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Research Kernels

Our Latest Research Results - May 2013

Exertional Myopathy in a Pileated Woodpecker (*Dryocopus pileatus*) Subsequent to Capture

Authors: M.G. Ruder, B.L. Noel, J.C. Bednarz, M.K. Keel
Submitted to: Journal of Wildlife Diseases
It is common and essential for scientists to capture and handle wildlife in order to better understand certain aspects of their ecology and biology. However, this is not without risk to the animal. This report describes exertional myopathy in pileated woodpeckers after they were captured for an ecological study. This disease is caused by over-exertion and stress during capture and handling. This represents the first report of this disease in this species and serves as a reminder to consider this disease during the design of field studies.
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Surface-Enhanced Raman Scattering (SERS) Detection of Multiple Viral Antigens Using Magnetic Capture of SERS-Active Nanoparticles

Authors: J. Neng, M.H. Harpster, W.C. Wilson, P.A. Johnson
Submitted to: Biosensors and Bioelectronics
A highly sensitive multiplex assay was developed for detection of the viral zoonotic pathogens West Nile virus (WNV) and Rift Valley fever virus (RVFV). The system utilizes nanotechnology that results in a simple to run assays that could be adapted to a biosensor platform that can be adapted for portable diagnostic applications.
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The First Digestive Prolyl Carboxypeptidase in *Tenebrio molitor* larvae

Authors: I.A. Goptar, D.A. Shagin, I.A. Shagina, E.S. Mudrik, Y.A. Smirnova, D.P. Zhuzhikov, M.A. Belozersky, Y.E. Dunaevsky, B.S. Oppert, I.Y.Filippova, E.N. Elpidina
Submitted to: Insect Biochemistry and Molecular Biology
We are studying digestive enzymes in stored product insects to determine their function. Ultimately, we hope to use this information to develop new insect control methods. We examined the function of one digestive enzyme, prolyl carboxypeptidase (PRCP), in the yellow mealworm, the first such enzyme to be fully characterized in an insect. We discovered that PRCP is critical to the digestion of proteins in cereals. Our data indicate that the enzyme may be a target for the development of new control methods to prevent damage to stored grains and products.

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Characterization of cDNAs Encoding Serine Proteases and Their Transcriptional Responses to Cry1Ab Protoxin in the Gut of *Ostrinia nubilalis* Larvae

Authors: J. Yau, L.L. Buschman, B.S. Oppert, C. Khajuria, K.Y. Zhu
Submitted to: PLoS One

Insect proteases in a target pest affect the efficacy of insecticidal microbial toxins, such as those from the bacterium *Bacillus thuringiensis* (Bt).. Larvae of the European corn borer, a major target of Bt transgenic corn, express a suite of proteases at various locations in the gut. Our data suggest that protease genes can be grouped by genetic relatedness and expression patterns in the gut. We found that some protease genes were increased in expression when larvae were exposed to toxin. These data represent the most comprehensive study to date on larval gut proteases and the effect of Bt toxin on gene expression in the European corn borer. The data can be used to improve transgenic constructs for efficacy and durability in the field.

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Efficacy of a Combination of Beta-Cyfluthrin and Imidacloprid and Beta-Cyfluthrin Alone for Control of Stored-Product Insects on Concrete

Authors: C.G. Athanassiou, N. Kavallieratos, F.H. Arthur, J.E. Throne
Submitted to: Journal of Economic Entomology
Insecticides are used as residual surface treatments to control stored-product insect pests in mills, warehouses, and food storage facilities. We tested a combination of two new insecticides, beta-cyfluthrin and imidacloprid, for control of seven species of stored-product insect pests on concrete surfaces in laboratory studies. The rusty grain beetle, the sawtoothed grain beetle, and two psocid species were very susceptible to the insecticide

combination, with mortality of 97-100% after 7 days of exposure. In contrast, the hide beetle and the red and confused flour beetles were tolerant to the insecticide, as mortality did not exceed 57, 25, and 17%, respectively, after 7 days of exposure. In a separate test, beta-cyfluthrin alone was at least as effective as the combination treatment for control of the red flour beetle and the sawtoothed grain beetle. Our results indicate that the simultaneous use of beta-cyfluthrin with imidacloprid is no more effective on concrete than beta-cyfluthrin alone, and efficacy of both formulations varies with the target species.
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Retroactive Maintains Cuticle Integrity by Promoting the Trafficking of Knickkopf into the Procuticle of *Tribolium castaneum*

Authors: S.S. Chaudhari, Y. Arakane, C.A. Specht, B. Moussian, K.J. Kramer, S. Muthukrishnan, R.W. Beeman
Submitted to: Developmental Cell
Insects must periodically replace their protective, inelastic exoskeleton as they grow. This complex, delicate, and intricate process is an attractive target for intervention with a biopesticide, but is still not well understood. We recently showed that the replacement exoskeleton is shielded from collateral damage during degradation and recycling of the overlying old exoskeleton by a protective protein called “Knickkopf”. In the present work, we show that Knickkopf requires the presence of a second protein called “Retroactive”, and that this latter protein probably acts by chaperoning Knickkopf to its proper extracellular location in the new exoskeleton. Identification of all the protein components of exoskeletal synthesis and recylcing will enable us to design novel biopesticides that target the most sensitive aspects of insect development.
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Particle Models for Discrete Element Modeling of Bulk Grain Properties of Shelled Corn

Authors: J.M. Boac, M.E. Casada, R.G. Maghirang, J.P. Harner
Submitted to: Transactions of the ASABE
Computer simulations using the discrete element method (DEM) are capable of reducing the large effort and cost of evaluating grain handling issues experimentally. However, adequate particle models have not been developed and validated for most types of grain. We tested the capability of over 100 candidate models of corn kernels to predict angle of repose, flow from a hopper, and bulk density determined using the FGIS standard field measurement method. The best particle model was a single-sphere particle model with a particle coefficient of restitution of 0.30, particle coefficient of static friction of 0.30 for corn-corn contact (0.275 for corn-steel interaction), particle coefficient of rolling friction of 0.05, normal particle size distribution with a standard deviation factor of 0.4, and particle shear modulus of 185.2 MPa. We also found that an alternate model, with particle coefficient of static friction of 0.20 for corn-steel interaction and a shear modulus of 20 MPa, can be used to reduce computation time by about 80% in cases where lower accuracy of the predicted bulk density can be tolerated.
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Imputation of Unordered Markers and the Impact on Genomic Selection Accuracy

Authors: J. Rutkoski, J.A. Poland, J.L. Jannink, M. Sorrells
Submitted to: Genetics
Next-generating sequencing can be used to generate low-cost DNA markers for use in plant breeding. This approach of using sequencing to generate markers can be used even on species with complex genomes such as wheat. When using next-generation sequencing to generate DNA markers, missing data is common and marker data points must be imputed (estimated) prior to generating genetic models to predict yield and agronomic performance. In contrast to maize or rice, for example, wheat along with many other important crop species does not yet have a ‘reference genome sequence’. The reference genome sequence enables ordering of the DNA markers and simplifies the process of imputing missing data points. To address this issue of imputing missing data points in wheat and other ‘non-model’ species, we explored imputation algorithms for unordered DNA markers. We used data from barley, maize and wheat and tested the imputation accuracy of four different algorithms including k-nearest neighbors, singular value decomposition, random forest regression, and expectation maximization. We found that the random forest algorithm consistently produced the most accurate imputation results. Based on this study, suitable algorithms such as random forest can be used to impute missing data in datasets of unordered DNA markers. The imputed datasets can be used to generate genomic selection models with good accuracy in predicting yield and agronomic performance.
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