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Research Kernels

Our Latest Research Results - December 2012

Culicoides sonorensis Rearing Protocol

Authors: D.S. Snyder, J.A. Kempert, W.E. Yarnell, A. Ellis, L.W. Cohnstaedt
Submitted to: Journal of Visualized Experiments
The Arthropod-Borne Animal Diseases Research Unit has developed specialized methods and equipment for colonizing and raising *Culicoides* in laboratory conditions. *Culicoides* (Diptera: Ceratopogonidae) biting midges transmit many disease agents and *Culicoides sonorensis* is the primary vector of the bluetongue virus (BTV) that afflicts cattle, sheep, and wild ruminants in the U.S. The small size and difficulty of colonizing and maintaining these insects has limited studies of this important insect therefore in 1956 *Culicoides variipennsis (sonorensis)* was colonized as a way to study its ability and competence to transmit BTV and to examine methods of vector control. Since this time improvements in large scale production and standardization of rearing techniques has enabled production of 2.5 million adult midges annually. These colonized *Culicoides* are the only ceratopogonid that are maintained continuously at these numbers at an insectary in the U.S. Rearing and maintaining colonies of *Culicoides* is difficult because the insect's natural conditions must be mimicked in the laboratory, therefore special techniques to match the natural biology, behavior, habitat, and diet were needed. The careful attention to details has allowed for the successful rearing of *Culicoides* in both the short and long term. Large scale production has been attributed to the detailed procedures and specialized insectary equipment that has taken over 50 years to develop.
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Vector Competence of *Culicoides sonorensis* for Epizootic Hemorrhagic Disease Virus Serotype 7

Authors: M.G. Ruder, E.W. Howerth, D.E. Stallknecht, A.B. Allison, D.L. Carter, B.S. Drolet, E. Klement, D.G. Mead
Submitted to: Parasites & Vectors
The biting midge is widely distributed in the U.S. and is the only known insect to transmit the viruses that cause epizootic hemorrhagic disease in white-tailed deer and cattle. Of the seven proposed epizootic hemorrhagic disease virus (EHDV) types, only three are currently present in the U.S. (domestic types), and four are exotic. One exotic type that caused widespread disease among Israeli dairy cattle herds was recently shown experimentally to cause disease in our white-tailed deer. This indicates that if this exotic virus were to be introduced into the U.S., our white-tailed deer populations would be severely affected and the virus could become established if we have the insects to transmit this virus. The study described here was done to determine if U.S. midges could become infected by this exotic type of EHDV and whether it could then transmit the virus to our white-tailed deer, resulting in widespread outbreaks. The results of the study showed that our biting midge species is, in fact, susceptible to infection and can transmit the virus between white-tailed deer. These findings are useful to diagnosticians, veterinarians, researchers, cattle producers, wildlife professionals and others involved in livestock and wildlife health and management.
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Gall Midges (Hessian Flies) as Plant Pathogens

Authors: J.J. Stuart, M.S. Chen, M.O. Harris, R.H. Shukle
Submitted to: Annual Review of Phytopathology
The Hessian fly is a major insect pest of wheat. Hessian fly is also a representative of a large group of pests, the gall midges. In many respects, Hessian fly and other gall midges are like biotrophic pathogens. Hessian fly interacts with wheat in a typical gene-for-gene manner, has a fixed feeding site, and manipulates host plants extensively. This review paper summarizes recent advances in research on the Hessian fly – wheat interaction.
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Infrared Absorption Characteristics of *Culicoides sonorensis* in Relation to Insect Age

Authors: K.H.S. Peiris, B.S. Drolet, L.W. Cohnstaedt, F.E. Dowell
Submitted to: Medical and Veterinary Entomology
Biting midge *Culicoides sonorensis* is the vector that transmits Bluetongue viral disease in domestic and wild ruminant animals. Only female adult insects can transmit the disease. Determination of the age structure of female insect population is important before adopting control interventions in that control of the disease becomes more effective only when the proportion of adult insects is high in the insect population. Present methods of age

determination of Culicoides midges are laborious and time consuming. Therefore, we investigated the absorption of mid- infrared light in relation to the age of insects. We noted that systematic changes in infrared absorptions at specific wavelengths occur with the age of insects. As a result, infrared spectroscopy can be used to determine the age structure of insect populations. This will enable rapid determination of the age composition of midge populations which will help implementation of insect control programs to manage dissemination of Bluetongue disease effectively.
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The Case for a Generic Phytosanitary Irradiation Dose of 250 Gy for Lepidoptera Eggs and Larvae

Authors: G.J. Hallman, V. Arthur, C.M. Blackburn, A.G. Parker
Submitted to: Journal of Radiation Physics and Chemistry
Ionizing radiation is being used increasingly as a phytosanitary treatment to overcome biological barriers to trade in agricultural products. Generic treatments (one dose is used for a group of commodities and/or quarantine pests) allow for broader application. A generic dose of 250 Gy is proposed for all eggs and larvae of the insect Order Lepidoptera, a key group of quarantine pests. The measure of efficacy of this treatment is prevention of emergence of normal-looking adults when the most radiotolerant stage, late larva, is irradiated. This dose is supported by many studies comprising 29 species in 10 lepidopteran families, including some of the most important families and species of quarantine importance. Two of the studies found that doses >250 Gy were necessary, but they are contradicted by other studies with the same species showing that <250 Gy is adequate. In comparison a dose of 150 Gy for Tephritidae (fruit flies) was accepted by APHIS and the International Plant Protection Convention when only 14 species were studied and a number of studies did not support that low of a dose. A dose of 250 Gy for all Lepidoptera eggs and larvae gives a liberal margin of error that no insects in the group will survive the treatment.
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Measurement of Single Soybean Seed Attributes by Near Infrared Technologies. A Comparative Study

Authors: L.E. Agelet, P.R. Armstrong, I.R. Clariana, C.R. Hurburgh
Submitted to: Journal of Agricultural and Food Chemistry
Measurement of single seed composition for soybean breeders allows the selection of seeds with traits attributed to either genetics or agronomics, or both of these influences in combination. Four single-seed near infrared spectrometer systems were evaluated for their ability to predict soybean oil content, protein content and seed weight. Each system used slightly different measurement methods. The ability to predict seed traits varied somewhat by what trait was being measured and which system was used. For most cases the best measurement systems were for those that measured seed traits from several angles facilitated by the seed moving during measurement. This work helps breeders to determine the accuracy that can be obtained with single seed near infrared measurement and what instrumentation system is best suited for the trait they are trying to measure. Ultimately, single seed selection can expedite and reduce costs of varietal development by easily selecting varietal lines with the desired traits.
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Improved High-Throughput Bioassay for *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae)

Authors: B.S. Oppert, T.D. Morgan
Submitted to: Journal of Stored Products Research
We need a high throughput bioassay to evaluate the effects of potential test compounds for control of larvae of a major storage pest, the lesser grain borer. Traditional bioassay methods are not optimal for insects like the lesser grain borer, with immature stages that develop inside wheat kernels. We developed a diet consisting of egg yolk, brewer's yeast, and amylopectin that supports the larval stages of lesser grain borer. The diet can be made into a slurry that is easy to pipette and can be washed away to collect immature stages for other tests. We demonstrate that X-ray analysis can be used to observe developing larvae. However, simple weighing of groups of infested diet during the second week of the bioassay proved sufficient to distinguish between diets containing materials that were harmful to developing lesser grain borer larvae. The method is applicable for screening potential biopesticides to control lesser grain borer damage to grains and stored products.
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