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Research Kernels

Our Latest Research Results – July and August 2010

Near-Infrared Spectroscopy as a Complementary Age Grading and Species Identification Tool for African Malaria Vectors

Authors: M. Sikulu, G.F. Killeen, L.E. Hugo, P.A. Ryan, K.M. Dowell, R.A. Wirtz, S.J. Moore, F.E. Dowell
Submitted to: BioMed Central (BMC) Parasites and Vectors

Mosquito survival is recognized as one of the imperative determinants of transmission for the pathogens they carry. For example, malaria vectors can only transmit malaria parasites when they are at least 10 days old because of the lengthy period required for Plasmodium parasite development in the mosquito. Traditionally, scientists relied upon labor-intensive and skilled techniques to assess disease transmission potential. We applied near-infrared spectroscopy (NIRS) to age-grade and differentiate mosquito species that transmit malaria. This method is simple, rapid (~1s), and non-destructive. We were able to classify mosquitoes as old or young with about 85% accuracy, and determine their species with about 90% accuracy. These findings have importance for monitoring control programs where reduction in the proportion of older mosquitoes of specific species that have the ability to transmit malaria is an important outcome.

Contact Floyd Dowell, telephone 785-776-2753, email floyd.dowell@ars.usda.gov.

Predicting Hot-press Wheat Tortilla Quality Using Flour, Dough and Gluten Properties

Authors: F. Barros, J.N. Alviola, M. Tilley, Y.R. Chen, V.R. Pierucci, L.W. Rooney
Submitted to: Journal of Cereal Science

Currently, the suitability of wheat lines for tortilla production is done by milling the wheat, evaluating the flour, and processing it into tortillas. Wheat milling to tortilla evaluation takes about 90 h, which is distributed over 4 weeks. Moreover, it requires at least 1 kg of flour to do all the tests. This makes the wheat line screening process time-consuming, labor-intensive and costly. Developing prediction equations is one approach to make this screening process more efficient. For example, from our results, one can predict tortilla diameter from any given flour by having the mixograph mixing time and dough resistance to extension values. Both parameters are determined using tests that are easy and require a small amount of flour sample. Moreover, the mixograph test can be completed in a short time and is already widely used in the academe and the industry. In addition, the dough resistance to extension can also predict (alone or with another parameter) tortilla L* value, specific volume and rupture force at day 0. The extensibility test that is used to determine this parameter is done with a texture analyzer, and has the advantage of good repeatability.

Contact Michael Tilley, telephone 785-776-2759, email michael.tilley@ars.usda.gov

Dissection of Genetic Components of Preharvest Sprouting Resistance in White Wheat

Authors: S. Liu, G. Bai, S. Cai, C. Chen
Submitted to: Molecular Breeding

Pre-harvesting sprouting (PHS) refers to rain-induced seed germination in a physiologically mature wheat head prior to harvest. Sprouted wheat grain usually has poor flour quality and may receive discounts when sold. White wheat varieties are often more susceptible to PHS due to low levels of seed dormancy compared to red wheat varieties. Using DNA marker technology, four genes that control delayed seed germination, were identified from a white-seeded Chinese wheat landrace named Tutoumai A. A gene on chromosome 4A consistently showed a major effect while the other three genes only showed a minor effect in some experiments. The sprouting tolerance gene in the Chinese landrace should be useful to improve PHS resistance in US white wheat varieties.

