

Abstracts of Some Papers Presented at the 2007 Annual Meeting of the Kentucky Academy of Science

Edited by Robert J. Barney

AGRICULTURAL SCIENCES

Performance of Pacific White Shrimp *Litopenaeus vannamei* Raised in Static Heterotrophic Tank Systems Exposed to Different Light Sources and Intensities. DAVID R. WOOD*, RUSSEL S. NEAL, BRIAN M. BOUDREAU, SHAWN D. COYLE and JAMES H. TIDWELL, Aquaculture Research Center, Kentucky State University, Frankfort, KY 40601.

The market for shrimp has consistently shown high consumer demand. To support the development of inland shrimp culture in the United States, a trial was conducted to evaluate the effect of different light regimes on shrimp cultured in intensive heterotrophic systems. The trial used 3.8-m³ polyethylene tanks with five light treatments: 1) Sunlight with natural diurnal cycle acting as control (midday - 718 lux); 2) one metal halide light (1074 lux); 3) one fluorescent light (214 lux); 4) two fluorescent lights (428 lux); and 5) three fluorescent lights (642 lux). There were three replicate tanks per treatment and each was separated by black plastic to prevent light contamination. Each tank was stocked with a density of 465 shrimp/m² at an initial mean weight of 0.4 grams. Tanks were harvested after 92 days and final average individual weight, percent survival, harvest yield, and FCR were determined. Light treatment had a significant impact ($P < 0.01$) on average individual weight, survival, harvest yield (kg/m²), and feed conversion ratio. Differences in production parameters among shrimp in the Natural Light (control), Metal Halide, and 1-Fluorescent treatments were not significantly different ($P > 0.05$). However, there was a linear negative relationship ($P < 0.01$; $R^2 = 0.758$) between the number of fluorescent fixtures and harvest yield, survival, and feed conversion efficiency. Decreased survival in 2 and 3-Fluorescent fixture treatments appeared to be related to greater concentrations of filamentous bacteria in those tanks. Natural Light, Metal Halide, and low levels of fluorescent light appeared to inhibit, or did not promote, high concentrations of those bacteria.

A Spacing Calculator for Mixed Plantings. MICHAEL K. BOMFORD, Community Research Service, Kentucky State University, Frankfort, KY 40601.

The most appropriate way to compare mixed plantings to pure stands is a matter of debate among ecologists and agricultural scientists but a consensus has emerged that mixed plantings tend to be more productive. Few horticulture extension materials offer practical advice for designing mixed plantings. One exception, a popular series of gardening manuals, recommends that plant spacing in mixtures be set to the mean of monoculture spacing recommendations for component crops. In most cases this results in a lower plant density in mixtures than

in segregated pure stands, reducing the likelihood of realizing a mixture yield advantage. An improved method for calculating mixture spacing is proposed that sets total plant density in mixed plantings equal to the combined density of segregated pure stands. This method is intended to allow meaningful comparisons of mixtures to pure stands, and increase the likelihood of realizing a yield advantage from mixed planting. The method derives mixture spacing recommendations from monoculture spacing and the proportion of the mixture accounted for by each crop. A mixture spacing calculator that uses the method is available online (http://organic.kysu.edu/Companion_spacing.html).

Evaluation of Alternative Bioethanol Feedstock Crops. JOHN A. RODGERS*, MICHAEL K. BOMFORD, CHANGZHENG WANG, BRIAN GEIER and ANTHONY SILVERNAIL, Community Research Service, Kentucky State University, Frankfort, KY 40601.

Growing concern about foreign energy dependence has led to increased interest in biofuels as domestically-produced, alternative energy sources. The United States is now the world's largest producer of ethanol fermented from plant carbohydrates. More than 95% of this ethanol is currently made from the grain of corn (*Zea mays* L.) through a production process that consumes 75–90% as much energy as is available from the fuel. Other crops may offer superior energy returns, or be more compatible with sustainable production systems suitable for adoption by limited-resource farmers. We compared carbohydrate yield of corn, Jerusalem artichoke (*Helianthus tuberosus* L.), sweet potato (*Ipomoea batatas* L.), and sweet sorghum (*Sorghum bicolor* L.) grown organically in irrigated 8 m² plots in a completely randomized design with four replicates. Sweet potato and sweet sorghum, respectively, produced approximately 580 and 280% more carbohydrate per unit cultivated area than sweet corn. Sweet sorghum and sweet potato show potential as alternative biofuel feedstock crops, compatible with low input production systems.

Grain Yield Loss Due to Variation of In-row Spacing of Corn. TODD BALLARD*, MARVIN RUSSELL, ELMER GRAY, TODD WILLIAN and MARTIN STONE, Department of Agriculture, Western Kentucky University, Bowling Green, KY 42101.

Uneven plant spacing within rows of corn (*Zea mays* L.) usually affects grain yield negatively. Average plant spacing is an incomplete index of density; plant distribution must also be considered. In 2007, relationships between corn yields and in-row spacings were examined using different indices of spacing (distance between

individual plants, average plant spacings, and standard deviations) on four producer managed plots and 27 researcher managed plots. Linear correlations between these indices and grain yield were calculated. Researchers at Purdue University (AGRY-94-02) used the statistical standard deviation, σ , to relate in-row spacing variability and grain yield. A linear model of loss for $\sigma > 2$ inches was proposed as $Y = Y_0 - a\sigma$ with slope varying from 2.5 to 5.0 bushels per acre depending on genotype and environment. For most plots, σ did not vary enough between rows to demonstrate a significant linear relationship. However, for one plot the correlation was -0.84 and significant; σ was 4.4 resulting in predicted yield loss of 26 Bu/A. A more comprehensive model (Ducan's Grain Yield Model) is being tested to define the relationship between spacing and yield.

Early Fall Aerification and Topdressing Effects on Bermudagrass (*Cynodon dactylon*) P. B. WOOSLEY, T. SEYMOUR and B. WEST*, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

Spring dead spot is a common disease of bermudagrass in Kentucky and throughout the South. The pathogen attacks the root system of bermudagrass in the fall resulting in dead circular patches of turf once green-up occurs in the following spring. Different aerification types and topdressing with sand in the fall were evaluated on 'Quickstand' bermudagrass. Topdressing treatments resulted in faster spring green-up and better turf quality in the late fall and spring. Solid tine aerification was similar to the control in regards to bermudagrass quality and green-up while linear aerification significantly reduced bermudagrass green-up and quality. Improving drainage in the fall by aerification and increasing spring green-up could help reduce the incidence and effects of spring dead spot.

Landscape Construction at the Felts Log Cabin. ELIZABETH ALEWINE* and MARTIN STONE, Department of Agriculture, Western Kentucky University, Bowling Green, KY 42101.

