

foreign aircraft and missile concepts of concern to our security and defense. Over the years research information has been acquired for eleven aircraft, twelve surface-to-air missiles, five air-to-air missiles, two air-to-surface missiles, two surface-to-surface missiles, five ballistic missiles, two anti-tank missiles, four reentry vehicles, and one wing-in-ground effect vehicle.

TRACING THE GROWTH OF U.S. AIRPOWER AND THE AIRCRAFT INVOLVED. M. Leroy Spearman, Langley Research Center, Hampton, VA The U.S. military first recognized a role for aviation in 1907 with the establishment of an Aeronautical Division in the U.S. Army Signal Corps. The U.S. Navy acknowledged a role for aviation in 1910. The Army procured an airplane from the Wright Brothers in August 1908 and began flight tests at Ft. Meyers, VA. A year later an improved Wright Flyer was accepted by the Army as 'Airplane No. 1'. Another American designer, Glenn Curtiss, was becoming well known and in 1911 a Curtiss airplane was the second airplane to be sold to the U.S. Army. The first airplane to be built for the U.S. Navy was a Curtiss airplane 1911. The first appropriation for military aeronautics was in the 1912 War Department for \$125,000. From these funds, orders were placed for three Wright airplanes and two Curtiss airplanes. War broke out in Europe in 1914 and it was apparent that a disparity existed between European progress and U.S. foot-dragging in the field of military aviation. In 1915 the U.S. Congress approved legislation to create a research facility to enhance aeronautical programs. In 1916 property was purchased just north of Hampton, VA that provided a flying field for aeronautical research and flight testing. Named Langley Field, a portion of the field was set aside for construction of the newly created National Advisory Committee for Aeronautics (NACA). The U.S. entered World War I in 1917 and did learn from flying and building European airplanes. Significant growth began in the 1920's with trainers, bombers, first Navy fighters and Army pursuits, observation airplanes, the first monoplanes, attack airplanes, first jet aircraft in early 1940's, first twin-engine fighter jets, swept-wing concepts, advanced supersonic designs such as the Century series of fighters - a total of over 60 military aircraft designs appeared from 1940 to 1980. Currently some aircraft using stealth technology are being deployed.

### **Agriculture, Forestry and Aquaculture Science**

YIELD AND RIPENING OF GREENHOUSE TOMATOES IN RESPONSE TO DAYTIME TEMPERATURE. Mark Kraemer & Françoise Favi, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Greenhouse-grown tomatoes are a high-value crop for limited-resource producers in the mid-Atlantic states. Increased heating costs in recent years have encouraged many to reduce growing temperatures. Measurement of photosynthetic rates indicated lower temperatures were feasible and some professional growers recommended them. However, little actual data was available in the published literature. Thus, we evaluated tomato yield differences between a warm and cool greenhouse sections. The average daytime temperature in the warm section averaged about 2°C greater than the cool greenhouse. Night temperatures were similar. Each section had 18 tomato plants (var. Trust) arranged in three rows.

The experiment was run for 3 months in the fall of 2009 and again in 2010, with warm and cool sections reversed. The results indicated that total fruit yield was the same for both sections but that fruit ripened faster in the warm section. It is recommended that growers allow temperatures to rise during sunny days by reducing venting and using CO<sub>2</sub> generators. Increased heating costs during cold, sunny periods could be repaid with earlier harvests.

