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WHITEFLY SENSITIVITY TO PLANT VOLATILES. F. Djibodé-Favi<sup>1</sup>, W. Mallory<sup>1</sup> & C. Cantrell<sup>2</sup>, <sup>1</sup>Agricultural Research Station, Virginia State University, Petersburg, VA 23806 & <sup>2</sup>Natural Products Utilization Research Unit USDA-ARS National Center for Natural Products Research, University Ave., University, MS 38677. Sweet potato whitefly, which costs 1.6 billion to U.S. agriculture, is a sap feeder that also transmits viruses to crops. The adult stage produces wax particles, which profusely dust any visited surface. Our objective was to show that wax particles were also induced by infected plant volatiles. Young adult whiteflies harvested in 25 ml vials were fumigated with volatiles from either lemon grass or produced by the leaves' peltate glands of *Vernonia galamensis* identified as the sesquiterpene lactone Prevercistifolide-8-o-isobutyrate with no fumigated control. The lemon grass grown in our greenhouse mainly produces Citral (70%). Wax produced was collected on no. 2 Whatman paper, visualized using a scanning electron microscope and analyzed with a gas chromatograph. They barely produced wax when fumigated with lemon grass volatiles because they died in 15 min. Wax produced by non-fumigated whiteflies was made of 49.9% of C<sub>32</sub> Aldehyde, 22.9% of C<sub>32</sub> Alcohol, 30% of C<sub>34</sub> Aldehyde, 13% of C<sub>34</sub> Alcohol and five types of wax esters that made up 22.77% of the particle composition. Fumigation with vernonia gland extract showed 13.4%, 14.3%, 2.9% and 13% respectively. By contrast, the later has eleven wax esters that made up 56.3% of the particle composition. We discovered that wax particles mop up peltate gland secretions to increase whitefly fitness on vernonia leaves.

PHENOLOGY AND NATURAL ENEMIES OF THE PINE BARK ADELGID, *PINEUS STROBI*, IN VIRGINIA FORESTS. Holly A. Wantuch, Scott M. Salom & Thomas P. Kuhar, Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. The pine bark adelgid, *Pineus strobi* (Hemiptera: Adelgidae), is a native herbivore of eastern white pine, *Pinus strobus*, in eastern North America. Like many other adelgid species, the pine bark adelgid is a phloem feeding insect with limited mobility. Spending the majority of its life anchored to a single location on a tree, it can be found either on the bark, stem, or needle base. The only known predator to specialize on pine bark adelgid is *Laricobius rubidus* (Coleoptera: Derodontidae), about which relatively little is known. *L. rubidus* is closely related to *Laricobius nigrinus*, a biological control agent introduced to the eastern U.S. to manage the hemlock woolly adelgid, *Adelges tsugae*. These species successfully hybridize and produce fertile offspring, but it is unknown if interaction with an introduced sibling species and its respective adelgid

prey species will have any implications for *L. rubidus* or the pine bark adelgid. Thus, it is important to characterize the phenological patterns of these insects, specifically in their southern ranges, where they have not been studied previously. This study was funded by the USDA Forest Service Grant 11-DG-11083150-010.

**POLAR VORTICES: CAN THEY REALLY KILL THE STINK BUGS?** Thomas P. Kuhar & John D. Aigner, Department of Entomology, Virginia Tech, Blacksburg, VA 24061-0319. The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), was accidentally introduced from Asia into Pennsylvania in the late 1990s, and is spreading across North America. As it moves to more northerly regions, we are uncertain about how severe winter climate might affect this species. The supercooling point (SCP), is the temperature at which crystallization of the body fluids occurs, and provides an estimate of the lethal low temperature limit of insects. From 2013 to 2014 we determined the SCPs of BMSB adults collected each month. Supercooling points changed with season, all fall and winter SCPs, which averaged about -13 to -14°C, were significantly colder than SCPs taken from insects in summer. During early January 2014, much of North America experienced a “polar vortex”, of uncommonly cold arctic air from the North Pole, which enabled us to measure field mortality of BMSB under extreme conditions (temperatures < SCP). Virtually 99% mortality occurred to BMSB adults held in insulated containers outside, compared to very low mortality of bugs held indoors. Wild BMSBs often overwinter in aggregations beneath loose bark on dead trees and in rock crevices. BMSBs that exhibit this behavior probably suffered high mortality in the extreme low temperatures of the 2014 polar vortex. However, because many BMSBs also seek winter refuge in human-built structures, recent polar vortices have not noticeably impacted BMSB populations as a whole. Thus, uncertainty remains about the impact of severe winter temperatures on BMSB populations.

