Center for Grain and Animal Health Research

Research Kernels

Our Latest Research Results • March 2010

Unconventional Conservation among Genes Encoding Small Secreted Salivary Gland Proteins from a Gall Midge

Authors: M.S. Chen, X. Liu, H. Zhao, J.J. Stuart, S. Hulbert

Submitted to: Science Magazine

Organisms adapt to environment changes through a range of genetic and epigenetic mechanisms. Various models have been developed to explain genetic adaptation and evolution based on genetic and epigenetic phenomena observed previously. During characterization of genes encoding small secretory salivary gland proteins (SSSGPs) of Hessian fly, we discovered an unconventional conservation pattern that is hard to explain by current evolution models and theories. Within very short regions, there are tandem repeats containing multiple members of gene families that are highly diversified in coding regions, but highly conserved in the rest of the genes including introns. Sequence analysis suggested that diversifying selection was part of the mechanism for hyper-diversity in coding regions, whereas functional constraints were likely responsible for the conservation of the regulatory regions. However, other unknown genetic mechanisms were also likely involved in the genetics of these groups of genes. This report may provide a foundation for the discovery of new genetic mechanisms involved in gene evolution and functional adaptation.

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Aphid Feeding Activates Expression of a Transcriptome of Oxylipin-Based Defense Signals in Wheat Involved in Resistance to Herbivory

Authors: C.M. Smith, X. Liu, L.J. Wang, X. Liu, M.S. Chen, S. Starkey, J. Bai

Submitted to: Journal of Chemical Ecology

The Russian wheat aphid (RWA), *Diuraphis noxia*, significantly reduces wheat and barley yields worldwide. Host plant resistance is one of the methods for controlling the damage caused by this pest. A better understanding of the molecular aspects of arthropod resistant plants may result in the improvement of the host plant resistance strategy in integrated pest management. This research was conducted to identify genes and other products that are differentially regulated in resistant and susceptible plants in responding to RWA attacks, using microarray and other technologies. We found that RWA-infested resistant plants upregulated >180 genes related to various defense processes. These genes were either not upregulated or delayed in production in susceptible plants when they were attacked by RWA. Further research on these differentially expressed genes should result in a better understanding of the molecular mechanisms in wheat resistance to RWA, which may eventually lead to more durable resistance.

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Multiplex Real Time PCR for Detection of Wheat Streak Mosaic Virus and *Triticum* Mosaic Virus

Authors: J.A. Price, J.T. Smith, A. Simmons, J.P. Fellers, C.M. Rush

Submitted to: Journal of Virological Methods

Wheat streak mosaic virus (WSMV) and *Triticum* mosaic virus (TriMV) are widespread throughout the southwestern Great Plains states. Both viruses have similar symptoms which makes visual identification almost impossible. The current ELISA method for detection of the viruses in plant samples uses antibodies specific to each of the viruses, but can be insensitive to low concentrations and depends on having high quality antiserum. The PCR method can be more sensitive and does not depend on antiserum. In both cases, only one of the viruses can be tested for per assay. The work that is being reported is a new multiplex method to test for both viruses at the same time in the same assay. Because of the higher sensitivity, it is superior to previous testing methods and can be used to more rapidly and more accurately diagnose these viruses.

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A Comparison of Hamster Anesthetics and Their Effect on Mosquito Blood Feeding

Authors: C.M. Murrieta, K.E. Bennett, M.A. Stuart, M.S. West, M.M. Miller

Submitted to: Journal of Entomological Science

Hamsters or mice are often anesthetized before use in mosquito feeding experiments. Mosquito blood feeding success was compared using hamsters anesthetized with two common anesthetic protocols. This experiment found that for the *Aedes aegypti* mosquito, anesthetic choice appeared to make a difference; however, due to high variability in individual hamster selection by the mosquitoes, further replicates of the study will be needed to see if this is significant.

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AFLP and Dart Mapping and QTL Analysis of Drought Tolerance in a Spring Wheat Population

Authors: L.M. Alexander, F.M. Kirigwi, J.P. Fellers, A.K. Fritz

Submitted to: Crop Science

Water is the main limiting factor in crop production and significantly affects yields and quality in wheat production. However, breeding for drought tolerance is difficult because tolerance can be measured by many traits and is regulated by many genes across the genome. This work reports on further efforts to try to identify gene regions in the wheat genome that are involved in drought tolerance. The mapping techniques used in this study are more efficient at finding important regions in the genome. Twelve wheat chromosomes, 1D, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6D, 7A, and 7B, have regions associated with drought tolerance, while four more DNA markers were found linked with a drought tolerance with the one major locus on 4AL. One of the new markers could explain almost 1/3 of the differences between the experimental lines for grain fill rate and for yield. Plant breeders are using the markers to help move this region on 4AL into breeding lines to improve crop performance in drought conditions.

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Molecular Mapping of Adult-Plant Race-Specific Leaf Rust Resistance Gene Lr12 in Bread Wheat

Authors: S. Singh, R.L. Bowden

Submitted to: Molecular Breeding

Leaf rust is the most important disease of wheat worldwide. Wheat leaf rust resistance gene Lr12 is effective in adult plants, but not in seedlings. However, this gene can be effective in seedlings when the complementary gene Lr27 is also present. Our long term goal is to understand how Lr27 increases the effectiveness of Lr12. In this paper, we determined the chromosome location of Lr12 and identified molecular markers that flank the gene. These may be useful for further fine mapping studies that could eventually lead to isolating the gene.

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Corn and Sorghum Characteristics Influencing Nixtamalization Performance

Authors: W.B. Johnson, W.S. Ratnayake, D.S. Jackson, K-M Lee, T.J. Herrman, S. Bean, S.C. Mason

Submitted to: Cereal Chemistry

A major food use of dent corn (*Zea mays* L.) and sorghum (*Sorghum bicolor* L. Moench) is in the commercial production of tortillas, snack chips, and related foods through the traditional alkaline cooking process known as nixtamalization. Understanding which kernel characterization tests are predictive of nixtamalization performance would aid in developing better methods for selecting grain for processing. These methods may include development of predictive equations based on a few characterization tests or the creation of classification schemes that would allow processors to assign a particular lot of grain as best for nixtamalization or some other use. We found that characteristics such as kernel hardness, moisture content, starch and protein content were important factors related to nixtamal moisture content. Location and hybrid factors influenced most kernel characteristics and nixtamalization processing variables. Identifying sample growing locations would aid in screening samples for nixtamalization.

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Evaluation of Four Sorghum Hybrid Flours Used in Formulating Gluten-Free Noodles

Authors: L. Liu, T.J. Herald, D. Wang, S. Bean, J.D. Wilson, F. Aramouni

Submitted to: Cereal Chemistry

The number of people diagnosed with celiac disease has increased; subsequently, the market for gluten-free products is experiencing rapid growth. Consumption of Asian noodles is also rising in the United States. Typically, such noodles are produced from wheat and, therefore, are not suitable for the celiac market. This research evaluated four sorghum hybrids for production of wheat-free Asian style noodles suitable for the celiac market. Noodles made from the different sorghum hybrids were significantly different in color, texture, and cooking quality. Flour particle size was found to be correlated to several noodle quality traits. This information can be used by the gluten-free food industry in selecting sorghum hybrids for noodle production.

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