LOCATION OF THRIPS (THYSANOPTERA: THIRIPIDAE) ON SOYBEAN SEEDLINGS AND IMPLICATIONS FOR SAMPLING. J.A. Samler<sup>1</sup>, D.A. Herbert<sup>1</sup>, S. Malone<sup>1</sup>, D. Owens<sup>1</sup>, T.P. Kuhar<sup>2</sup>, & C. Brewster<sup>2</sup>. <sup>1</sup>Department of Entomology, Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA 23437. <sup>2</sup>Department of Entomology, Virginia Tech, Blacksburg, VA 24061. Thrips feeding can cause significant injury to soybean seedlings resulting in stunted growth and delayed maturity. Determining accurate numbers of thrips on plants is necessary for making control decisions. Currently, sampling is based on assessing populations on whole plants which very labor intensive. This research was conducted to determine where thrips are located on soybean plants and whether subsamples of plant material are adequate for monitoring populations. Using a stratified random sampling method, soybean plants were randomly selected and systematically sectioned into three parts: the top three unopened leaflets (Terminal); the first fully expanded trifoliolate (Trifoliolate); and the remainder (Remainder) of the plant which was cut at the base just above the soil surface. Thrips larvae and adults were washed from each plant sample and the leaf area was measured. Results showed that the soybean Terminal has the highest density of thrips larvae ( $\mu = 1.412$ ) while the Remainder of the plant has the highest absolute count ( $\mu = 4.515$ ) when density is not a factor. There was no correlation between the number of larvae and leaf area in any of the plant sections (Terminal:  $r = -0.0086$ ,  $p = 0.9628$ ; Trifoliolate:  $r = -0.2742$ ,  $p = 0.1289$ ; Remainder:  $r = -0.1158$ ,  $p = 0.5280$ ). Larval counts from the Remainder of the plant had the strongest correlation with whole plant counts ( $r = 0.895$ ,  $p = <0.0001$ ). Implications are that whole plant samples are the most accurate even though labor intensive.

INVESTIGATING THE ROLE OF OLFACTION IN THE HOST PLANT SELECTION OF HARLEQUIN BUG (MURGANTIA HISTRIONIC), PEST OF COLE CROPS. Wallingford, A.K., T.P. Kuhar and P.B. Schultz. Dept. of Entomology, Virginia Tech. Harlequin bug (HB) is a piercing-sucking pest of cole crops. Adult and nymphal feeding causes cosmetic injury to vegetables sold as greens and, if left untreated, HB infestations can stunt or kill a plant. There is potential for managing HB by planting a preferred or more attractive host plant, or trap crop, to divert insect feeding away from the protected cash crop. This study evaluated several species of brassicales and a non-host control for HB host preference and thereby the suitability for use as a trap crop. Caged choice tests show that HB adults prefer to feed on mustard (*Brassica juncea* 'Southern Giant Curled') over, arugula (*Eruca sativa*), bean (*Phaseolus vulgaris*), collard (*B. oleracea* 'Champion'), rapini (*B. rapa* 'Roquette') and rapeseed (*B. napus* 'Athena'). Olfactometer choice tests showed that male HB are attracted to the odors from the leaves of both bean (non-host) and mustard (preferred host) over clean air, but when given a choice

between the two, males orient to mustard over bean. This is not the case for females as they do not orient to odors from mustard or bean, and show no preference for the odors of one over the other. Male and female HB both orient to odors produced by the combination of odors from males feeding on mustard leaves (presumably emitting an aggregation pheromone) over mustard leaves alone, while neither orient to males feeding on bean versus bean alone and do not orient to males alone versus clean air. Implications for trap crop implementation are discussed.

POTENTIAL USE OF CHLOROPHYLL FLUORESCENCE TO IDENTIFY DIFFERENCES IN TRANSPIRATION EFFICIENCY IN PEANUT. Jacqueline F. Hawkins & George T. Byrd, School of Natural Sciences & Mathematics, Ferrum College, Ferrum, VA 24008. Production of peanut (*Arachis hypogaea* L.) often occurs in areas prone to drought, therefore genotypic selection should be based on efficient use of water. This study examined the potential use of chlorophyll fluorescence for assessing genotypic variation in peanut transpiration efficiency (TE), defined as the weight of dry matter per unit of water transpired. The experimental hypothesis was the rate of decline in chlorophyll fluorescence in peanut leaves would differ under different watering regimes and among genotypes and these differences would be correlated with TE. Since reports show TE to be correlated with specific leaf weight (SLW), this trait was also assessed. Seventeen genotypes were grown in closed containers in a soil-sand mix and subjected to two soil moisture regimes—well-watered and water-deficit. Peanut genotypes differed in TE, however, TE did not differ between well-watered and water-deficit conditions. Transpiration efficiency was positively correlated with SLW across water treatments ( $r = 0.75$ ). Correlation between TE and chlorophyll fluorescence, however, was not significant. Although chlorophyll fluorescence has shown promise to indicate water-deficit stress responses in species like cotton and sorghum, peanuts showed little difference in the decline in chlorophyll fluorescence under well-watered and water-deficit conditions. Further research is needed to determine the relationship between chlorophyll fluorescence and traits associated with drought tolerance in peanut. (Supported by a Faculty Development Grant, Ferrum College).

