



Research Kernels

Our Latest Research Results • May 2009

Directional flow of summer aeration to manage insect pests in stored wheat

Authors: F.H. Arthur and M. Casada

Submitted to: Applied Engineering in Agriculture

Using low-volume ambient air to cool stored grain is a common management practice in the southern plains, but little research has been done recently to determine if the direction of airflow makes a difference regarding the cooling patterns. We conducted a study by using suction aeration, pulling air downward through the grain mass, as compared to pressure aeration, the standard strategy of pushing cool air upward through the grain mass. Results of a two-year study show that temperatures on the upper surface of the grain mass were consistently cooler with suction aeration than with pressure aeration. The resulting insect pest populations were also generally lower in the bins with suction versus pressure aeration. Our results demonstrate that using suction aeration would cool the upper surface zone of the grain mass, which is vulnerable to insect infestation, and could reduce the need for additional pesticide inputs through this reduction in pest pressure.

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Effects of over-expression of high molecular weight glutenin subunit 1dy10 on wheat tortilla properties

Authors: V.R.M. Pierucci, M. Tilley, R.A. Graybosch, A.E. Blechl, S. Bean and K.A. Tilley

Submitted to: Journal of Agricultural and Food Chemistry

The tortilla industry is one of the fastest growing segments of the U.S. baking industry with annual sales surpassing \$6 billion. Flour used in tortilla production has been typically optimized for bread making and thus the flour properties that determine good quality bread do not necessarily provide good quality tortillas. The high molecular weight glutenin subunit (HMW-GS) proteins are important in the formation of the gluten matrix. Flour that had a higher level of one HMW-GS was used to make tortillas. The tortillas had different quality in several parameters such as diameter, shelf stability and overall quality. This data will allow wheat breeders to target the characteristics for development of tortilla or multi-use wheat lines and decrease the addition of additives to adjust flour quality in the tortilla industry.

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Mechanical properties of beetle elytral cuticle, a biological composite material

Authors: J. Lomakin, C. Eichler, Y. Arakane, K.J. Kramer, R.W. Beeman, M.R. Kanost and S.H. Gehrke

Submitted to: Biomacromolecules

The exoskeleton, or cuticle, forms a protective outer covering or "skin" of insects, and is a potential model for next-generation plastics that would have increased biodegradability and environmental safety. In this work we have quantified the physical properties of the developing adult cuticle. We monitored the brittleness, elasticity and strength of cuticle of the new beetle wing covers as they harden and dry immediately after the insect sheds its old skin. Studies such as these will lead to better understanding of insect growth and development, better strategies for disrupting the associated genes for pest control, and new ideas for the design of next-generation biodegradable plastics.

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Putting most of the eggs in one basket: influence of habitat fragmentation on functional space use

Authors: S.A. Romero, J.F. Campbell, J.R. Nechols and K.A. With

Submitted to: Functional Ecology

Commercial food processing facilities from a stored-product insect perspective are large complex landscapes of favorable habitat patches within a matrix of unfavorable areas. Insects become pests when they are able to successfully exploit this type of landscape, and pest management tactics such as sanitation and structural modification are effective if they impact the abundance, distribution, and connectedness of these patches in a way to make the landscape less favorable for the pest. Red flour beetle is a major insect pest of flour mills and serves as a useful model organism to address fundamental landscape ecology questions that have application to pest management. Using behavioral landscape ecology experimental approaches, we determined how female beetle movement and egg laying behavior changed if the total amount of flour was held constant, but the pattern of its distribution was manipulated. Results demonstrated that female beetles initially moved through the landscape in a pattern related to the underlying flour distribution pattern, but that they

laid eggs in a more aggregated pattern. The size of individual patches influenced egg laying, with beetles preferentially laying eggs in larger patches of flour, but laying a greater density of eggs in small isolated cells than in equivalent sized areas within larger patches. This information coupled with other ongoing studies related to population consequences of these egg laying decisions will provide insight into the fitness consequences of landscape pattern and ultimately into how landscape manipulation can impact populations.

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Interaction of temperature and drought stress on physiology and yield of spring wheat

Authors: P.V.V. Prasad, S.R. Pisipati, I. Momcilovic and Z. Ristic

Submitted to: Crop Science

High temperature (heat) and drought stress are among the two most important environmental factors influencing crop growth, development, and yield. Objectives of this study were to investigate the interaction effects of high temperature and drought stress during reproductive development on physiological, vegetative, and yield traits and expression of a chloroplast protein synthesis elongation factor (EF-Tu) of wheat (*Triticum aestivum* L.). The effects of high temperature and drought stress were interactive when temperature stress was severe. For leaf chlorophyll content and reproductive growth and traits such as spikelet fertility, grain yield, and harvest index, the combined effects of heat stress and drought were more severe than additive effects of heat and drought alone. Heat stress and the combination of heat and drought but not drought stress alone resulted in overexpression of EF-Tu. This study highlights that differential interactive effects between high temperature and drought on various physiological and yield processes are based on severity of heat stress. High temperature stress caused significant yield decreases under both irrigated and drought conditions, suggesting that tolerance to heat stress would be beneficial to wheat production even under drought conditions.

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Non-destructive determination of age and species of *Anopheles gambiae* s.l. using near-infrared spectroscopy

Authors: V. Mayagaya, K. Michel, G. Killeen, M. Benedict, R.A. Wirtz, H.M. Ferguson and F.E. Dowell

Submitted to: American Journal of Tropical Medicine and Hygiene

Each year 350-500 million cases of malaria occur worldwide, and over one million people die. Controlling malaria by reducing human-insect contact

has been one of the most successful approaches to reduce transmission. An obstacle to the control of malaria transmission in sub-Saharan Africa is that several of the most important vector species, which have distinct behavior, ecology and response to control, cannot be readily identified without the application of relatively expensive and sophisticated methods. Thus, there is a need for a rapid species identification technique. In addition, estimation of the age of malaria vectors is of prime importance for the measurement of transmission and control success. Because only relatively old malaria vectors are capable of transmitting malaria, knowledge of the age distribution of these populations is essential for prediction of the proportion of potentially infectious vectors, and how this changes over time and in response to control measures. Here, we evaluate the potential of a near-infrared spectroscopy for rapid species and age identification of two members of the *An. gambiae* species complex, *An. arabiensis* and *An. gambiae* s.s. This non-destructive technique predicted the species of field-collected mosquitoes with about 80% accuracy, and the relative age of females as young or old with about 80% accuracy. For applications in which rapid assessment of the general age structure and species composition of wild vector populations is needed, NIRS offers a valuable alternative to traditional methods.

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