The felts Log Cabin is located on the campus of Western Kentucky University. Built in the early 1800's by Archibald Felts, the cabin was occupied by his descendants until 1968. The dogtrot floor plan, V- notched logs, and stone chimneys are some of the historical architectural features of the cabin. It was donated to the Kentucky Library and Museum at WKU in 1980, and now serves as on-site exhibit of early frontier life in Kentucky. The new landscape design for the cabin includes a kitchen garden with period-appropriate plants and out door demonstration areas. The inventories and journals of the Shaker community in South Union provided the basis for the vegetables used in the kitchen garden, including 'Late Flat Dutch' cabbage and 'Long Scarlet' radish. Dye plants, such as Bloodroot and Virginia creeper, are included in the kitchen garden, and the front of the cabin will be used

to display examples of field crops, including 'Stowell's Evergreen' corn. An area close to the cabin has been designed for a native plant display. Construction of these gardens in the spring of 2008 will involve the removal of grass around the cabin in keeping with historical accuracy. Combined with the cabin's location on campus, this will increase the potential for soil erosion. A fence and plants that are intended to act as vegetative filters are included in the design to help slow water runoff, and the use of raised planting beds and mulch to cover the bare soil will minimize soil loss. The native plant garden is intended to act as an introduction to the cabin, and will provide a selection of plants native to forests of Kentucky. Many plants are not typically seen outside of wild woodland settings, such as Strawberry bush (*Euonymus americanus*), several Trillium, Bird's-Foot Violet (*Viola pedata*), and Rattlesnake Orchid (*Goodyera pubescens*), and should increase visitors' enjoyment of the entire display. A path will connect the native garden to the cabin exhibit, and an informational pamphlet about the cabin and native gardens will be provided to the visitors.

Evaluation of Stocking Density and Light Intensity on the Growth and Survival of the Pacific White Shrimp (*Litopenaeus vannamei*) Reared in Zero Exchange Systems. RUSSELL S. NEAL*, BRIAN M. BOUDREAU, SHAWN D. COYLE and JAMES H. TIDWELL, Aquaculture Research Center, Kentucky State University, Frankfort, KY 40601.

The majority of research on heterotrophic systems has been performed in greenhouses in tropical or sub-tropical environments. In temperate regions, insulated agricultural buildings, such as those used for growing poultry or swine, could provide more economical temperature control. However, natural sunlight may be important to these complex microbial populations. The objective of this study was to evaluate the effects and interactions of stocking density and light level on the growth and survival of *Litopenaeus vannamei* in zero exchange heterotrophic systems. This could provide essential information for efficient system design in temperate regions. In a greenhouse twelve, 3,800-L conical-bottom tanks were filled with de-chlorinated city water, salted to 25 ppt salinity, inoculated with heterotrophic bacteria, and randomly assigned one of four different treatments combinations. The study was a 2×2 factorial with main effects being stocking density (139 shrimp/m² vs. 278 shrimp/m²) and light (natural light vs. low level artificial). Natural light tanks received ambient greenhouse light. Black plastic covered one half of the greenhouse and a single, 60-watt incandescent light bulb was used as a light source for each low-light tank. Juvenile *Litopenaeus vannamei* (0.40 ± 0.28 g) were stocked at random into each tank. After 12 weeks, there was a statistically significant ($P < 0.05$) interaction between density and light level for survival, average weight, and harvest weight. However, natural light significantly increased production ($P < 0.05$) at both stocking densities. Future research

should investigate how light spectrum and intensity affects the microbial population of these systems.

Total Replacement of Fish Meal with Commercial Yeast Extract (NuPro®) and Soybean Meal in Practical Organic Diets for Nile tilapia, *Oreochromis niloticus*. KIMBERLY A. TROSVIK*, LINDA S. METTS, KENNETH R. THOMPSON and CARL D. WEBSTER, Aquaculture Research Center, Kentucky State University, Frankfort, KY 40601.

Fish meal is the main protein source in most fish diets, and it also provides essential nutrients necessary for growth. These attributes, added to the competition for its use in livestock and poultry feeds, increase its demand, making it the most expensive macro-ingredient of a fish diet. There are many potential alternative protein sources, with both soybean meal and yeast being two favorable ingredients. The objective of this study was to assess organically-certified yeast and soybean meal as a complete protein replacement for fish meal in organic tilapia diets. A 6-week feeding trial was performed in a recirculating system comprised of 36, 10.0-L tanks stocked with 20, 200 mg fish per tank. Fish were fed three times daily one of five formulated diets with 7 replicates per diet. Diet 1 was formulated similar to a commercially-available diet. Diets 2, 3, 4, and 5 contained no fish meal, but instead contained 10%, 20%, 30%, and 40% NuPro®, respectively. Organic soybean meal was the second major protein ingredient in all diets. At the end of the feeding trial, tilapia fed Diet 1 had a significantly ($P < 0.05$) higher final weight and specific growth rate than fish fed other diets. Fish fed Diet 1 also had a significantly lower feed conversion ratio than fish fed other diets. Results indicate that diets which contained NuPro® were not adequate for optimal growth in small tilapia; however, further studies must be done as very little is known about the effects of NuPro® on fish.

Conifer Decline at Baker Arboretum. PATRICK HARRIS*, MARTIN STONE, DANA KING, KRISTIN GOODIN and JENNIE DANKS, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

The Baker Arboretum is a 15 acre private garden, established over 15 years ago near Bowling Green, which serves as a horticultural teaching and research facility for students and faculty at Western Kentucky University. The horticultural collections specialize in dwarf conifers, Asian maples, and American and Asian dogwoods and their hybrids. Over the past few years, an apparently non-pathogenic decline has been seen in the growth of some conifers. By noting the position of the terminal bud scar, textural, and morphological changes in the stem, the growth of 33 specimens from four genera were noted for the past four years. Growth of 13 taxa were significantly reduced for the most recent years, 2006 and 2007, compared to the previous year's growth, 2004 and 2005. Tests revealed soil pH between 7.0 and 7.6 which was elevated for these acid-loving plants. Base saturation for

soil calcium was excessive (up to 92%) compared to magnesium. Irrigation water did not contain excessive calcium but was low in magnesium and may be a contributing factor. Further research will continue and a complementary in-ground study is underway on site using *Chamaecyparis* and *Picea*.

