identified better than others using NIRS. The imaging system was not able to identify mold species well. Both methods could discriminate between the uninfected and more heavily infected kernels but neither method was adequate for identifying lesser infected kernels. Overall, results indicate the methods could potentially be used for pre-screening of samples to determine if a more time consuming, but accurate, analysis is needed.

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Material and Interaction Properties of Selected Grains and Oilseeds for Modeling Discrete Particles

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Experimental investigations of grain handling and commingling can be expensive and time-consuming, but computer simulations can reduce the large effort required to evaluate these handling operations. Relevant grain physical properties must be known to accurately simulate grain handling operations. This study reviewed published physical properties needed to model commingling of major grains and oilseeds with the discrete element method (DEM) and used these properties to develop and validate an effective particle model using soybeans as the test seed. A single-sphere particle model best simulated soybean kernels in bulk property tests such as angle of repose and bulk density. The best particle model had coefficient of restitution of 0.6; static friction of 0.45 for soybean-soybean contact (0.30 for soybean-steel interaction); rolling friction of 0.05; normal particle size distribution with standard deviation factor of 0.4; and shear modulus of 1.04 MPa. The results of this study will be used to simulate commingling of major grains and oilseeds to accurately predict impurity levels in grain handling, which can help farmers and grain handlers reduce costs during transport and export of grains and make U.S. grain more competitive in the world market.

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Infiltration and Erosion in Soils Treated with Dry PAM of Two Molecular Weights and Phosphogypsum

Authors: M. Iliasson, I. Shainberg, L.E. Wagner, D.N. Warrington, G. Levy

Submitted to: Australian Journal of Soil Research

Soil amendments such as gypsum and anionic polyacrylamide (PAM), both environmentally safe soil amendments, have been used to reduce soil erosion by wind and water. Water soluble PAMs are effective because they stabilize soil structure, prevent clay dispersion and improve soil clay flocculation. Gypsum is effective because, upon dissolution, it releases salts into the rainwater that prevent clay dispersion and thus reduce soil aggregate breakdown. The effectiveness of PAMs also depends on its molecular weight (MW) and soil properties. We investigated the effects of surface applied granular PAM (20 kg ha-1) of two molecular weights (medium and high) together with gypsum (4 Mg ha-1) on the infiltration rate, runoff and erosion from 5 soils ranging in texture from loamy sand to clay, during simulated rainstorms. Surface application of PAM (for both molecular weights) supplemented with gypsum resulted in up to four times the steady state infiltration rate when compared to the control treatment (no amendments applied). In addition, the combined treatments of PAM and gypsum also produced up to five times less runoff and erosion than the control treatment. The combined treatments also showed significant beneficial differences compared to the PAM and gypsum only treatments as well. PAM with moderate molecular weight was considerable more effective in reducing soil loss than PAM with high molecular weight. More studies, in which PAM with different molecular weight is applied in the form of dry granules, are needed in order to maximize the efficiency of PAM application in a soil-specific management approach to controlling soil and water losses.

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Development of Single-Seed Near-Infrared Spectroscopic Predictions of Corn and Soybeans Constituents Using Bulk Reference Values and Mean Spectra

Authors: P.R. Armstrong, J.G. Tallada, C. Hurburgh, D.F. Hildebrand

Submitted to: Transactions of the ASABE

Methods to measure the composition of single seeds of corn and soybeans would significantly enhance the ability of breeders to improve hybrids and varieties by selecting seeds that target breeder composition goals. Near-infrared reflectance spectroscopy (NIRS) is a method that has previously been used to measure single seed composition, such as protein, oil, and starch, but developing NIRS calibrations to do this generally requires the compositional measurement of single seeds. This cannot always be easily done and thus a method to calibrate for single seeds using bulk sample measurement was investigated as an alternative approach. NIRS calibrations using bulk sample methods were developed for corn protein, oil, starch, and kernel density; soybean protein, oil, and fiber. Results show that accurate seed measurement is possible although soybean fiber measurement is less accurate. These methods will allow NIRS calibrations to be developed more quickly and easily and should also expedite the development of commercial hybrids.

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Characterization of the Composition and Molecular Weight Distribution of Carob Germ Protein Fractions

Authors: B.M. Smith, S. Bean, T.J. Schober, M. Tilley, T.J. Herald, F. Aramouni

Submitted to: Journal of Agricultural and Food Chemistry

Gluten free breads typically suffer from poor quality and are typically produced from cake batter like systems rather than from dough. This causes problems both in food quality and in food processing. Intense research has been focused on finding and developing non-wheat proteins that are capable of forming a dough. This research measured the molecular weight of carob germ proteins which are known to have dough like properties. The molecular weight of carob germ proteins were found to be lower than of gluten, which is one reason why the carob germ proteins do not produce a dough as strong as gluten. Differences in other properties such as solubility were also found, which may contribute to the weakness of carob germ protein dough. This research provides insight into the properties of proteins needed to form dough and provides further insight into possible ways to modify proteins from other sources, including corn and sorghum, to form dough. Dough formation in non-wheat proteins will improve the quality of wheat-free foods and also will provide information to better understand the functionality of wheat gluten proteins.

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Evaluation of Quantitative PCR Reference Genes for Gene Expression Studies in *Tribolium castaneum* After Fungal Challenge

Authors: J.C. Lord, K.L. Hartzer, M.J. Toutges, B.S. Oppert

Submitted to: Journal of Microbiological Methods

Quantitative polymerase chain reaction (qPCR) is the predominant means for measuring gene expression in all organisms and is widely used with the red flour beetle, a model insect for diverse biological investigations. Selection and validation of more than one stable reference gene is a basic but neglected requirement for qPCR. It is especially difficult when insects are heavily infected with pathogens that cause the breakdown of normal life processes. We tested several candidate genes and identified three that are stable through several stages of larval development and at early and late stages of fungal infection and three that have acceptable stability. These reference genes will allow accurate quantification of gene expression in the red flour beetle and have broad applicability for beetles under stressful experimental conditions.

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