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Research Kernels

Our Latest Research Results - September 2011

Quantitative Trait Loci for Fusarium Head Blight Resistance in U.S. Hard Winter Wheat Cultivar Heyne

Authors: X. Zhang, G. Bai, W.W. Bockus, X. Ji, H. Pan
Submitted to: Crop Science
Fusarium head blight (FHB) is a destructive disease that can significantly reduce grain yield and quality. Hard winter wheat (HWW) cultivars growing in US Great Plains are mostly susceptible. Genetic factors, also called quantitative trait loci (QTL) controlling FHB resistance have not been reported in HWW to date although they have been identified in many Chinese cultivars and other sources. 'Heyne' is a moderately FHB-resistant HWW from Kansas. We found three QTL are responsible for resistance in 'Heyne' after analyzing a recombinant inbred population from the cross 'Trego'/'Heyne' using molecular markers. The three QTL were mapped on chromosomes 3AS, 4DL, and 4AL and reside in 'Heyne'. These QTL can be used for improving FHB resistance in U.S. hard winter wheat by pyramiding them with Fhb1 or other major resistance QTL from Asian sources.
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Gene Discovery in EST Sequences from the Wheat Leaf Rust Fungus *Puccinia triticina* Sexual Spores, Asexual Spores and Haustoria, Compared to Other Rust and Corn Smut Fungi

Authors: J. Xu, J.P. Fellers, W. Zhu, D. Joly, T. Eilam, T. Banks, M. Mayo, J. Ali, B. McCallum, B. Saville, R. Linning, M. Dickenson, I. Antonov, M. Donaldson, Y. Anikster, S. Monro, B. Whnhoven, R. Moore, M. Borodovsky, G. Bakkeren
Submitted to: Biomed Central (BMC) Genomics
Wheat leaf rust is one of the most economically important diseases of wheat worldwide. The leaf rust fungus has repeatedly shown the ability to rapidly adapt to resistant varieties that have been periodically released to producers. In order to design more durable types of resistance, novel approaches are needed. The objective of this work was to obtain a better understanding of the fungal genes that are expressed at various stages in the life cycle of the pathogen. A database of 13,328 fungal genes was constructed and compared to databases from four other related fungi. Many genes were evolutionarily conserved between five species, but over 40% of the genes from the leaf rust fungus were unique. This database will be invaluable for the identification of the key genes that control the virulence of the pathogen or trigger the resistance response of the host.
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Early Stage Phytohormone and Fatty Acid Profiles of Plants Associated with Host and Non-Host Resistance to Hessian Fly (Diptera: Cecidomyiidae) Infestation

Authors: L. Zhu, M.S. Chen, X. Liu
Submitted to: Journal of Economic Entomology
Hessian fly is an important insect pest of wheat that causes damage to seedlings as well as lodging of adult plants. The purpose of this study was to compare the induction of plant hormones and fatty acids in resistant wheat cultivar 'Molly' and a nonhost rice cultivar called 'Nipponbare'. In general, chemical changes were more rapid in the wheat plants than the rice plants. Salicylic acid and 12-oxo-phytodienoic acid were increased in both wheat and rice and may be important components of the defense response. This report provides a foundation for future work on the role of phytohormones and fatty acids in the defense response against Hessian fly.
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Pilot-Scale Processing of Sorghum Protein Concentrates Using Extrusion-Enzyme Liquefaction

Authors: N. De Mesa-Stonestreet, S. Alavi, J. Faubion, S. Bean
Submitted to: Food Research International
Factors affecting the pilot-scale production of sorghum protein concentrates using extrusion-enzyme liquefaction were studied. Sorghum protein concentrates produced by extrusion-enzyme liquefaction had higher protein purity and in vitro protein digestibility (62 to 70%) than either raw or batch liquefied sorghum flour. Extrusion-enzyme liquefaction is a high throughput method for producing sorghum protein concentrates with a potential for commercial scale-up. Sorghum is safe for consumption by celiac patients, and sorghum protein concentrate may improve the nutritional and functional qualities of gluten-free foods.
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Modulation of Kernel Storage Proteins in Grain Sorghum

Authors: T. Kumar, I. Dweikat, S. Sato, Z. Ge, N. Neresian, H. Chen, T. Elthon, S. Bean, B.P. Ioerger, M. Tilley, T. Clemente
Submitted to: Journal of Plant Physiology
Grain sorghum ranks fifth among the cereals world-wide with respect to its importance for food and feed applications. However, sorghum is known to have lower protein digestibility than other cereals such as wheat and corn. To address this issue, transgenic sorghum was developed that expressed a hybrid wheat protein along with lines that down regulated the gamma and alpha kafirins. Experimental sorghum lines were found to have altered protein body structure and digestibility. Such lines could have an impact on the utilization of sorghum in feed and bio-fuel applications.
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Food Source Provisioning and Susceptibility of Immature and Adult *T. castaneum* on Concrete Partially Treated with Chlorfenapyr (Phantom®)

Authors: F.H. Arthur, E.A. Fontenot
Submitted to: Journal of Pest Science
A new insecticide, Phantom®, will kill the red flour beetle, a major pest of stored products, but there is no information on how well it will work when food is present. We exposed adult red flour beetles, and also larvae and pupae, on a concrete surface that was partially treated with Phantom®. Food (flour) was put in the untreated area of the concrete. Some adults were able to escape insecticide exposure and lay eggs in the flour. Larvae were more susceptible than adults and usually died before they could reach the adult stage, even if they reached the flour. Residual control of larvae lasted for several weeks. Results show mobile adults could escape exposure to Phantom®, but the larvae could not and were therefore more susceptible to the insecticide.
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Lethal and Sub-Lethal Effects from Short-Term Exposure of *Rhyzopertha dominica* on Wheat Treated with Storicide II®

Author: F.H. Arthur
Submitted to: Journal of Pest Science
When pest insects are exposed on treated stored grains, mortality may not immediately occur. A study was conducted by exposing adult male and female lesser grain borers on stored wheat treated with different concentrations of the insecticide Storicide II®, for different time periods, and then transferring them to untreated wheat. At the lower concentrations or shorter exposure times, the parent beetles survived exposure, females were less susceptible than males, and they were able to produce offspring on the untreated wheat. As the concentration and/or exposure time increased, the exposed parent beetles died and the production of offspring declined, indicating that death occurred before mating or egg-laying. Results show males may be more susceptible to Storicide II® than females, and there may be a delayed mortality effect on the exposed parental adults that will affect production of offspring.
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The Knickkopf Protein is Essential for Accumulation and Protection of Chitin in the Insect Exoskeleton

Authors: S.S. Chaudhari, Y. Arakane, C.A. Specht, B. Moussian, D. Boyle, Y. Park, K.J. Kramer, R.W. Beeman, S. Muthukrishnan
Submitted to: Science
The shedding and replacement of the exoskeleton (skin) is a unique and sensitive aspect of insect physiology that could be exploited by appropriately-targeted biopesticides. A vital aspect of this process is digestion and recycling of the old skin, and reuse of recycled components for synthesis of the new skin. A great mystery has been how the developing new skin is protected from digestion while the old skin is being degraded. It was previously thought that such selective degradation was accomplished by a physical barrier (an impermeable membrane) that separated the old from the new skin, protecting the latter. In this work, we showed that this is not true, and that exoskeleton-digesting enzymes are present in both the new and the old skins. We also showed that the new skin is protected from degradation by these enzymes by a specific, protective protein called “Knk”. Discovery of insect proteins needed for protection of the exoskeleton could lead to the development of new biopesticides that act by disruption of such proteins.
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