Baby Corn as a Potential Crop in Kentucky. MARTIN STONE*, ELMER GRAY and TODD WILLIAN, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

Baby corn is the young, unfertilized ears of corn and is usually consumed fresh or canned. There is little difference between sugar enhanced and field corn cultivars for taste or sugar content in baby corn. There is a narrow range of size tolerance and size specifications that must be followed for both length and width of the ears. Husked ears must be between 5–10 cm long, yellow, with uniform and straight rows with the bottom-end width between 1.0–1.5 cm. Currently found primarily in Asian cuisine, it is in demand by high-end American restaurants. The United States is the world's largest consumer of baby corn but very little acreage is produced domestically. Therefore, the U.S. is also the world's leading importer. Baby corn requires similar agronomic and environmental conditions as field corn. It may suffer fewer late season pests because it is harvested around mid-season thereby avoiding many late season pests. For this reason, it may be a crop suitable for high value organic production. Plants may be picked several times during the growing season and any given plot of corn may be picked up to ten occasions each season. A relatively young crop with much potential for domestic and world growth, it is a potentially successful high value crop for Kentucky producers. Restaurants and farmer's markets are likely sales outlets.

Preliminary Evaluation of Baby Corn at Bowling Green, Kentucky in 2007. LARAMIE STONE*, WARREN EAST High School; ELMER GRAY, TODD WILLIAN and MARTIN STONE, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

Baby corn is the edible, young, unfertilized ears of corn and is usually consumed fresh or canned. A field trial was conducted during the 2007 growing season at the Western Kentucky University research farm. Three cultivars of field corn with varying degrees of genetic flex, DeKalb 65–47 (low), DeKalb 63–46 (medium), and DeKalb 64–78 (high) were planted on 30 inch rows. Plots were four rows wide, 30 feet long, and data was taken on the center two rows only. Three plant population densities of each flex cultivar were planted at 36,000, 46,000, and 57,000 plants per acre. Baby corn was hand harvested on 3 to 4 day intervals beginning at 60 DAP (days after planting) and continued for ten harvests through 92 DAP. The highest population densities produced the greatest cumulative production. The highest flex cultivars produced the greatest cumulative production followed by medium and then low flex cultivars. However, for much of the season,

the average ear size was too great to meet market specifications. Later in the season when the average ear size was acceptable, the ears were cosmetically unmarketable. Field corn appears to be a viable specialty crop for Kentucky producers but more refinement is required in cultivar and plant density selection.

Lifespan of Rumen Microbes in Rumen Transfaunate. FELICIA POOL* and JENKS BRITT, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

The rumen is a fermentation vat where bacteria and protozoa convert feedstuffs to volatile fatty acids, methane, carbon dioxide, ammonia, and microbial cells. The purpose of the present study was to determine how long the microbes present in a cow's rumen can survive outside of the rumen. When the natural fauna of the rumen is killed via antibiotics, lack of sodium bicarbonate, or other cause, contents of a healthy cow's rumen can be used to re-inoculate the affected cow's rumen; this process is called transfaunation. Three samples were taken from the rumen of a cow via a rumen cannula. Samples 1, 2, and 3 were stored at 21, 38, and 2°C, respectively. Before the samples were subjected to different temperatures and at 4-hour intervals after that, the samples were observed for motility and gas production. Motility is indicative of protozoan survival; gas production indicates bacterial survival. After all motility had ceased, the samples were stored at 38°C to determine how long they would produce gas. At first observation, the order of diminishing activity was sample 2, 3, 1. Sample 3 remained motile the longest; sample 1 produced gas for the longest period of time. The results demonstrate that protozoa survive equally well at 21 and 2°C; they did not survive as well at 38°C. Bacteria survived the longest at 38°C, but did not survive well at 2°C. These results demonstrate that rumen transfaunate should be stored anaerobically in a thermos and used within a few hours of collection.

Teat Order Establishment of Neonatal Pigs and Its Relationship to Weight Gain. AMANDA GRAY, SARAH THOMAS and GORDON JONES, Department of Agriculture, Western Kentucky University, Bowling Green, KY 42101.

The nursing patterns of 348 neonatal pigs from 39 crossbred litters at the Western Kentucky University farm were observed. The time required to establish a teat position and observations on the retention of that position were recorded daily in 1-hour intervals from birth to weaning. Pigs were cross fostered and observed to determine if the same or a different teat position was established on the foster sow. The effect of teat position on weight gain was also determined by weighing the pigs at birth and at weaning. Analysis of data indicated that teat order was established between 24 and 48 hr after birth. Anterior teats (teats 1–2) were preferred over posterior teats (teats 6–7) with 100% of sows having pigs established on anterior teats compared to only 74% on posterior. After

fostering, only 12.5% of pigs remained on the same teat as on their birth sow. Seventy-five percent of fostered pigs chose a teat that was not previously selected for nursing by any of the pigs in the foster sow's litter. Pigs with greater birth weights tended to nurse from the middle teats (teats 3–5) while the smaller pigs were located on the most anterior and posterior teats. Birth weight accounted for 18% of the variation in weaning weight. No significant relationship was found between teat order and weight gain. This research suggests the need for additional data to determine the effects of cross-fostering on weight gain, morbidity, and mortality of pigs.

A Classroom Project to Engage Turfgrass Management Students. P. B. WOOSLEY* and J. E. KESSELL, Western Kentucky University, Department of Agriculture, Bowling Green, KY 42101.

Students were given the assignment in a turfgrass management class to grow and care for a turf baby. Students were given an empty pot and some turfgrass seed. The students were responsible for choosing the soil, mowing height, fertility program, and growing environment for their turf babies. Students were also asked to document certain stages of development in a turf baby book. Eleven different turfgrass species were used. The project helped students learn about turfgrass establishment, growth and development, fertility, management practices, and specie identification.

The Kentucky State University Ornamental Pawpaw Project. KIRK W. POMPER*, SHERI B. CRABTREE, JEREMIAH D. LOWE and R. NEAL PETERSON, Community Research Service, Land Grant Program, Kentucky State University, Frankfort, KY 40601.

There is a strong demand for new plant materials with ornamental potential for the Kentucky nursery industry. *Asimina triloba* (Pawpaw) is a tree native to the eastern U.S., producing large red flowers and large, edible fruit. *Asimina reticulata* (Netted Pawpaw) is native to Florida and southern Georgia and is a large shrub that produces elongated white flowers and inedible fruit. The objective of this project was to examine the potential of *A. triloba* and *A. reticulata* crosses as ornamental trees or bushes for the Kentucky nursery industry. Crosses (F1) between *A. triloba* and *A. reticulata* were performed in 1993. Greenhouse grown seedlings were field planted in 1995 and resulted in seedling shrubs. In 2001, shrubs produced red flowers that displayed a range of flower shapes; fruit was infrequent and inedible. In 2005, fruit was collected and seeds extracted from these plants. In 2006, F2 seedlings were then propagated in containers in the greenhouse from the open pollinated seeds collected from these F1 selections. About 40 seedlings germinated, grew vigorously, and became dormant in fall of 2006. Seedlings were over-wintered at 4°C. In 2007, seedlings began to flower in the greenhouse. Selections of note were: KSUOR001P (pink flowers), KSUOR002Y (yellow), KSUOR003Y (yellow-green), and KSUOR004R (red).

