GMPRC
Grain Marketing and Production Research Center

Research Kernels

Our Latest Research Results • August 2008

Application of acetate buffer in pH adjustment of mash and its influence on fuel ethanol fermentation

To support bio-industrial use of sorghum such as ethanol production, one research need is to identify sorghum hybrids with improved ethanol yields and efficiencies. In order to accomplish this, methods are needed to screen a relatively large and diverse set of samples from the huge pool of sorghum breeding lines, evaluate their performance in a bench-scale "dry-grind" conversion of sorghum to ethanol and identify key factors affecting ethanol yield and conversion efficiency. To save time and improve small scale mashing procedures, an acetate buffer was quantitatively pipetted to liquefied mashes.. Ethanol yields of 18 sorghum hybrids improved significantly (2.0-5.9% relative increases, 3.9% on average) by changing the method for pH adjustment from traditional HCl to the acetate buffer. Furthermore, ethanol yields obtained using the two methods were highly correlated, indicating the acetate buffer did not influence resolution of the procedure used to differentiate grain samples varying in fermentation quality.

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Color image based sorter for separating red and white wheat

A low cost sorting device for wheat was built using a standard personal computer and color camera. Programming techniques used in computer video games were used so that the throughput of the sorter would be high while keeping the sorter cost low. The sorting system was tested on its ability to separate red wheat from white wheat for wheat breeding programs. At a wheat throughput of 30 kernels per second, or 3.5 Kg per hour, the sorter is able to correctly separate 95% to 99% of the wheat. The accuracy is 15 to 20% higher than what can be achieved with traditional sorters. This sorter will help breeding programs isolate desirable kernels so that they can be propagated, which will results in faster releases of new and improved varieties of grain.

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Chitin synthases are required for survival, fecundity and egg-hatch in the red flour beetle, *Tribolium castaneum*

Chitin is the main component of the cuticle which forms a protective outer covering of insects and is also required for the lining of the digestive sac. We have recently characterized the roles of the two chitin synthase enzymes in exoskeleton and midgut of larvae, but there is very little evidence concerning the functions of these two enzymes in embryos or adults. We used a technique called "RNA interference" to selectively eliminate the function of each of the two genes in the red flour beetle to see if either enzyme is required at these stages of development. We showed that both enzymes are required for adult reproductive success. Without the first enzyme, adults either do not lay eggs at all, or if they do, the eggs are defective and do not hatch. Without the second enzyme, the adults can't digest food, and die of starvation. Studies such as these will lead to better understanding of insect growth and development and better strategies for disrupting the associated genes for pest control.

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Correlation between visual and optical sorting of Fusarium-damaged kernels in winter wheat

Fusarium head blight (FHB), or scab, is a destructive disease of wheat. FHB causes yield reductions of up to 50% and crop losses in the US have exceeded $1 billion in some years. In addition, FHB can produce the toxin deoxynivalenol which must be below FDA guidelines. Visible detection of FHB is laborious and subjective and we evaluated the use of automated near-infrared technology to detect FHB. Results showed that visual detection was strongly correlated to NIR detection and that the NIR method was more repeatable. This technology should help the grain industry more consistently detect FHB and thus improve the safety of the US food supply. The technology can also be used to rapidly screen new wheat lines for FHB resistance.

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Molecular and functional analyses of amino acid decarboxylases involved in cuticle tanning in *Tribolium castaneum*

The exoskeleton forms a protective outer covering or “skin” of insects, and is essential for movement, resistance to infection, and mediating oxygen exchange. We have recently characterized the roles of several components involved in the hardening and darkening of the exoskeleton after the insect sheds its old skin. By inhibiting the normal functioning of these intermediates, we showed that they were needed to confer the proper hardness, flexibility and color of the mature exoskeleton. Studies such as these will lead to better understanding of insect growth and development and better strategies for disrupting the associated genes for pest control.

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Characteristics and sorting of white food corn contaminated with mycotoxins

Mycotoxins are known carcinogens that can be found in grain, nuts, and cottonseed due to fungal infection in the field. Food having mycotoxins above FDA guidelines cannot be traded across state borders and result in lost revenue for farmers and grain handlers. Mycotoxins are produced by naturally occurring fungi and tend to infect drought stressed or damaged kernels in the field. This study identified characteristics of white corn having fungal damage and mycotoxins. Furthermore, we tested the feasibility of separating corn kernels having high levels of mycotoxins from those with low or no mycotoxins using commercially available sorting machines. For white corn, it was found that after two passes through a commercially available high speed optical sorter, aflatoxin (one of the more common mycotoxins) could be reduced by an average of 88%. Approximately half of the aflatoxin contaminated kernels missed by the optical sorter were larger, asymptomatic kernels with cracks in their outer skin. The remaining aflatoxin was found in smaller kernels damaged from insect feeding, many without germs.

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Functional analysis of four neuropeptides, EH, ETH, CCAP and bursicon and their receptors, in adult ecdysis behavior of the red flour beetle, *Tribolium castaneum*

Insects must shed their old skins as they grow in size, but the behavior and physiology of this delicate and complex process of metamorphosis is still only poorly understood. We identified a group of hormones in the red flour beetle that are required for normal metamorphosis, and we showed that disruption of these hormones results in failure to shed the old skin, causing the death of the insect. Each of these newly-discovered hormones can become a target in screening assays for new biopesticides that disrupt insect growth and development.

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