USDA Research Kernels

Our Latest Research Results – January 2015

Cis-mediated down-regulation of a trypsin gene associated with Bt resistance in cotton bollworm

Authors: C. Liu, Y. Xiao, X. Li, B.S. Oppert, B.E. Tabashnik, K. Wu
Submitted to: Science Reports
Bacillus thuringiensis (Bt) toxins have been effective in controlling target insect pests, but resistant populations of insects threatens the long-term efficacy of Bt crops. The cotton bollworm is effectively controlled by transgenic crops expressing Bt toxins, but laboratory strains of the bollworm have been selected for resistance. By studying one of these resistant bollworm strains, we found that expression of a gut enzyme was greatly decreased in the resistant strain, and this was linked to why this insect pest was not effectively controlled by the toxin. The mechanism of the decreased production of the enzyme was due to changes in the genetics of the resistant strain. These studies will help to refine resistance management and prolong the use of Bt crops to control major pests.
Contact Brenda Oppert, telephone 785-776-2780, email Brenda.Oppert@ars.usda.gov

Transmission and epidemiology of bluetongue and epizootic hemorrhagic disease in North America: current perspectives, research gaps and future directions

Authors: M.G. Ruder, T.J. Lysyk, D.E. Stallknecht, L.D. Foil, D.J. Johnson, C.C. Chase, D.A. Dargatz, E.P.J. Gibbs
Submitted to: Vector Borne and Zoonotic Diseases
Bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV) are closely related viruses transmitted by small blood-feeding insects called *Culicoides* biting midges. These viruses infect a variety of domestic and wild ruminant hosts; however, the susceptibility to clinical disease associated with BTV or EHDV infection varies greatly among host species, as well as between individuals of the same species. In general, BTV primarily causes disease in sheep and sometimes cattle and other wild ruminants, whereas EHD is the most significant viral disease of white-tailed deer but also impacts cattle and some other wild ruminants. These viruses have circulated in the USA for over 60 years but recent changes in the patterns of infection and disease have forced the scientific community to revisit some fundamental areas of research related to the epidemiology of these diseases. In particular, the virus-*Culicoides*-ruminant interactions and the environmental conditions that drive disease patterns. The aim of this review is to identify research and surveillance gaps that obscure our understanding of BT and EHD in North America. Numerous reviews focusing on various aspects of BT and EHD epidemiology and pathobiology have been published and readers are referred to these papers for a comprehensive literature review. Here we focus on the North American perspective of recent BTV and EHDV events and the associated epidemiology research gaps.
Contact Mark Ruder, telephone 785-776-5571, email Mark.Ruder@ars.usda.gov

Effect of temperature on replication of epizootic hemorrhagic disease viruses in *Culicoides sonorensis* (Diptera: Ceratopogonidae)

Authors: M.G. Ruder, D.E. Stallknecht, E.W. Howerth, D.L. Carter, R.S. Pfannenstiel, A.B. Allison, D.G. Mead
Submitted to: Journal of Medical Entomology
Epizootic hemorrhagic disease (EHD) is a viral disease of wild and domestic ruminants transmitted by small insects known as *Culicoides* biting midges. Seasonal EHD outbreaks typically occur in the United States during the warmer months of late summer and early autumn. For many viral diseases transmitted by insects, including EHD, replication of the virus within the insect host has been shown to depend on temperature. In general, cooler ambient temperatures slow virus replication in insect vectors, whereas viruses replicate faster and to higher titers at warmer ambient temperatures. This becomes important when trying to understand disease transmission from animal-to-animal by the insect vector during different environmental conditions. In order to better understand EHDV replication within the *Culicoides* vector, we experimentally infected *Culicoides sonorensis* with EHDV and held the insects at three different temperatures (20°C, 25°C, 30°C) during the incubation period. Three different virus serotypes were evaluated. Across all three EHDV serotypes, the time it took for virus replication to reach levels high enough for potential virus transmission to a host decreased with increasing temperature.
Contact Mark Ruder, telephone 785-776-5571, email Mark.Ruder@ars.usda.gov