These seedlings showed great variation in flower form and color, and would be desirable to the ornamental industry. Clonal propagation methods and winter hardiness will be evaluated over the next 5 years.

Taste Test Evaluations of Primocane Fruiting Blackberries from the University of Arkansas Breeding Program Grown in Kentucky. JEREMIAH D. LOWE¹*, KIRK W. POMPER¹, SHERI B. CRABTREE¹, JOHN R. CLARK² and JOHN G. STRANG³. ¹Atwood Research Facility, Land Grant Program, Kentucky State University, Frankfort, KY 40601; ²Fruit Culture & Breeding, 316 Plant Science Bldg., University of Arkansas Fayetteville, AR 72701; and ³Department of Horticulture, N-318 Agricultural Sciences North, University of Kentucky, Lexington, KY 40546. (jeremy.lowe@kysu.edu).

Primocane fruiting blackberries have the potential to produce a niche-market crop for Kentucky growers from late summer until frost. In June 2006, six selections of primocane fruiting blackberries from the University of Arkansas breeding program (APF-27, APF-40, APF-41, APF-42, APF-46, and APF-77) and the commercially available primocane fruiting cultivars Prime-Jim® and Prime-Jan®, were established at the Kentucky State University (KSU) Research Farm. In August of 2007, taste test evaluations were performed on freshly harvested fruit from all selections. In taste tests held at KSU and University of Kentucky, 21 participants sampled three fruit from each selection and were asked to evaluate the following characteristics on a scale of 1 to 5: flavor, sweetness, bitterness, tartness, color (all, 5 = intense, 1 = mild), texture (5 = hard, 1 = soft), appearance (5 = like, 1 = dislike), and seediness (5 = seedy, 1 = not seedy). Participants were also asked to award points to their favorite three selections (3 points = 1st place, 2 points = 2nd place, 1 point = 3rd place). Statistically significant differences were detected among the selections in all categories with the exception of tartness and seediness. The selection APF-40 ranked highest in flavor, sweetness, color, and appearance and ranked lowest in bitterness, tartness, and seediness. APF-40 received the highest score of 29 points and Prime-Jim® scored the lowest with one point. Initial taste test trials indicate consumers prefer the advanced primocane fruiting selections over currently available primocane fruiting blackberry cultivars; however, additional evaluation will be needed over the next several years.

Phenolic Content and Antioxidant Capacity of Fractionated Extract of the Pawpaw Cultivar 'PA Golden'. HIDEKA KOBAYASHI*, CHANGZHENG WANG and KIRK W. POMPER, Human Nutrition Program, Kentucky State University, Frankfort, 40601.

Pawpaw (*Asimina triloba* (L.) Dunal), a deciduous species of the eastern U.S., bears the largest edible fruit of all native trees. Investigations have previously examined phenolic content (PC) and antioxidant capacity (AC) of 14 pawpaw genotypes at full maturity. However, the high sugar content of pawpaw pulp has hindered a further elucidation

of phytochemical constituents by chromatographic analysis. The objective of this study was to identify high PC and AC fractions with low sugar content. In an effort to remove sugar, pawpaw pulp was fractionated by using vacuum chromatography. Acetonic (AcOH) extract was first made with fruit pulp of the popular pawpaw cultivar 'PA Golden', which was lyophilized and then reconstituted with double distilled water (DDH₂O), followed by fractionation with different solvents in the order of DDH₂O (F1), 50% methanol (MeOH) (F2), 100% MeOH (F3), 100% AcOH (F4), and 50% AcOH (F5). Fractionated extracts were lyophilized and PC and AC were estimated with Folin-Ciocalteu assay and ferric reducing/antioxidant power (FRAP) assay. Absorbance readings for both Folin-Ciocalteu (760 nm) and FRAP (595 nm) assays were recorded up to 2 hr. F5 had the greatest PC and AC of pawpaw fractions examined. Interestingly, PC and AC of F2 were much lower than those of F5. These findings are a direct contrast to previously published reports on PC of fractionated lowbush blueberry extract, revealing considerable differences between blueberry and pawpaw phenolic constituents and antioxidant components in acquired fractions.

The Effect of Kaolin Clay (Surround WP) on Black Rot Disease in Grapes. SANJUN GU*, ANGIE WHITEHOUSE and KIRK W. POMPER, Community Research Service, Kentucky State University, Frankfort, KY 40601.

Grape black rot (*Guignardia bidwellii*) is a devastating fungal disease in Kentucky. Production of grapes is severely limited if this disease is not controlled. The objective of this study was to investigate the effect of Surround WP (kaolin clay) on the control of black rot disease in grapes. 'Norton', 'Chambourcin' and 'Chancellor' grapes, which were planted in randomized complete blocks in 2003 at the Kentucky State University Research Farm, were sprayed every 7–10 days with Surround WP, Manzate fungicide, or water (control) from the time of budbreak (late April) to veraison (late August). Disease incidence on leaves and berries was recorded at veraison. The disease incidence and severity on leaves, based on the percent of leaves with lesions and the number of lesions per leaf, was most severe in vines treated with Surround (26%, 2.8), followed by control (18%, 1.4) and Manzate (9%, 0.3). The disease incidence on fruit showed no difference ($P = 0.55$) between treatments; vines treated with Surround, Manzate, or water had 61%, 51%, and 63% of berries infected, respectively. Surround and Manzate did not affect vine phenology, harvest time, number of fruit clusters per vine, or fruit composition (berry weight, sugar content, and pH). Surround WP did not prevent black rot infection of grape leaves or berries.

Effect of Soybean Oil and Stylet-Oil on Delaying Budbreak in Grapes. SANJUN GU*, HEATHER PENN and KIRK W. POMPER, Community Research Service, Kentucky State University, Frankfort, KY 40601.

Grape production in Kentucky is challenged by late spring frosts, which can damage expanding buds, shoots,

flowers and florets, and cause subsequent loss of yield and fruit quality. However, cultivars with late budbreak, either natural or induced, may avoid late frost damage. The objective of this study was to determine if dormant oil sprays delayed grape vine budbreak. Dormant 'Cabernet Franc', 'Lemberger' and 'Traminette' grapevines were sprayed with soybean oil or Stylet-Oil, at 0%, 5% or 10%, on March 5th and 27th, 2007. One-year-old dormant canes from treated and untreated vines were collected one day after oil application, cut to one-bud segments, and forced at 25°C under constant fluorescent lighting to induce budbreak. After oil application, phytotoxicity of soybean oil and Stylet-Oil to grape buds and shoots was evaluated; higher oil concentrations resulted in increased bud mortality. There was no significant difference in phytotoxicity among cultivars. Oil treatments applied on either date did not delay budbreak for any cultivars, except for 'Traminette', which showed delayed budbreak of 6 or 8 days when 5% or 10% Stylet-Oil was applied on March 5th, respectively. The dormant status of vines influenced the effect of oil application, based on application date. Days to 50% budbreak were constant in 'Cabernet Franc' and 'Lemberger', but were reduced sharply in 'Traminette' from February to April.