**CHANGES IN PHYSICAL, CHEMICAL AND ANTI-NUTRITIONAL PROPERTIES DURING DEVELOPMENT OF VEGETABLE SOYBEAN (EDAMAME).** Arrieyana Cartier, Yixiang Xu, Daniel Kibet, Krystal Jordan, Ivy Elena, Stephanie Davis, Edward Sismour, Maru Kering & Laban Rutto, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Changes in physical, chemical and anti-nutritional characteristics of two vegetable soybean varieties (‘Asmara’ and ‘Mooncake’) during seed development were investigated. Pods were sampled weekly for six weeks starting from developmental stage 5 (R5) to 8 (R8). Changes over time in measured attributes were similar but the rate of change differed among the two varieties. In both varieties, seed moisture content and intensity of green color decreased as seed developed with the most significant decline observed in the last two weeks of sampling. Seed weight peaked at R6 then gradually decreased thereafter, while seed hardness increased throughout the sampling period with ‘Asmara’ recording significantly higher seed hardness at R8. For both varieties, protein accumulation occurred mostly in the later stages, while significant lipid accumulation was observed in the early stages of development. Among the sugars, fructose content decreased with seed development,

sucrose content increased to R6 before decreasing, and there was rapid accumulation of raffinose and stachyose in the last two weeks of sampling. Total phenolic content decreased between R5 and R6, but increased with further seed development and maturation. Tannin and phytate content in seed increased throughout the sampling period. Changes in trypsin inhibitory activity varied with variety reaching a maximum at R6 for 'Asmara, and closer to maturation for "Mooncake." Our data provide the physical, chemical and anti-nutritional basis for harvesting vegetable soybean at R6 namely: peak seed weight and sucrose content, lower values of oligosaccharide and anti-nutrients, and intense green color.

ELUCIDATING THE ANOREXIGENIC MECHANISM OF NEUROPEPTIDE AF. M. S. Delp<sup>1</sup>, B. A. Newmyer<sup>2</sup>, M. A. Cline<sup>1</sup> & E. R. Gilbert<sup>1</sup>, <sup>1</sup>Department of Animal and Poultry Sciences, Virginia Tech, Blacksburg, VA 24060 & <sup>2</sup>Department of Neuroscience, University of Virginia, Charlottesville, VA 22904. Neuropeptide AF (NPAF), a member of the RFamide family, is encoded by the same gene as neuropeptide FF (NPFF), which causes short-term anorexia. However, reports on the role of NPAF on appetite-related process are lacking. Thus, central injections of 4.0, 8.0 and 16.0 nmol NPAF were administered to chicks to observe its effect on food and water intake. Chicks treated with 8.0 and 16.0 nmol central NPAF decreased both their food and water intake. In a second experiment, chicks that received central NPAF had an increased number of c-Fos immunoreactive cells in the dorsomedial (DMN), paraventricular (PVN) and ventromedial (VMH) nuclei. The arcuate nucleus and lateral hypothalamic area were not affected. In the third experiment, there were no differences in mRNA abundance of appetite-associated factors in NPAF-injected chicks in whole hypothalamus. In the fourth experiment, the DMN, PVN and VMH were isolated and the abundance of melanocortin receptor 4 (MC4R) mRNA and neuropeptide Y receptor 5 (NPY5R) mRNA increased in the VMH of NPAF-injected chicks. In a fifth experiment, NPAF-treated chicks exhibited fewer feeding pecks and spent less time perching, whereas they spent an increased time in deep rest. We conclude that NPAF causes anorectic effects that are associated with the hypothalamus.