Management of North American *Culicoides* biting midges: Control options and research needs

Authors: R.S. Pfannenstiel, B.A. Mullens, M.G. Ruder, L. Zurek, L.W. Cohnstaedt, D. Nayduch
Submitted to: Vector-Borne and Zoonotic Diseases
Biting midges are vectors of two important viruses infecting North American cattle, deer and sheep; bluetongue (BTV) and epizootic hemorrhagic disease (EHDV). While these viruses have been identified for over 60 years, we still lack an adequate understanding of the basic biology and ecology of the primary known vector, *Culicoides sonorensis*, and know even less about other possible vector species. The major gaps in our knowledge of the biology of biting midges are broad and include: understanding the ecology of juveniles, the identity of potential alternate vector species, interactions of midges with both pathogens and vertebrates, and the effectiveness of potential control measures. Due to these broad and numerous fundamental knowledge gaps, vector biologists and livestock producers are left with few options to respond to or understand outbreaks of EHDV or BTV in North America, or respond to emerging or exotic biting midge transmitted pathogens. Here we outline current knowledge of vector ecology and control options for North American biting midges and delineate research recommendations aimed to fill knowledge gaps and lead to the design and implementation of control tactics.
Contact Robert Pfannenstiel, telephone 785-776-2799, email Robert.Pfannenstiel@ars.usda.gov

Colonization of bison (*Bison bison*) wallows in a tallgrass prairie by *Culicoides* spp (Diptera: Ceratopogonidae)

Authors: R.S. Pfannenstiel, M.G. Ruder
Submitted to: Journal of Vector Ecology
Culicoides biting midges are small insects that transmit a number of important disease agents to livestock and some wild ruminants. Active and relict bison wallows in a grassland habitat were evaluated as breeding sites for biting midges after rains in the summer of 2013. Five species of biting midges were reared out of wallows. The most commonly reared species; *Culicoides sonorensis* and *C. variipennis* were reared only from active wallows, presumably because of contamination with bison feces and/or other animal materials. Two other species, *C. crepuscularis* and *C. haematopotus,* were reared from relict wallows that had no bison use. Some wallows held water for 5-6 weeks which conceivably could allow breeding of two midge generations.
Contact Robert Pfannenstiel, telephone 785-776-2799, email Robert.Pfannenstiel@ars.usda.gov

West Nile Virus

Authors: D.S. McVey, W.W. Wilson, C.G. Gay
Submitted to: OIE Scientific and Technical Review
This review covers the basic biology of the West Nile virus and the host-vector-pathogen interactions that result in significant disease in wild birds, horses, and humans. The review describes the basic properties of the virus, cellular infection and pathogenesis of disease, and the ecology of virus maintenance, amplification, and transmission. Disease epidemiology and risk estimation strategies that are currently in use are reviewed. Host immune responses and vaccination practices are also described. Principles of vector control, exposure control and long-term risks through climate and habitat factors are included.
Contact Scott McVey, telephone 785-537-5561, email Scott.Mcvey@ars.usda.gov

Phytosanitary irradiation in ports of entry: a practical solution for developing countries

Authors: E. Bustos-Griffin, G. Hallman, R. Griffin
Submitted to: International Journal of Food Science & Technology
Recently the US has permitted countries to treat imports with irradiation for phytosanitary purposes at approved ports of entry in the US. This manuscript discusses the possibilities for developing countries to economically use this approval to explore the feasibility of using phytosanitary irradiation to overcome quarantine barriers to trade in their fresh commodities. Those benefitting from this work will be US consumers of fresh produce and the wholesale and retail markets in the US that can provide a broader assortment of fresh produce because previously absent produce will now be available.
Contact Guy Hallman, telephone 785-776-2705, email Guy.Hallman@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research
1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/main/site_main.htm?modecode=30-20-05-00