Assessment of Annonaceous Acetogenin Activity in Ripe Pawpaw (*Asimina triloba*) Fruit and Twig Tissue. LATRICE FAULKNER*, JEREMIAH D. LOWE and KIRK W. POMPER, Land Grant Program, Kentucky State University, Atwood Research Facility, Frankfort, KY 40601-2355.

Pawpaw [*Asimina triloba* (L.) Dunal] contains Annonaceous acetogenins, which are promising new anti-tumor and pesticidal agents, present in extracts of twigs, fruit, seeds, roots, and bark. Ripe fruit potentially represent a large source of biomass for the extraction of acetogenin compounds. Identification of high acetogenin fruit concentration is difficult due to fruit availability and perishability. Identification of high acetogenin genotypes using twigs could provide a rapid screening method for high acetogenin selections. The objective of this study was to determine if there is a correlation between acetogenin content in ripe fruit and twigs. Five ripe fruit and actively growing twig tissues were harvested from each of the pawpaw cultivars NC-1, Sunflower, Taytwo, Wabash, and Wells. Fruit pulp was homogenized, placed in ziplock bags, and stored at -15°C until extraction. Pulp and dried twig tissue was extracted with 95% ethanol. The Brine Shrimp Test (BST) bioassay was employed to assess acetogenin activity. The BST identified acetogenin activity in the pulp and twig tissue of all cultivars examined. There was a high positive correlation between twig and fruit activity. There was low fruit and twig activity in the cultivars Sunflower and Wells, and high activity in both tissues in the cultivar NC-1. Other cultivars showed intermediate activity in both fruit and twig tissues. Twig tissue can be used as a rapid screening method to identify high acetogenin genotypes.

Leaf Size and Stomatal Density Varies by Pawpaw (*Asimina triloba*) Variety. SHERI B. CRABTREE*, KAMERO NEBLETT and KIRK W. POMPER, Community Research Service, Land Grant Program, Kentucky State University, Frankfort, KY 40601.

The pawpaw [*Asimina triloba* (L.) Dunal] is a native tree fruit common to the eastern U.S. As the satellite site for the USDA National Clonal Germplasm Repository for *Asimina* species, goals of the KSU pawpaw research program include description and classification of unique germplasm. Leaf stomatal density has not been previously calculated for pawpaw. Plants with fewer stomata on their leaf surfaces are generally better-adapted to dry conditions. The objective of this study was to examine leaf morphology and frequency of stomata in 10 pawpaw cultivars. Five leaves were collected from 10 different pawpaw cultivars (Shenandoah, Rappahannock, Middletown, Mitchell, NC-1, Overleese, PA-Golden, Sunflower, Taytwo, and Wells) at the KSU research farm. The length, width, and thickness of each leaf were measured, and leaf stomata were counted using fingernail polish leaf impressions and a compound light microscope at 400× magnification. Differences in leaf size among cultivars were observed. The cultivars Wells, Taytwo, and PA-Golden had the longest leaves (over 18 cm), while Taytwo, Wells, and Overleese had the widest leaves (over 8 cm). The cultivars with the largest leaf area were Taytwo (166 cm²) and Wells (156 cm²). Leaf thickness did not significantly vary among cultivars. Stomatal density varied significantly by cultivar, with Taytwo having the most stomata per mm² (415) and Shenandoah and Middletown the fewest (144 and 152/mm²). These cultivars could potentially be more drought-tolerant than others due to their low stomatal density.

Assessment of Clonality in Native Kentucky Pawpaw Patches Using Intersimple Sequence Repeat Markers. LAUREN A. COLLINS*, LI LU, JEREMIAH D. LOWE, SHERI B. CRABTREE and KIRK W. POMPER, Land Grant Program, Kentucky State University, Atwood Research Facility, Frankfort, KY 40601.

Pawpaw [*Asimina triloba* (L.) Dunal] is a fruit tree native to the Southeastern area of the United States. Pawpaw is high in nutritional value, and could possibly be a new potential crop for farmers in Kentucky. Kentucky State University serves as the USDA National Clonal Germplasm Repository, or gene bank, for pawpaw. Assessing genetic diversity and evaluating pawpaw germplasm for the repository collection is a top priority. Pawpaw is usually found in the understory of hardwood forests, often in large patches. Pawpaw forms rootsuckers and therefore it has been suggested that most pawpaw patches are clonal in nature. Clonality of patches would affect sampling strategies in assessing genetic diversity. The objective of this study was to utilize intersimple sequence repeat (ISSR) markers to determine if DNA fingerprint patterns indicate that all trees in a patch are clones. Leaf samples were collected from trees in three

native patches in central Kentucky. DNA was extracted from leaves using a Dnamite plant kit. The DNA concentration was quantified, and diluted to 1 ng/ul. The diluted DNA was amplified by the polymerase chain reaction (PCR) using the ISSR primers UBC841T or UBC841C and then run on a 2% agarose gel overnight to separate PCR products. The gel was stained with ethidium bromide, photographed and scored. DNA fingerprints identified at least two genotypes in each patch, indicating the patches were not entirely clonal. This information will impact future sampling strategies in assessing genetic diversity in pawpaw.

Constructed Wetland Microcosms for Remediation of Water Contaminants. ERIC T. TURLEY* and GEORGE F. ANTONIOUS, Kentucky State University, Land Grant Program, Department of Plant and Soil Science, Frankfort, KY 40601.

The increased use of agrochemicals such as synthetic pesticides and fertilizers demands practices for remediation of these environmental contaminants. Constructed wetlands can be designed and utilized to reduce or eliminate some of the negative effects of agrochemicals on runoff water quality. At Kentucky State University Research Farm, twelve constructed wetland microcosms were established. Six microcosms were filled with river gravel and six filled with limestone (size #2). Eighteen sweet flag (*Acorus calamus*) were planted in 6 microcosms (nine in 3 river gravel and nine in 3 limestone microcosms). Microcosms were used to study their performance for removal of orthophosphate ions, $\text{NO}_3\text{-N}$, $\text{NH}_4\text{-N}$, turbidity, and total suspended solids (TSS) from surface waste water discharge. Biological oxygen demand (BOD_5), pH, dissolved oxygen (DO), and temperature were also measured. Plants were fertilized with Peters and appropriate water level in microcosms was maintained. Plants were also monitored for growth and performance in the two types of rocks. Water samples were collected at regular time intervals to monitor performance of microcosms. The results revealed that microcosms containing the two types of rocks, limestone or river gravel, and planted with sweet flag had 16% increase in dissolved oxygen compared to microcosms without sweet flag plants. The $\text{NO}_3\text{-N}$ content in microcosms containing crushed limestone was reduced by 40.1% compared to microcosms containing river gravel.

