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Research Kernels

Our Latest Research Results - October 2012

Genic and Non-Genic Contributions to Natural Variation of Quantitative Traits in Maize

Authors: X. Li, C. Zhu, C-.T. Yeh, W. Wu, E.M. Takacs, K.A. Petsch, F. Tian, G. Bai, E.S. Buckler IV, G.J. Muehlbauer, M.C.P. Timmermans, M.J. Scanlon, P.S. Schnable, J. Yu

Submitted to: Genome Research

Many important traits in crop species are quantitative traits and are controlled by many genes with minor effects. The complex genomes of these crop species are major challenges to understand the genetic control of these traits. Here we conducted whole genome scans of quantitative traits to identify trait-associated DNA point mutations and assessed their genomic distribution in maize. The point mutations collectively explained 44 to 59% of the total variation across maize quantitative traits, and 79% of the explained variation could be attributed to mutations located in genes or within upstream promoter regions. Focusing on those regions is a cost-effective approach to study quantitative traits in the species with complex genomes.

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Validation of Molecular Markers for New Stem Rust Resistance Genes in U.S. Hard Winter Wheat

Authors: A. Bernardo, R.L. Bowden, M.N. Rouse, M.S. Newcomb, D.S. Marshall, G. Bai

Submitted to: Crop Science

Stem rust is one of the most serious diseases of wheat worldwide. The discovery of new virulent stem rust races in the Ug99 race complex brings a new threat to global wheat production. Stacking several stem rust resistance genes in one adapted variety is one strategy to develop durably resistant varieties. Stacking stem rust resistance genes is only feasible with accurate DNA markers tightly linked to stem rust resistance genes. In this study, DNA markers linked to resistance genes *Sr2*, *Sr22*, *Sr26*, *Sr32*, *Sr35*, *Sr39,* and *Sr40*, were evaluated for usefulness in marker-assisted breeding of hard winter wheat. Useful markers for all the genes were validated and are recommended for marker-assisted stacking of these genes to develop wheat cultivars with stem rust resistance against Ug99 races.

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Effects of Flour Conditioning on Cannibalism of *Tribolium castaneum* Eggs and Pupae

Authors: P.W. Flinn, J.F. Campbell

Submitted to: Environmental Entomology

The red flour beetle is a serious pest of flour mills and stored grain. Cannibalism by adult and larval red flour beetles of eggs and pupae can have important implications in population regulation. As the red flour beetles develop, the flour becomes conditioned. This is due to an accumulation of beetle feces, chemicals produced by the beetles, and nutritional depletion of the flour. There is a need to understand how different levels of flour conditioning affect the rate of cannibalism of the red flour beetle. We found that larvae had the highest rates of egg and pupal cannibalism, followed by adult females. Adult males had the lowest rates of cannibalism. Cannibalism of eggs by female adults was highest in fresh flour, and decreased with the amount of flour conditioning. The level of flour conditioning had no affect on rates of cannibalism by larvae or adult males. These results will enable scientists to develop an improved computer model for the red flour beetle, which can be used to predict insect outbreaks and develop better insect pest management recommendations.

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Control of Stored Product Pests by Ionizing Radiation

Author: G.L. Hallman

Submitted to: Journal of Stored Products Research

The use of food irradiation is increasing in the world because it can assist in solving some food problems such as food-borne illness and quarantine of agricultural commodities. This review article focuses on the use of irradiation in stored products for pest control. The doses required to control stored product pests range from 50 Gy for yellow mealworm to 450 Gy for Angoumois grain moth. Although small amounts of grain and pulses are irradiated in the world today, that amount is increasing, especially in Asia. Thirty three countries permit irradiation of some stored products with 14 permitting it for all stored products. One area that may show promise for use on exported grain is to prevent seeds from invasive plants from growing.

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Characterization of cDNAs Encoding Putative Serine Proteases and their Transcriptional Responses to Cry1Ab Protoxin in the Gut of *Ostrinia nubilalis* Larvae

Authors: J. Yao, L.L. Buschman, B.S. Oppert, C. Khajuria, K.Y. Zhu

Submitted to: PLoS One

Insect proteases affect the efficacy of insecticidal microbial toxins, such as those from the bacterium *Bacillus thuringiensis* (Bt). Thus, understanding the expression of protease genes in a target pest is important to more effectively design and deploy Bt toxins. Larvae of the European corn borer, a major target of Bt transgenic corn, express a suite of proteases at various locations in the gut. Our data suggests that protease genes can be grouped by genetic relatedness and expression patterns in the gut. We found that some protease genes were increased in expression when larvae were exposed to toxin. These data represent the most comprehensive study to date on larval gut proteases and the effect of Bt toxin on gene expression in the European corn borer. The data can be used to improve transgenic constructs for efficacy and durability in the field.

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Isolation and Characterization of Camelina Protein Fractions from Camelina Meal

Authors: N. Li, G. Qi, S. Bean, D.L. Blackwell, X.S. Sun, D. Wang

Submitted to: Journal of Agricultural and Food Chemistry

There is increasing interest in the use of proteins for bio-based products such as bio-plastics and adhesives. Protein rich co-products of fermentation and oil extraction procedures provide good starting material for the extraction of proteins for bio-industrial uses. This research project evaluated extraction procedures for extracting proteins from camelina meal, the residue left after extraction of oil from *Camelina sativa*. The physicochemical properties of the extracted proteins were also determined. Highest purity protein isolates were obtained when samples were first degummed. The major protein classes found in the camelina meal with globulin and glutelin, which as expected, differed in their physicochemical properties. Understanding how extraction procedures influence protein composition and functionality is important for the eventual use of any protein source, thus this research will aid in the continued development of proteins in bio-industrial applications.

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Can Protein Levels be Economically Increased?

Authors: D.B. Arnall, J. Mullock, B.W. Seabourn

Submitted to: Fluid Journal

Trial studies were conducted on hard red winter wheat at two different Oklahoma locations. Across both locations, no evident trends in grain yields developed, but trends were found in grain protein results. Low protein values were reported. Reasons for the low protein include lack of response in yield due to late-season applications of nitrogen and extreme heat and drought during the spring and summer. These environmental conditions may have drawn soil moisture from greater depth, subsequently contributing to higher nitrate level in the plant during periods of stem elongation through grain fill. As is often the case in field experiments, no final conclusions were drawn from a single year of data collection.

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Evaluation and Functionality of Different Commercial Wheat Flours for Tortilla Production

Authors: E.S. Posner, A.A. Chew-Guevara, M. Mitre-Dieste, E. Perez-Carrillo, E. Heredia-Olea, J.D. Wilson, S. Saldivar-Serna

Submitted to: Journal of Cereal Science

The conventional dry wheat milling process starts with the gradual scraping of the endosperm in the mill break stages, followed by various mechanical means of separating the bran from the endosperm and the final steps of reducing the endosperm particles with degrees of cleanliness. Mills vary in their milling equipment and, flow-sheet diagrams that accordingly affect differently the major components of the flour: starch and gluten. Through the handling and processing steps in the mill, these major constituents responsible for flour quality could be altered physically and chemically to some extent. Five commercial mills in Mexico were used to identify the most critical milling variables related to flour performance for hot-press tortilla quality and shelf life. The most dominating variables that affected flour performance were wet gluten content, gluten strength, water absorption, stability of flour during mixing, starch damage and flour particle size. This work provides useful milling parameter information in the production of wheat flour for one of the fastest growing markets, tortillas.

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