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Research Kernels

Our Latest Research Results • August 2009

Properties of Field-Sprouted Sorghum and Its Performance in Ethanol Production

Authors: S. Yan, X. Wu, J. Dahlberg, S. Bean, F. MacRitchie, J.D. Wilson, D. Wang
Submitted to: Journal of Cereal Science

A common problem among cereal grains is pre-harvest sprouting which can occur when mature grain crops are exposed to high levels of rain while still in the field. The high levels of moisture cause the grains to sprout which alters the kernel structure and generally decreases the value of the grain for most typical uses. This project was undertaken to look at the effect of pre-harvest (or field) sprouting of sorghum on its use in ethanol production. Field sprouted samples were found to ferment about 50% faster than non-sprouted sorghum. The amount of ethanol produced from the sprouted sorghum was similar to that of non-sprouted grains. This means that field sprouted sorghum can be used effectively in ethanol production and sorghum grain damaged by field sprouting would still have value.

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Vitamin and Mineral Supplementation Positively Impacts Micronutrient Intakes of Older Adult Kansans

Authors: A. Weeden, V. Remig, C.A. Holcomb, R. Baybutt, T.J. Herald
Submitted to: American Dietetic Association

Older adults frequently report use of vitamin and mineral (VM) supplements. Despite possible improvements in dietary intake, concern remains over potential excessive nutrient consumption from VM supplement use. The purpose of the study was to evaluate micronutrient intakes of older adult volunteers from 35 Kansas senior centers. The volunteers were predominately white females, with an annual income of <$24,000, who reported eating a noon meal at the local senior center. Vitamins D and E, calcium and magnesium were the micronutrients most likely to be consumed below the recommended Dietary Reference Intake. VM supplement use most improved the intakes of vitamins E, D and B6, calcium and folic acid. With the inclusion of VM supplements, intakes of niacin, folic acid and vitamin A were most likely to exceed the Tolerable Upper Limit (UL). VM supplements consumed by subjects within this study significantly improved micronutrient intakes without consistently exceeding the UL.

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Comparison of Methods for Extracting Sorghum Proteins from Distillers Dried Grains with Solubles

Authors: Y. Wang, M. Tilley, S. Bean, X.S. Sun, D. Wang
Submitted to: Journal of Agricultural and Food Chemistry

Sorghum is an important crop in the Central Plains and ranks behind only wheat and maize in production. Sorghum is used worldwide as both animal feed and human food, but its major use in the US is animal feed. Increasing amounts are being used for fuel production; ~15% of the U.S. sorghum crop is fermented and used for ethanol production. The main coproduct from grain-based ethanol production is distillers dried grains with solubles (DDGS), of which more than 450 kilotons are generated annually from the fermentation of grain. DDGS is the high protein (~30-40% on average) residue left after starch is converted to ethanol. It serves as an inexpensive source of protein to supplement livestock feed. From 450 kilotons of sorghum DDGS, more than 136 kilotons of sorghum protein (on average) is available for use. As more ethanol plants are built in response to demand for fuel ethanol, there will be an increasing supply of DDGS with potential oversupply in regions with a high density of ethanol plants. Very little research has been conducted on extraction of sorghum proteins from DDGS. Objectives of this study were to compare various methods for extracting sorghum proteins from DDGS and characterize the chemical composition as well as physical and thermal properties, of the isolated proteins. We found that extraction conditions affected purity and thermal properties of the extracted protein. One method produced protein with 98.9% purity. This information will benefit future studies on functional properties of sorghum protein and use of sorghum protein from DDGS for industrial applications.

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The Major Threshability Genes Soft Glume (sog) and Tenacious Glume (Tg), of Diploid and Polyploid Wheat, Trace Their Origin to Independent Mutations at Non-Orthologous Loci

Authors: S. Sood, V. Kuraparthy, G. Bai, B.S. Gill
Submitted to: Theoretical and Applied Genetics

Wild wheat is difficult to thresh whereas modern wheat is easy to thresh. Therefore threshability was an important trait for wheat to become a major grain crop for human consumption. The wild wheat floret is wrapped by tough

glumes that make spikes difficult to thresh, whereas cultivated wheats have soft glumes and are free-threshing. In this report, we identified the chromosome locations of the soft glume (sog) gene of a diploid wheat relative, *Triticum monococcum* and the tenacious glume (Tg) gene of common wheat, using chromosome-specific molecular markers. The sog gene was located close to the centromere on the 2AS chromosome arm of *T. monococcum* whereas Tg was located in the most distal region on the chromosome arm 2DS of common wheat. The different positions suggest that the threshability mutations have independent evolutionary origins.

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Genetic Diversity in the U.S. Hard Red Winter Wheat Cultivars as Revealed by Microsatellite Markers

Authors: B. Prasad, M.A. Babar, X.Y. Xu, G. Bai, A.R. Klatt

Submitted to: Crop and Pasture Science

Knowledge of the genetic diversity existing in previously released US hard red winter wheat (HRWW) cultivars from the Great Plains is essential for effective use of these genetic resources in breeding programs. This study evaluated 60 cultivars historically released from 1900 to 2005 using 62 molecular markers. We found that genetic diversity gradually increased in cultivars released after the 1970s. Cultivars released in the 1990s had the highest genetic diversity. Molecular marker data separated 60 cultivars into eight groups and the grouping closely matches with their pedigrees and regional distribution. Our results indicate that genetic diversity of HRWW cultivars from the Great Plains has increased in the past century, and the trend is continuing.

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Molecular Mapping of Wheat Leaf Rust Resistance Gene Lr42

Authors: X. Sun, G. Bai, B.F. Carver, R.L. Bowden

Submitted to: Crop Science

Leaf rust is an important foliar disease of wheat worldwide. Leaf rust resistance gene Lr42 from the wild wheat relative, *Aegilops tauschii*, has been used as a source of rust resistance in breeding programs. To identify molecular markers closely linked to Lr42, a segregating population of near-isogenic lines contrasting for the presence of Lr42 was developed in the hard winter wheat cultivar Century background and evaluated for rust infection type at both seedling and adult-plant stages. Two markers closely linked to Lr42 were identified on the short arm of wheat chromosome 1D. These markers will be useful for marker-assisted selection for Lr42 in new wheat varieties.

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Analysis of Transgenic Wheat (*Triticum aestivum* L.) Harboring a Maize Gene for Plastid EF-Tu: Segregation Pattern, Expression, and Effects of the Transgene

Authors: J. Fu and Z. Ristic

Submitted to: Plant Molecular Biology

We previously reported that transgenic wheat carrying a maize gene (transgene) for a chloroplast protein, EF-Tu, displays reduced injury and enhanced rate of photosynthesis following exposure to a short-term heat stress (18 h at 45°C). In the current study, we investigated the segregation pattern of the transgene and the synthesis of EF-Tu protein in transgenic wheat. In addition, we also investigated the effects of the transgene on heat injury of leaf proteins, and assessed grain yield in transgenic plants after exposure to a brief heat stress (18 h at 45°C). The results showed that transgenic wheat carries a single copy of maize gene for EF-Tu. The transgenic wheat produced maize EF-Tu protein and the protein appeared to contribute to heat tolerance by protecting heat-labile proteins from heat injury in a non-specific manner. The transgenic plants also showed better grain yield, compared to their non-transgenic counterparts, after exposure to a short-term heat stress. Further studies to assess performance and grain yield of this transgenic wheat under prolonged exposure to heat stress in the field are needed.

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