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Research Kernels

Our Latest Research Results - July 2013

Rift Valley Fever Risk Map Model and Sero-prevalence in Selected Wild Ungulates and Camels from Kenyan

Authors: S.C. Britch, Y.S. Binepal, M.G. Ruder, H. Kariithi K. Linthicum, A. Anyamba, J. Small, C.J. Tucker, L. Ateya, A. Oriko, S. Gacheru, W.C. Wilson
Submitted to: PLoS One

Rift Valley Fever (RVF) is an acute viral zoonosis endemic in Africa and the Arabian Peninsula. The disease is caused by the mosquito-transmitted arbovirus, Rift Valley fever virus (RVFV) in the family Bunyaviridae. The virus was first identified in 1931 during investigations into the cause of sudden abortions on a farm in the Rift Valley province of Kenya. Since then, epidemics have been repeatedly reported (with outbreak intervals of 3-15 years) in much of sub-Saharan and North Africa, as well as outbreaks outside of Africa (Saudi Arabia and Yemen). Humans infected by RVFV develop influenza-like symptoms ranging from fever to fatal encephalitis and hemorrhages. Domestic and wild animals show abortions (pregnant animals) and high mortality rates (young animals). Forecasting models and early warning systems can predict climatic conditions that are frequently associated with RVF outbreaks, which may eventually be used to implement effective and timely disease control measures. Previous studies have demonstrated that wild animals may play central roles in RVF outbreaks. With this in mind, we sought to examine temporal and spatial change patterns in RVF sero-prevalence in Kenyan wildlife and determine if there is a relationship between predicted RVF risk and wildlife sero-prevalence with the hope that the data presented will be useful in developing spatial models predicting high risk of exposure to RVFV in sub-Sahara Africa.

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A Hierarchical Network Approach for Modeling Rift Valley Fever Epidemics with Applications in North America

Authors: L. Xue, L.W. Cohnstaedt, M.H. Scott, C. Scoglio
Submitted to: PLoS One

Rift Valley fever (RVF) is a vector-borne zoonotic disease which causes high morbidity and mortality in livestock. In the event Rift Valley fever virus is introduced to the United States or other non-endemic areas, understanding the potential patterns of spread and the areas at risk based on disease vectors and hosts will be vital for developing mitigation strategies. To examine RVF in the United States a general network-based mathematical model was designed. Given a lack of empirical data on disease vector species and their vector competence, this discrete time epidemic model uses stochastic parameters following several PERT distributions to model the dynamic interactions between hosts and likely North American mosquito vectors in dispersed geographic areas. Spatial effects and climate factors are also addressed in the model. The model is applied to a large directed asymmetric network of 3,621 nodes based on actual farms to examine a hypothetical introduction to some counties of Texas, an important ranching area in the United States. The nodes of the networks represent livestock farms, livestock markets, and feed lots, and the links represent cattle movements and mosquito diffusion between different nodes. Cattle and mosquito (*Aedes* and *Culex*) populations are treated with different contact networks to assess virus propagation. Rift Valley fever virus spread is assessed under various initial infection conditions (infected mosquito eggs, adults or cattle). A surprising trend is fewer initial infectious organisms result in a longer delay before a larger and more prolonged outbreak. The delay is likely caused by a lack of herd immunity while the infections expands geographically before becoming an epidemic involving many dispersed farms and animals almost simultaneously. Cattle movement between farms is a large driver of virus expansion, thus quarantines are the best mitigation strategy to prevent further geographic spread. The findings from simulations can help to guide and design mitigation strategies in the future.

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Purkinje Cell Heterotopy with Cerebellar Hypoplasia in Two Free-Living American Kestrels (*Falco sparverius*)

Authors: A.G. Armien, D.L. McRuer, M.G. Ruder, A. Wunschmann
Submitted to: Veterinary Pathology

This report describes a congenital malformation in the brain of two free-living American kestrels. The abnormal size and shape of the cerebellum in each bird was likely caused by disruption of the molecular mechanisms that dictate cellular migration, placement, and maturation. Possible causes for this disruption may include viral infection, nutritional deficiency, toxic insult, or an inherited genetic defect. Developmental disorders of the central nervous system (CNS), especially the cerebellum, are commonly reported in mammals.