Natural Capsaicin in *Capsicum chinense*: Concentration vs. Origin. HU YOON-HYEON* and GEORGE F. ANTONIOUS, Land Grant Program, Department of Plant and Soil Science, Kentucky State University, Frankfort, KY 40601; TERRY BERKE, Seminis Seed Co., Woodland, CA; and ROBERT L. JARRET, USDA/ARS Plant Genetic Resources Conservation Unit, Griffin, GA 30223.

Capsaicin [N-vanillyl-8-methyl-6-(E) noneamide] is the most pungent of the group of compounds known as

capsaicinoids in chili peppers. A survey was conducted to screen fruits of 307 hot pepper accessions of *Capsicum chinense* selected from the USDA germplasm collection for their major capsaicinoids content (capsaicin and dihydrocapsaicin). Seeds of *C. chinense* from fruits originated from Belize, Brazil, Colombia, Costa Rica, Ecuador, Mexico, Peru, Puerto Rico, Suriname, United States, and Venezuela were planted in the field in Woodland, California.

Mature fruits were harvested and their capsaicinoids were quantified. Concentrations of capsaicin and dihydrocapsaicin varied between origins and between accessions (genotypes) of the same origin. Statistical analysis revealed that fruits obtained from seeds originated in Mexico, Brazil, and United States produced the greatest concentration of total capsaicinoids. Among all accessions analyzed, accession PI-438644 (Mexico) had the greatest total capsaicinoids content (2.38 mg g^{-1} fresh fruit) and accession PI-441619 (Brazil) had the greatest capsaicin content (2.2 mg g^{-1} fresh fruit), while PI-441623 (Brazil) had the greatest dihydrocapsaicin content (1.8 mg g^{-1} fresh fruit). PI-640900 contained the greatest capsaicin content (1.6 mg g^{-1} fresh fruit) among all accessions selected from United States. Quantification of capsaicinoids in the selected accessions allowed the identification of accessions with greatest levels of capsaicinoids. Accessions PI-438644 (Mexico), PI-441619 (Brazil), and PI-640900 (United States) were identified as potential candidates for mass production of capsaicinoids, or for breeding of varieties having greatest capsaicinoids content.

Screening *Brassica* Species for Glucosinolate Content. GEORGE ANTONIOUS* and MICHAEL BOMFORD, Community Research Service, Department of Plant and Soil Science, Kentucky State University, Frankfort, KY 40601 and PAUL VINCELLI, Department of Plant Pathology, University of Kentucky, Lexington KY 40546.

Glucosinolates (GSL), a group of naturally occurring thioglucosides, are compounds in Cruciferous crops that can be used as biofumigants because their hydrolysis products, isothiocyanates, are toxic to some soil-borne plant pathogens. Our goal was to survey *Brassica* accessions from the National Germplasm Repository to identify potential cover crops that could be soil-incorporated to eradicate sclerotia (survival bodies) of *Sclerotinia sclerotiorum*, an important pathogen of winter vegetables grown in unheated high tunnels and oospores of *Phytophthora* blight in summer-grown bell peppers. Ten accessions that demonstrated relative cold tolerance, rapid maturity, and superior biomass production were selected from 48 accessions. The selected accessions were grown under fall greenhouse (low stress), winter high tunnel (moderate stress), and spring field (high stress) conditions. These included seven accessions of *Brassica juncea* (Indian mustard), one of *Brassica napus* (oil seed rape), one of *Brassica campestris* (field mustard), and one of *Eruca sativa* (arugula). Quantification of total GSL was

based on inactivation of the endogenous thioglucosidase and liberation of the glucose moiety from the GSL molecule by addition of standardized thioglucosidase and colorimetry. GSL concentration of greenhouse, high tunnel, and field-grown plants averaged 24, 36 and 80 μ moles g^{-1} fresh weight (leaves and stems), respectively. Accessions with the highest GSL content tended to be *B. juncea*. We conclude that environmental stress on growing plants can increase the level of GSL in *Brassica* plants.

Yield and Quality of Hot Pepper Grown with Various Soil Amendments at Kentucky State University Farm. JAMI A. ROGERS* and GEORGE F. ANTONIOUS, Land Grant Program, Department of Plant and Soil Science, Environmental Toxicology Program, Kentucky State University, Frankfort, KY 40601.

Optimizing crop yield without sacrificing quality is the goal of all farmers. Amending the soil can be an inexpensive way of increasing crop yield. The objective of this study was to determine which of three soil amendments (yard waste compost, sewage sludge, or wood chips) would most positively affect the yield and quality of peppers grown at KSU Research Farm. Five *Capsicum* accessions were selected from the USDA *Capsicum* germplasm collection based on our previous research. Two accessions from *Capsicum chinense*, two from *C. baccatum*, and one from *C. annuum* were selected. After each harvest mature fruits were weighed and counted. Length, width, wall thickness and color of fruits as well as plant length and width were also recorded. There was no significant difference between the treatments within the individual fruit parameters such as fruit weight, length, width, and wall thickness. There were significant differences between plant length and width with sewage sludge and yard waste compost producing significantly larger plants than either wood chips or no mulch treatments. Yard waste compost and sewage sludge also produced significantly greater yields than wood chips and no mulch.

Heavy Metals in Soil, Runoff Water, and Eggplant Fruits from Soil Amended with Sewage Sludge and Yard Waste Compost. MICHAEL SOMUAH*, ZACHARY RAY, TEJINDER KOCHHAR and GEORGE ANTONIOUS, Land Grant Program, Department of Plant and Soil Science, Kentucky State University, Frankfort, KY 40601 and JOHN SNYDER, Department of Horticulture, University of Kentucky, Lexington, KY 40546.

Contaminated surface water has become a critical environmental problem. Land application of soil amendments such as sewage sludge can increase concentration of nutrients and heavy metals in surface runoff and their accumulation in edible portions of plants at harvest. A field study was conducted on a silty-loam soil of 10% slope at Kentucky State University Research Farm. Eighteen plots of 22 $\times$ 3.7 m each were separated using metal borders and the soil in six plots was mixed with sewage sludge and yard waste compost (SS-YW) each at 15 t acre^{-1} , six plots were mixed with sewage sludge at 30 t acre^{-1} , and six unamended plots were used for

comparison purposes. Plots were planted with eggplant, *Solanum melongena*, as the test plant. The objectives of this investigation were to: 1) assess chemical and physical properties of soil following addition of soil amendments and their impact on the yield and quality of eggplant fruit; 2) determine the effect of soil amendments on the transport of nutrients ($\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$) and heavy metals (Cd, Cr, Ni, Pb, Zn, Cu, and Mo) into surface water; and 3) investigate the effect of this practice on heavy metal bioavailability in eggplant fruits at harvest. Concentrations of heavy metals in soil were below the USEPA limits. Total marketable yield and quality of fruits were greatest in SS-YW treatment.