Contact Guihua Bai, telephone 785-532-1124, email guihua.bai@ars.usda.gov

Mapping Quantitative Trait Loci for Quality Factors in an Inter-Class Cross of US and Chinese Wheat

Authors: X. Sun, F. Marza, H. Ma, B. Carver, G. Bai
Submitted to: Theoretical and Applied Genetics

Wheat quality factors are important in determining the suitability of wheat for end-use products and economic value, and they are major targets for marker-assisted breeding. A recombinant inbred population from a cross between the Chinese hard red wheat Ning7840 and the US soft red winter wheat Clark were evaluated for quality traits including grain protein content (GPC), test weight (TW), kernel weight (KW), and kernel diameter (KD), and hardness index (HI) at three Oklahoma locations from 2001 to 2003. A genetic map was constructed to identify quantitative trait loci (QTLs) responsible for these traits. Eight QTLs for TW, seven for KW, six for KD, two each for GPC and the HI measured by near-infrared reflectance (NIR) spectroscopy, and four for the HI measured by the single kernel characterization system. A QTL for HI was located at the Pinb-D1 gene for hardness on chromosome 5DS. The consistency of

quality factor QTLs across environments reveals their potential for marker-assisted selection.
Contact Guihua Bai, telephone 785-532-1124, email guihua.bai@ars.usda.gov

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

Authors: S. Sood, V. Kuraparthy, G. Bai, B.S. Gill
Submitted to: Theoretical and Applied Genetics
Wild wheat species are difficult to thresh whereas our modern cultivated wheat varieties are easy to thresh. It is thought that threshability was an important trait for wheat to become a major grain crop for human consumption. The floret of wild wheat is enclosed by tough glumes that make spikes difficult to thresh, whereas cultivated wheat has soft glumes and is free-threshing. In this report, we identified the chromosome locations of the soft glume (sog) gene of a diploid wheat relative, *Triticum monococcum* and tenacious glume (Tg) gene of common wheat using chromosome-specific molecular markers. The sog gene was located close to the centromere on chromosome 2AS of *T. monococcum* whereas Tg was located on the most distal region of chromosome 2DS of common wheat. The genes sog and Tg appear to have different evolutionary origins.
Contact Guihua Bai, telephone 785-532-1124, email guihua.bai@ars.usda.gov

A New Gut-Specific Chitinase Gene Essential for Regulation of Chitin Content of Peritrophic Matrix and Growth of *Ostrinia Nubilalis* Larvae

Authors: C. Khajuria, L.L. Buschman, M.S. Chen, S. Muthukrishnan, K.Y. Zhu
Submitted to: Insect Biochemistry and Molecular Biology
Chitin is an important structural component of the insect cuticle. For insects to grow and change from one developmental stage to another, chitin in the cuticle and the peritrophic matrix needs to be digested and replaced with new chitin. Therefore, the metabolic pathways of chitin in insects are targets for insecticides for use in pest management. This research has led to the identification of a new gut-specific chitinase gene from the larvae of European corn borer, an important insect of corn. The gut-specific chitinase plays an important role in regulating the chitin content of the peritrophic matrix and it affects the growth and development of European corn borer larvae. The identification of this new chitinase provides a foundation for further research that may lead to practical applications and to a better understanding of chitin content regulation in insects.
Contact Ming Shun Chen, telephone 785-532-4719, email ming-shun.chen@ars.usda.gov

Efficacy of *Bacillus thuringiensis* Cry3Aa Protoxin and Protease Inhibitors toward Coleopteran Storage Pests

Authors: B.S. Oppert, T.D. Morgan, K.J. Kramer
Submitted to: Pest Management Science
Environmental impacts and resistance to insecticides pose serious challenges to stored-product pest control. In an effort to find new environmentally friendly and effective control products for pests of stored products and grains, we evaluated the effect of bacterial toxins and digestive protease inhibitors on selected beetle storage pests. The yellow mealworm was most sensitive to the bacterial toxin, as has been demonstrated previously, but protease inhibitors had no effect on toxicity. We found that the bacterial toxin had little effect on the red flour beetle, with or without protease inhibitors. However, the bacterial toxin reduced the growth and increased mortality of the lesser grain borer, and these effects were increased with the addition of protease inhibitors. These data suggest that a combination of bacterial toxin and protease inhibitor may have application in the integrated pest management of the lesser grain borer.
Contact Brenda Oppert, telephone 785-776-2780, email brenda.oppert@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research

1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/npa/cgahr