However, descriptions of congenital CNS disorders in birds are rare and this report provides insight into a novel cerebellar disorder observed in a wild avian species.
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Expression and Functional Characterization of an Endoglucanase from *Tribolium castaneum* (TcEG1) in Saccharomyces Cerevisiae

Authors: D. Shirley, C. Oppert, T.B. Reynolds, B. Miracle, B.S. Oppert, W.E. Klingeman, J.L. Jurat-Fuentes
Submitted to: Journal of Insect Science
Some insects have enzymes that can efficiently process plant material, and thus these enzymes may have applications in the biofuels industry. One such enzyme comes from the red flour beetle, which we previously identified as a potential plant-processing enzyme in extreme conditions, such as very alkaline environments. We put the gene for this enzyme in a yeast system to determine the feasibility for biofuels production. The yeast-expressed enzyme was similar to that of the beetle enzyme, demonstrating that expression of the gene in different systems does not disrupt the activity of the protein. We speculate that this yeast system may be useful in cases where harsh alkaline conditions are necessary for processing of plant materials for applications such as biofuels.
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Movement of *Tribolium castaneum* Within A Flour Mill

Authors: A.A. Semeao, J.F. Campbell, R.J. Whitworth, P.E. Sloderbeck
Submitted to: Journal of Stored Products Research
Understanding the movement patterns of stored-product insect pests within a food processing or storage facility is important in terms of identifying and targeting pest management at sources of infestation and determining their potential to avoid pest management tactics. In this case study, we demonstrated using a mark-recapture technique that the red flour beetle, *Tribolium castaneum*, was able to move among floors within a flour mill, but the majority (86%) of beetles were recovered on the same floor on which they were marked. For individuals that moved to a different floor, most moved downward (70%) and typically only to an adjacent floor (87%). Use of heat treatments to disinfest structures is an important pest management tool, but insects have the ability to move away from unfavorable temperatures. During a heat treatment of the mill there was an increase in the number of beetles captured, indicating increased movement, but there was not an increase in movement of marked beetles between floors. These results suggest that the rate of heating was sufficient to not allow the beetles time to move to cooler floors and escape the treatment. Results of this study indicate that red flour beetles are mobile enough that sources on other floors need to be considered in making pest management decisions.
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Registration of 'Tiger' Wheat

Authors: T.J. Martin, G. Zhang, A.K. Fritz, R. Miller, M.S. Chen
Submitted to: Journal of Plant Registrations
A new wheat cultivar, 'Tiger', was released by the Kansas Agricultural Experiment Station. Tiger is a hard white winter wheat with adaptation to dry-land production and with high yield potential in western Kansas. Tiger has good disease and insect resistance, including resistance to the Hessian fly. In addition, Tiger has exhibited superior bread baking and noodle qualities.
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Qualitative and Quantitative Analysis of Lignocellulosic Biomass Using Infrared Techniques: A Mini-Review

Authors: P. Xu, J. Yu, T. Tesso, F.E. Dowell, D. Wang
Submitted to: Applied Energy
Lignocellulosic biomass has become an alternative source for production of chemicals and fuels because it is renewable and could reduce greenhouse gas emissions by replacing petroleum sources. The major components of lignocellulosic biomass are cellulose, hemicellulose, and lignin. Current wet chemical methods for biomass composition analysis using two-step sulfuric acid hydrolysis are time-consuming, labor-intensive, and unable to provide structural information about biomass. Infrared techniques provide fast, low-cost analysis, are non-destructive, and have shown promising results. Chemometric analysis has allowed researchers to perform qualitative and quantitative study of biomass with both near-infrared and mid-infrared spectroscopy. This review summarizes the progress and applications of infrared techniques in biomass study, and compares the infrared and the wet chemical methods for composition analysis. In addition to reviewing recent studies of biomass structure and composition, we also discuss the progress and prospects for the applications of infrared techniques.
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