POTENTIAL FISH PATHOGENS FOR CAGE AQUACULTURE IN VIRGINIA. David Crosby, Virginia Cooperative Extension, Virginia State University, PO Box 9081, Petersburg, VA 23806. Many farm pond owners raise catfish in cages for personnel consumption or to sell as a farm commodity to local markets in Virginia. These farmers typically buy catfish fingerlings that are sold into Virginia from out of state commercial catfish fingerling farms. What fish farmers do not realize that there is a potential disease risk involved with caged catfish. The typical bacterial pathogens that cage producers would encounter are *Aeromonas* and *Columnaris*. These are quite common in the aquatic environment and one of the leading causes of disease problems in cages. A new strain of *Aeromonas hydrophila* that has originated in Alabama is highly pathogenic. This strain has been observed in Virginia. A fish health study conducted at VSU during 2007 to 2009 found that catfish fingerling from commercial farms had various external parasites. These catfish typically had *Trichodina*, proliferative gill disease and *Ligictaluriadus* on the gills. In one case, highly pathogenic bacteria, Enteric Septicemia of Catfish, which is common to

catfish farming, was found during the study. This study also found that fish were exposed to endemic pathogens such as Ich and Trichophyra. By stocking commercial produced catfish a farmer increases the risk of bringing in pathogens that would cause a disease outbreak, or result in an epizootic from an endemic pathogen(s), or worst case scenario introduce a new potential pathogen to the fish farm.

THE WHY, WHERE, AND WHEN OF CEREAL LEAF BEETLE (*OULEMA MELANOPUS* L.). Chris Philips<sup>1</sup>, Ames Herbert<sup>1</sup>, Tom Kuhar<sup>1</sup>, Dominic Reisig<sup>2</sup>, and Sean Malone<sup>1</sup>. <sup>1</sup> Department of Entomology, Virginia Tech, Blacksburg, VA. and <sup>2</sup> Department of Entomology, North Carolina State University, Plymouth, NC. Because of the difficulty in predicting when and where cereal leaf beetle outbreaks will occur many growers in the Southeast apply insecticides on a calendar basis rather than using a threshold-based IPM approach. Our challenge is to develop new information and procedures that will encourage growers to reevaluate the way they are approaching spring-time insect control in wheat, and consider adoption of the IPM approach. Using small plot trials in 2010 and 2011, we found that a number of insecticides were effective at controlling CLB when applied at the right time. We also found that an IPM approach was more effective at controlling CLB than an automatic application. In addition, large scale surveys indicated that CLB was not randomly distributed on a field and regional scale. Finally, degree day information was used to create a predictive model for when peak CLB egg laying will occur. This model was used to predict the average calendar date of peak eggs for each population as well as for the average of all populations. In 2010 and 2011, the model predicted the average egg peak within 2 days and 1 day, respectively. Larval peaks occurred approximately 16 days after egg peak in 2010 and 17 days after egg peak in 2011. Given the accuracy of 182 DD, historical weather information was used to create a predictive map of when areas will exceed 182DD. This map predicted the calendar date for each area in Virginia within 4 days.