BLUEBERRY EXTRACTS PROTECT AGAINST ALCOHOL-INDUCED BODY DEFECTS IN FETAL MICE. Zach S. Gish, Sharang Penumesta, Diana J. Valle & Roman J. Miller, Department of Biology, Eastern Mennonite University, Harrisonburg, VA 22802. Nutrient dense blueberries have been shown to combat aging, osteoporosis, cancer, and insulin resistance, while enhancing vision, hepatic, renal, cardiovascular, and brain functions. In contrast, alcohol is a powerful teratogen, systematically affecting prenatal development as well as postnatal functioning. Our study explored the effects of anthocyanins derived from blueberries in protecting/mitigating ethanol-induced prenatal developmental deficiencies in a murine model. Swiss mice were administered alcohol (25% v/v of absolute ethanol in normal saline at 0.03 ml/g per maternal body weight) or normal saline, through IP injections on days 5 and 7 following impregnation. Anthocyanin injections (30 mg/kg per maternal body weight) were administered through subcutaneous neck injections on days 0, 5, 7 and 12.

Statistical analysis showed that the anthocyanin group was protected from gross developmental deficiencies over the binge alcohol group in regards to average body weight, crown-rump length, telencephalon size and liver size ( $p < 0.05$ ). While not delineating the mechanism, these preliminary results are the earliest support of the hypothesis that the antioxidant properties of blueberry anthocyanins mitigate the gross teratology effects of prenatal binge alcohol exposure. (Research supported in part by the Daniel B. Suter Endowment in Biology, Eastern Mennonite University.)

### Posters

DEVELOPING TOOLS FOR TRAP CROPS: ELUCIDATING THE BIOSYNTHETIC PATHWAY OF THE AGGREGATION PHEROMONE MURGANTIOL IN THE HARLEQUIN BUG STINK BUG (*MURGANTIA HISTRIONICA*). Jason Lancaster<sup>1</sup>, Dawn Gundersen-Rindal<sup>2</sup>, Donald C. Weber<sup>2</sup> & Dorothea Tholl<sup>1</sup>, <sup>1</sup>Biological Sciences, Virginia Tech, Blacksburg, VA 24061 & <sup>2</sup>USDA-ARS, Beltsville, MD. Harlequin bug (*Murgantia histrionica*) is a stink bug pest in the southeastern United States that feeds on crucifer crops and can cause considerable economic loss. Adult male harlequin bugs release the sesquiterpenoid aggregation pheromone murgantiol, which attracts other conspecifics to the host plant to feed and mate. Terpenoid aggregation or sex pheromones are produced by a variety of insect taxa, but their biosynthesis is largely unexplored. This project aims to identify the biosynthetic pathway as well as the tissue-specific site of biosynthesis of murgantiol in harlequin bug. We hypothesize that murgantiol is synthesized in a two-step pathway with a dual function prenyldiphosphate synthase/terpene synthase enzyme catalyzing its first step. RNAseq analysis identified a candidate gene, *MhFPSSI*, which is highly expressed in mature males but not in females, and may encode the proposed dual function synthase in murgantiol biosynthesis. We are in the process of functionally characterizing recombinant MhFPSSI. Moreover, we are currently using tissue dissection and transmission electron microscopy to examine the presence of murgantiol pheromone glands and *MhFPSSI* expression in these tissues.

### **Astronomy, Mathematics, and Physics with Material Science**

TAPE-INFLUENCED INFRARED AND THERMAL POWER GENERATION. Graham P. Gearhart, Brian C. Utter, & Giovanna Scarel, Department of Physics & Astronomy, James Madison University, Harrisonburg VA 22807. Infrared (IR) radiation can be harvested and turned into an alternative source of energy through the use of a power generator (PG) device. A glowbar source generates IR radiation which is then directed onto the PG device for an extended period of time, and a voltage is generated. Our data suggests voltage and temperature are influenced by both the color and presence of tape in IR power generation, and that it does not behave as thermoelectric power generation.