

Our Latest Research Results - January 2013

Expression of Lysozyme in the Life History of the House Fly (*Musca domestica* L.)

Authors: D. Nayduch, C. Joyner

Submitted to: Journal of Medical Entomology

All life history stages of house flies associate with septic environments teeming with bacteria, and employ physical and chemical defenses that allow them to thrive and persist in this niche. The bacteria and fungi digesting enzyme lysozyme is found in many animals, and in house flies was first described in the larval midgut, where it is used for digestion of microbe-rich meals. This study looked at the production of lysozyme on the mRNA (gene product) and protein (active enzyme) level across life history from egg through larva, pupa and adult. In addition, we determined the spatial location of lysozyme in the body of adult house flies exposed to high doses of bacteria. House flies produced lysozyme mRNA from 30-min after oviposition (when the embryo is first in contact with the septic environment) throughout all life stages to adulthood. In adult flies, lysozyme mRNA was detected both locally in the alimentary canal (where bacteria are located) and systemically in the fat body. Interestingly, lysozyme protein was only detected in larval stages and older adults, likely due to ingestion of immune-stimulating levels bacteria during these stages and not at other times in life history. Activation of the lysozyme gene to produce mRNA throughout the entire life of the fly ensures that this important defense molecule that can be readily synthesized into active protein when flies encounter bacteria. Thus, the production of enzyme from mRNA must be tightly regulated in flies, and merits further study. Lysozyme active enzyme primarily serves both a digestive and defensive function in larval and adult flies, and may be a key player in the ability of *Musca domestica* to thrive in microbe-rich environments. Contact Dana Nayduch, telephone 785-537-5566, email Dana.Nayduch@ars.usda.gov

Cytopathogenesis of Vesicular Stomatitis Virus is Regulated by the PSAP Motif of M Protein in a Species-Dependent Manner

Authors: T. Irie, Y. Liu, B.S. Drolet, E. Carnero, A. Garcia-Sastre, R.N. Harty

Submitted to: Viruses

Vesicular stomatitis virus (VSV) is an insect transmitted virus that causes disease in cattle, horses and swine. The matrix (M) protein is believed to play several important roles in the ability of the virus to cause disease. When a specific region of M was genetically

altered, the virus multiplied much less efficiently and caused significantly less disease in mice. Interestingly, this virus multiplied more efficiently in insect cells and caused much more cell death than is typical. These findings suggest that this specific region of the M protein of VSV plays an important role in how well virus grows and how much disease it is able to cause in different species.

Contact Barbara Drolet, telephone 785-537-5569, email Barbara.Drolet@ars.usda.gov

Introduction to the Wind Erosion Prediction System (WEPS)

Authors: J. Tatarko, L.E. Wagner

Submitted to: Agriculture Handbook

The Wind Erosion Prediction System (WEPS) was developed by a team of US Department of Agriculture (USDA) scientists in collaboration with other agencies and private cooperators in response to customer requests, primarily USDA Natural Resources Conservation Service (NRCS), for improved wind erosion prediction models. WEPS is designed to provide estimates of soil loss by wind from cultivated, agricultural fields. It is intended to replace the outdated Wind Erosion Equation (WEQ) as a prediction tool for those who plan soil conservation systems, conduct environmental planning, or assess offsite impacts caused by wind erosion. WEPS also has capabilities for other land management situations where wind affected soil movement is a problem. WEPS 1.0 consists of the computer implementation of the latest wind erosion science with a graphical user interface designed to provide easy-to-use means of entering inputs to the model and obtaining output reports. WEPS simulates not only the basic wind erosion processes, but also the processes that modify a soil's susceptibility to wind erosion. The structure of WEPS is modular and consists of a user interface, a science model including seven submodels, and four databases. The user interface is used to create input files using information from user inputs and the databases.