Agricultural and Environmental Laws in Kentucky: An Overview. CAROLINE R. WILSON* and GEORGE F. ANTONIOUS, Land Grant Program, Department of Plant and Soil Science, Water Quality and Environmental Toxicology, Kentucky State University, Frankfort, KY 40601.

Investigation of air and water quality in Kentucky, along with an overview of mandated laws established to protect the environment from ecological harm is growing because of increasingly harmful toxins being inadvertently consumed by ecological species. Global warming and depletion of the rate of extinction in certain plant and animal species due to environmental hazards are rising at alarming rates. Plants, animals and humans alike are being affected from poor soil and water quality, deterioration in air quality and increased consumption of toxic airborne substances. Previous laws were implemented to ensure that farmers use safe pesticides and producers manufacture products that minimize toxins such as pesticides, lead, photochemical oxidants and particulates. The recent discovery of lead found in imported products has caused a massive recall and influx of questions about environmental safety in the U.S. Laws were enacted and are being regulated across the nation to help control an overflow of toxic chemicals in our drinking water, air quality and agricultural crops. This overview investigates current legislation and recent changes to environmental laws and the importance of managing sustainability in our ecosystem.

Pollen from Genetically Modified Corn Does Not Affect Honey Bee Queen Rearing Behavior. THOMAS C. WEBSTER*, JOHN D. SEDLACEK and MARK MORIATY, Community Research Service, Kentucky State University, Frankfort, KY 40601.

The effects of genetically engineered Bt corn pollen, conventional corn pollen and sunflower pollen on honey bee queen rearing activity were compared. Cages containing approximately 200 worker bees were each fed a diet containing one of these pollen types. Female honey bee larvae were then placed into small plastic cups and introduced to the cages to stimulate the worker bees to deposit royal jelly as part of queen rearing behavior. Royal jelly provisioning was similar for cages fed Bt corn pollen (34.6 ± 4.5 mg), conventional corn (32.0 ± 6.1 mg) or sunflower (34.9 ± 5.7 mg) pollen. However, the growth of larvae over two days was greatest in cages of bees fed

sunflower pollen (18.3 ± 0.3 mg) and similar for larvae in cages fed Bt corn pollen (15.8 ± 0.5 mg) and conventional corn pollen (15.6 ± 0.3 mg). The proportion of introduced larvae accepted by the bees was equivalent for cages of bees fed each of the three diets. These results support other studies that indicate no harmful effects of Bt corn pollen on honey bees, and that corn pollen is less nutritious than sunflower pollen.

Ground Beetle Species Richness and Abundance in Organic, Conventional, and Genetically Engineered Bt Sweet Corn. KAREN L. FRILEY* and JOHN D. SEDLACEK, Community Research Service, Kentucky State University, Frankfort, KY 40601.

Ground beetles (Coleoptera: Carabidae) are predators of many insect pests in agroecosystems. Economically important insect pests that they prey upon in sweet corn fields include corn earworm, *Helicoverpa zea* (Boddie); European corn borer, *Ostrinia nubilalis* (Hübner); southwestern corn borer, *Diatraea grandiosella* Dyar; fall armyworm, *Spodoptera frugiperda* (J.E. Smith); and Japanese beetle, *Popillia japonica* Newman. Sweet corn was grown using organic, conventional, and genetically engineered production practices. Concerns regarding reduction in biodiversity and non target impacts in genetically engineered crops have been expressed. Thus, the objective of this research is to determine ground beetle species richness and abundance in the three cropping methods of sweet corn. Pitfall traps were used to capture ground dwelling insects. Four pitfall traps were placed equidistant from edges and from each other within the middle row of corn in two of three subplots in each plot. Pitfall traps were made from 473 cc plastic cups. Two cups were placed in each hole so the edge was flush with the soil surface. A rain cover, supported by 3 wooden blocks, was made from a 23 cm diameter plastic plate. A 118 cc 1:1 ratio of ethylene glycol and distilled H₂O was placed in each trap to preserve insects until collected. Pitfall traps were serviced at weekly intervals throughout the growing season. Total numbers of ground beetles increased from June 24 to July 25 in each cropping type. Initial analyses for three sampling periods revealed greater numbers of carabids in Bt plots than organic and conventional plots. Bt plots also had the greatest number of different species. *Harpalus pensylvanicus*, *Cyclotracheus soldalis*, and *Stenolophus* sp. were the most abundant ground beetle species caught.

Taste Preferences For Sweet Corn Grown Organically, Conventionally or Genetically Engineered Among Patrons of Two Farmers' Markets in Central Kentucky. JOHN D. SEDLACEK*, SUSAN B. TEMPLETON and KAREN L. FRILEY, Community, Research Service, Kentucky State University, Frankfort, KY 40601.

We examined consumer knowledge and taste preferences concerning sweet corn grown organically, conventionally and that which is genetically engineered. Consumer knowledge was quantified using a 10 question survey administered at the Lexington and Frankfort

Farmers' Markets. The questionnaire quantified attitudes and perceptions concerning sweet corn grown using each of the three cropping types. The survey culminated with taste paneling of corn harvested from each of the three cropping methods. An informal acceptance and sensory evaluation using informed/blind testing procedures was employed. Color, juiciness, sweetness, crispness, overall appearance, overall flavor, and overall texture were evaluated. The majority of respondents were female, Caucasian, non-farmers ranging in age from 45–64 years. Before completing the taste perception component of our survey, 49% of the respondents believed that the organically grown sweet corn would taste better. Surprisingly, for each market and year of the study, respondents preferred the genetically engineered sweet corn over that which was conventionally and organically grown for color, juiciness, sweetness, and crispness characteristics. Overall, taste test respondents preferred the genetically engineered sweet corn to the organically grown sweet corn by at least a 2.4:1 ratio for appearance, 2.6:1 for flavor, and 2.4:1 for texture. Differences in fertilizer amendments between the genetically engineered and conventional plots vs. the organic plots may be responsible for these differences. Another possible explanation could be weed pressure in the organic plots that was much more severe than in the conventional and genetically engineered plots.

Populations of Lady Beetles and Green Lacewings in Sweet Corn Grown With Organic, Conventional or Biotechnology Enhanced Cropping Methods. LESLYE S. BRENT*, KAREN L. FRILEY and JOHN D. SEDLACEK, Community Research Service, Kentucky State University, Frankfort, KY 40601.

