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Research Kernels

Our Latest Research Results • September 2009

Economic Value of Biosolids in a Semiarid Agroecosystem

Authors: H.J. Lagae, M. Langemeier, D. Lybecker, K. Barbarick
Submitted to: Agronomy Journal

Although municipal biosolids are widely used as a soil amendment on cropland in the US, little economic analysis has been done to determine its economic optimal application rate. In this article, data from a long-term study in Eastern Colorado where biosolids were applied in a winter wheat-fallow rotation on two sites was analyzed. The response of wheat yield to biosolids application rate was determined. The site on which biosolids had been applied since 1982 showed little response to added biosolids for most of the years analyzed (1993-2000), while the site which was started in 1992 showed a positive response of wheat yield to biosolids applied. The maximum wheat yield response was obtained from an application rate of 9.0 Mg/ha. Since the economically optimal level of biosolids to apply depends on the price received for the wheat as well as the total costs of the biosolids (including application costs), this optimal rate was determined for a range of wheat prices and biosolids costs. For a wheat price of $0.20/kg and a total cost of biosolids of $4.00/Mg, the optimal application rate was 7.3 Mg/ha. Finally, a comparison was made to the cost of commercial N fertilizer to obtain the value of the biosolids to the producer. In conclusion, it was determined that using biosolids as a soil amendment can have positive economic benefits; however, it needs to be monitored to avoid excessive nitrate accumulation or excessive levels of other nutrients or heavy metals.

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Precooked Bran-Enriched Wheat Flour Using Extrusion: Dietary Fiber Profile and Sensory Characteristics

Authors: H. Gajula, S. Alavi, K. Adhikari, T.J. Herald
Submitted to: Journal of Food Science

Consumers recognize the importance of dietary fiber to reduce serum cholesterol, cardiovascular and some cancers. Whole wheat flour and wheat bran are two of the most commonly used and important sources of dietary fiber. Extrusion processing was investigated to determine if this processing technology offers any additional advantage to improve quality attributes of foods manufactured with dietary fiber. Cookies and tortillas were used as model food system to evaluate dietary fiber process with an extruder. Extrusion precooking of the flours did not improve the consumer acceptability of cookies and tortillas; however the process did improve the products dietary fiber profile the soluble dietary fiber.

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Barrier and Mechanical Properties of Starch-Clay Nanocomposite Films

Authors: X. Tang, S. Alavi, T.J. Herald
Submitted to: Cereal Chemistry

Citizens are requesting better use of our natural resources and to reduce landfill waste. One means to contribute to this effort is to offer a biodegradable packaging material as an alternative to petroleum based packaging material. To this end, starch (either corn, waxy corn, wheat or potato) and clay were blended and melted in mixer called an extruder. The extruder prepared the starch-clay blend or composite into very small particles called nanocomposites. The results indicated that corn-clay nanocomposites exhibited better mechanical properties (tensile strength, water vapor permeability) compared to nanocomposites prepared from other starch sources. Packaging materials is used in most consumer products. The impact of the research may limit our dependency on foreign petroleum used to produce these packaging materials. Additionally, the biodegradable nature of the starch-clay nanocomposite packaging material will place less stress on our environment.

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Effects of Plastizers on the Structure and Properties of Starch-Clay Nanocomposites

Authors: X. Tang, S. Alavi, T.J. Herald
Submitted to: Carbohydrate Polymers

Biodegradable nanocomposites were successfully fabricated from corn starch and montmorillonite (MMT) nanoclays by melt extrusion processing. The structure and morphology of the nanocomposites were characterized by X-ray diffraction (XRD) and electron microscopy, and film properties were also measured. As a conventional plasticizer, the influence of glycerol content was first investigated. As the glycerol content decreased from 20% to 5%, the degree of clay exfoliation increased. Films with 5% glycerol exhibited the lowest water vapor permeability,

highest glass transition temperature, and highest tensile strength, but low elongation at break. Urea and formamide were tested as alternative plasticizers for the starch-clay nanocomposites. The formamide plasticized starch-clay nanocomposite films exhibited lower water vapor permeability, higher glass transition temperature, and higher tensile strength than the other two plasticizers when used at the same level.
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The Gut Transcriptome of the Hessian Fly (*Mayetiola Destructor*), a Member of the Gall Midges

Authors: S. Zhang, R.H. Shukle, O. Mittapalli, Y.C. Zhu, J.C. Reese, B.-Z. Hua, M.S. Chen
Submitted to: Biomed Central (BMC) Genomics
Hessian fly (*Mayetiola destructor*) is a serious pest of wheat and a model for the study of gall midge/plant interactions. The insect pest is controlled mainly through deploying resistant wheat. However, the rapid development of biotypes has made resistance in host plants short-lived, lasting for only 6-8 years for a specific resistance gene. Analysis of genes expressed in the gut of Hessian fly could lead to a better understanding of the mechanism for host toxicity, which may lead to improved durability of plant resistance. Analysis of gut genes could also provide targets for alternative strategies for controlling this pest using novel types of transgenes. This research systematically analyzed the genes expressed in the gut of Hessian fly larvae, which provides a foundation for further research on the function of individual genes and for identification of potentially useful targets.
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Insect Population Dynamics in Commercial Grain Elevators

Authors: P.W. Flinn, D.W. Hagstrum, C. Reed, T.W. Phillips
Submitted to: Journal of Stored Products Research
It is estimated that economic losses caused by insects to stored wheat in the USA range from 5 to 10% per year, or about 1.25 to 2.5 billion dollars. Many of the insecticides used by the cereal foods industry are being lost due to insecticide resistance or regulatory changes. Thus, alternative, economically viable methods for controlling these insects and reducing losses to raw commodities are required. In a study in which over 20,000 grain samples were taken in commercial grain elevators in Kansas, the primary insect pests in stored wheat were the lesser grain borer (44%), rusty grain beetle (36%), and red flour beetle (19%). The rusty grain beetle was the most prevalent species in June. In September through November, the rusty grain beetle and lesser grain borer were found at equal numbers in the grain. From February to March, the lesser grain borer became the most common species. Insect numbers were highest in the top layers of the grain and decreased with grain depth. In June, insect numbers were low but increased rapidly in September and remained relatively high through February. In March through May, insect numbers were relatively low. The data showed that the optimal time to fumigate the grain in Kansas would probably be in October or November. The findings from this study will be used to improve insect pest management programs for stored grain.
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Contest-Behavior of Maize Weevil Larvae when Competing within Seeds

Authors: N.M. Guedes, R.N.C. Guedes, J.F. Campbell, J.E. Throne
Submitted to: Journal of Animal Behavior
Maize weevils are cosmopolitan pests of stored grains. We investigated the behavioral mechanisms underlying fitness of an insecticide-resistant and a susceptible strain of maize weevils. No differences in the behavioral process were found, with both strains having an optimal egg density of two. That is, usually no more than two individuals will survive in a single maize kernel because of cannibalism. Understanding the biology of pest insects will help us design better pest management programs.
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