Contact John Tatarko, telephone 785-537-5542, email John.Tatarko@ars.usda.gov

Modeling Crop Residue Decomposition and Soil Surface Cover

Authors: S.J. van Donk, J.L. Steiner, H.H. Schomberg, P.W. Unger, F.A. Fox

Submitted to: Transactions of the American Society of Agricultural and Biological Engineers

The Residue Decomposition submodel of the Wind Erosion Prediction System (WEPS) simulates the decrease in crop residue (biomass) due to microbial activity. The decomposition process is modeled as a function of temperature and moisture. Decomposition is a function of decomposition days; under optimum temperature and moisture conditions one decomposition day per day is accumulated. Only a fraction of a decomposition day is accumulated if conditions are less than optimum. Biomass remaining after harvest is partitioned between various pools representing standing, flat, buried, and root biomass. Residue from different crops may decompose at different rates. Since residue decomposition can require a long period of time, crop residue biomass from sequential harvests is accounted for in three separate pools. Biomass from the most recently harvested crop will be in pool one, biomass from the previous crop in pool two, and there is a third pool for biomass from the oldest crop(s). After harvest, any residue biomass remaining from a previous crop is moved into the older age pools and residue from the just harvested crop is moved into pool one. Standing residue losses not only result from microbial activity, but also from physical forces. Physical transfer of crop residue from the standing biomass pool will reduce both the stem population and standing biomass. A daily estimate of the standing stem population is required in order to evaluate the vertical stem area that the wind encounters. This area is called the stem area index, which is calculated from standing stem number, stem height and stem diameter. It affects wind resistance and, ultimately, wind erosion. Tillage may alter the amount of residue in the different pools.

Contact John Tatarko, telephone 785-537-5542, email John.Tatarko@ars.usda.gov

Serine and Cysteine Protease-Like Genes in the Genome of a Gall Midge and Their Interactions With Host Plant Genotypes

Authors: H. Chen, Y.C. Zhu, J.R. Whitworth, J.C. Reese, M.S. Chen

Submitted to: Insect Biochemistry and Molecular Biology

Hessian fly is a major insect pest of wheat. The insect is mainly controlled through host plant resistance. Therefore, understanding the mechanisms of wheat defense against Hessian fly may provide useful information to improve wheat resistance to Hessian fly. One potential target for plant defense against insects is the digestive enzymes, particularly proteases, in the insect gut. This research took advantage of the availability of the Hessian fly genome sequence and systematically analyzed the composition and expression of all digestive proteases in the Hessian fly larval gut. Major putative digestive trypsin, chymotrypsin, and cysteine proteases were identified and their expression profiles among tissues and different developmental stages were determined. The study should provide a

foundation for future research for utilization of plant protease inhibitors for management of this insect pest. Contact Ming-Shun Chen, telephone 785-532-2719, email Ming-Shun.Chen@ars.usda.gov

Potential for Hypobaric Storage as a Phytosanitary Treatment: Mortality of *Rhagoletis pomonella* in Apples and Effects on Fruit Quality

Authors: R. Hulasare, M.E. Payton, G.J. Hallman, T.W. Phillips

Submitted to: Journal of Economic Entomology
Storage under low oxygen conditions increases the shelf life of fresh fruits and vegetables and is being used increasingly for that purpose on a commercial basis. It is known experimentally to kill insects as well and has been researched as a treatment to kill insects that may be present in fruit exported to areas where those insects do not exist and might become established. However, that application is not used commercially. Low pressure is a way of achieving low oxygen storage. Although it has been researched considerably for use against stored-product insects, little research has been done for control of quarantine pests of significance on fresh fruits and vegetables and no research that we are aware of has been done for control of an internal feeder in a fruit, which are the most important and difficult to manage quarantine pests. This research investigated low pressure to kill eggs and larvae of the apple maggot (*Rhagoletis pomonella*) in apples. Infested apples were exposed to two pressures, 3.33 and 6.67 kPa (kilopascals) (0.5 to 1 pound per square inch), in jars at 25 and 30°C (77 and 86°F) for 3-120 hours. Mortality of eggs and larvae increased with increase in time of exposure. Apples exposed to 3.33 kPa at 25 and 30°C for 3 and 5 d were unaffected for aroma and taste, although in 'Red Delicious' but not 'Golden Delicious' apples the internal and external appearances were affected. Eggs and larvae were all killed at conditions that did not affect 'Golden Delicious'. Use of low pressure for disinfestation and preservation of apples is a potential, non-chemical treatment for exported fruit. 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/npa/cgahr