OPTIMAL GROWTH CONDITIONS ACROSS ORGANIC Highbush BLUEBERRY CULTIVARS AND SOIL TREATMENTS. Braydon P. Hoover, Denay M. Fuglie, & Roman J. Miller, Eastern Mennonite Univ., Harrisonburg, VA 22802. Four growth parameters including height, primary stalk diameter, relative 'bushiness', and volume of plant cylinder were determined for four soil treatments and five highbush blueberry cultivars at Knoll Acres Organic Blueberry Farm in the autumn of 2010. Planter's Choice and pine straw composts had significantly higher values than both horse and sheep manure in height ( $75.5 \pm 2.7$ ) and bushiness ( $1171 \pm 140 \text{ cm}^3$ ), stalk diameters ( $8.20 \pm 1.60 \text{ cm}$ ) and plant cylinder volumes ( $381 \pm 37 \text{ dm}^3$ ) respectively. Chandler had significantly higher values in both the stalk diameter ( $8 \pm 0.36 \text{ mm}$ ) and bushiness ( $976.38 \pm 172.8 \text{ cm}^3$ ) parameters. Duke bushes had significantly lower plant cylinder volume ( $114683 \pm 14639 \text{ cm}^3$ ) than all other cultivars and Bluecrop bushes had significantly greater average heights ( $77.85 \pm 2.6 \text{ cm}$ ). The photosynthetic rates of Jersey bushes were found to be significantly higher than Bluecrop, however, no significant difference was found to indicate that soil treatments affected photosynthetic rate.

EFFICACY OF A NATIVE BEE FOR POLLINATION OF EASTERN ORCHARDS. Melanie Cutter & Mark Kraemer, Agricultural Research Station, Virginia State Univ., Petersburg, VA 23806. The blue orchard bee, *Osmia lignaria* Say, has been shown to be an excellent pollinator of tree fruits in western North America. A subspecies of this bee is widespread in eastern North America and may be similarly effective. The objective of our study was to determine pollen preference of this bee with respect to nest placement. Sets of 4 nest shelters were placed within the orchard, an adjacent hardwood forest, and along the border between orchard and forest. Each shelter contained a wood block with 24 nest holes. Prior to apple bloom, each nest shelter was provided with 3 nests of adult bees that were ready to emerge. Weekly images of nests were taken to date the completion of new nests. Pollen samples were collected from individual nest cells in early May, after the end of apple bloom. Random samples of 300 pollen grains per bee nest cell were identified to species using a scanning electron microscope. The results indicated that the bees preferred to collect pollen from nearby Eastern redbud (*Cercis canadensis* L.) trees than the orchard fruit trees. Placement of nest shelters did not make a significant difference in pollen preference. We concluded that eastern redbud trees near orchards could reduce the pollination efficacy of *O. lignaria* within eastern orchards.

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

OPTICAL CHARACTERIZATION OF SELF-ASSEMBLED POLYMER/MICROPARTICLES THIN FILMS. Daniela M. Topasna & Gregory A. Topasna, Department of Physics and Astronomy, Virginia Military Institute, Lexington, VA 24450. Thin films are an important component in many optical and electrical devices, including optical filters. We fabricated multiple layer thin films of sodium salt of poly(styrene sulfonate)/titania using a layer-by-layer self-assembly method. The optical properties of these films were determined based on the calculations of a theoretical numerical model that we developed. The UV-VIS-NIR measurements of these films performed in the 300-2400 nm range confirmed the relationship between the type and number of layers and were consistent with the modeled transmittance values at specific wavelengths.

DETERMINATION OF PHOTON ARRIVAL RATES AND S/N RELATIONSHIPS FOR THE VIRGINIA MILITARY INSTITUTE'S 0.5 METER TELESCOPE. Gregory A. Topasna & Daniela M. Topasna, Virginia Military Institute, Lexington, VA 24450. We determined the photon arrival rate for unfiltered CCD images using the Virginia Military Institute's 0.5 meter telescope. Observations of the open clusters NGC 1502 and M 44 were made using an Alta U6 CCD camera with different integration times. Aperture photometry was performed on stars of known visual magnitude and, using the standard CCD equation, the signal-to-noise ratio was determined for the different integration times. The photon arrival rate for each star was then determined from these data and the CCD equation. As a function of magnitude  $m$  the photon arrival rate is approximately equal to  $10^{(9.26-m/2.4)}$ . The