Sweet corn is among the most important and valuable vegetables grown in Kentucky during summer months. Important insect pests in sweet corn fields include corn earworm, *Helicoverpa zea*; European corn borer, *Ostrinia nubilalis*; southwestern corn borer, *Diatraea grandiosella*; and fall armyworm, *Spodoptera frugiperda*. Sweet corn was grown using organic, conventional, and genetically engineered production practices. Concerns regarding negative impacts on biodiversity and non-target beneficial insects in genetically engineered crops have been voiced. Therefore, the objective of this research is to determine lady beetle species composition and abundance and green lacewing abundance in the three cropping methods of sweet corn. Yellow sticky traps 232 cm² in area were used to capture flying insects at tassel and silk height during anthesis. Four sticky traps were placed equidistant from edges and from each other within the middle row of the center corn subplot in each plot. Pitfall traps were serviced weekly for 3 weeks. Pink Lady Beetle, *Coleomegilla maculata*, was the most abundant lady beetle caught followed by the Asian multicolored lady beetle, *Harmonia axyridis*. Few spotless lady beetle, *Cycloneda munda*; mildew-eating lady beetle, *Psyllobra viginumalata*; seven spotted lady beetle, *Coccinella septempunctata*; parenthesis lady beetle, *Hippodamia parenthesis*; and variegated lady beetle, *Hippodamia*

variegata; were captured. Green Lacewings, *Crysoperla carnea*, were captured in small numbers.

BOTANY

Floristic Survey of the Berea College Forest, Jackson, Madison, and Rockcastle Counties, Kentucky. RALPH L. THOMPSON, Berea College Herbarium, Department of Biology, Berea College, Berea, KY 40404.

A survey of the vascular flora of the Berea College Forest (BCF) in east-central Kentucky was made during 2002–2007. All BCF specimens in the Berea College Herbarium were also examined. Founded in 1897, BCF is the oldest established forest in Kentucky and one of the oldest managed forests in the United States. It consists of 3380 ha in parts of three counties: Jackson (656 ha), Madison (2343 ha), and Rockcastle (381 ha). A tract of 2703 ha of the BCF in Madison County has been listed as a Historic District by the National Register of Historic Places of the National Park Service, and a 51 ha tract of Mixed Mesophytic Forest in Rockcastle County has been set aside in perpetuity as the John B. Stephenson Memorial Forest State Nature Preserve. Vegetation is comprised of Western Mesophytic Forest, Mixed Mesophytic Forest, secondary succession areas, wetland habitats including five reservoirs, planted prairie species sites, and other non-forested anthropogenic-influenced areas. The known vascular flora is composed of 1015 specific and infraspecific taxa in 513 genera from 139 families. A total of 2107 herbarium specimens are cited in the annotated list: 547 from Jackson County, 950 from Madison County, and 610 from Rockcastle County. Taxonomic classification of species is Equisetophyta (2), Lycopodiophyta (4), Polypodiophyta (33), Pinophyta (13), and Magnoliophyta (963). One hundred ninety-five taxa (19.21%) are naturalized, introduced, adventive, or cultivated exotics. The largest families in species richness are the Asteraceae (141), Poaceae (100), Cyperaceae (64), Fabaceae (56), and Rosaceae (36). Four state-listed occurring naturally in/or bordering BCF are *Castanea dentata* (endangered), *Juglans cinerea* (special concern), *Paxistima canbyi* (threatened), and *Thermopsis mollis* (endangered). Four state records documented in the BCF are *Nuttallanthus canadensis*, *Polygonum densiflorum*, *Viburnum sieboldii*, and *Vicia tetrasperma*.

CHEMISTRY

Atom Efficient Syntheses of Short Push-pull Chromophores. KRYSTAL D. HOLLEY, TIFFANY R. SHORTER and JEANNE L. KUHLE*, Department of Physical Sciences, Auburn University, Montgomery, AL 36124.

Push-pull chromophores are molecules which allow for efficient intramolecular delocalization of π -electrons which makes them useful for many biological processes and for making logic devices that can essentially be turned “on” or “off.” This fluorescent “on-off” feature is the result of the intramolecular movement of the π -electrons. This movement of the π -electrons is made possible in a molecule which has one portion of its structure that can donate electrons temporarily at one side of the molecule (donor) while

another portion of its structure can accept this electron density (acceptor). A series of substituted phenylenediamines have been efficiently transformed to their carbamate derivatives in high yields under mild conditions. These reaction conditions are sensitive to the electron-donating and electron-withdrawing properties of the attached substituents. Electron-donating substituents are shown to facilitate carbamate formation under neutral reaction conditions without the need of a catalyst, while electron-withdrawing substituents on the aromatic amine require the assistance of a Lewis acid catalyst to produce the carbamate. Reaction progress has been followed using TLC, and all products have been characterized using ^1H NMR, ^{13}C NMR, FTIR, and GC-MS to further enhance the learning experience for undergraduates. These optimized reaction conditions should prove to be useful for a variety of applications including the synthesis of push-pull chromophores, organic dyes, and the tetraalkyl-phenylenediamine donor-acceptor systems, which are useful as molecular devices.

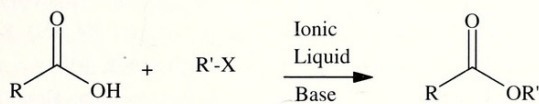
Efficient Mitsunobu Reactions of Protected Amino Acid Derivatives for Undergraduates. WHITNEY K. HELMS, OLUWAGBEMIGA I. KORIKO and JEANNE L. KUHLE*, Department of Physical Sciences, Auburn University, Montgomery, AL 36124.

The Mitsunobu reaction is a highly useful stereoselective reaction for the synthesis of pharmaceutical products due to its high degree of inversion of configuration involving alcohols. However, hindered alcohols often produce lower yields of the synthetic target. Another limitation of the Mitsunobu reaction is the requirement for an acidic reaction partner with a pK_a value of less than 10. Herein we report the use of the catalyst *N,N,N',N'*-tetramethyl azodicarboxylate (TMAD) instead of the diethyl azodicarboxylate (DEAD) with triphenylphosphine (TPP) catalyst system to apply the Mitsunobu reaction to several tertiary alcohols, and also to both enantiomers of the amino acid derivatives of 1-Amino-2-propanol, Valinol, 2-Phenylglycinol, Phenylalaninol, and Methioninol. Reaction progress has been followed using TLC, and all products have been characterized using ^1H NMR, ^{13}C NMR, and FTIR to further enhance the learning experience for undergraduates. This TMAD catalyst provides the additional advantage of producing fewer of the problematic by-products often associated with the traditional DEAD/TPP conditions, such as formation of phosphine oxide and hydrazinecarboxylate.

An Esterification Reaction Without an Acid Catalyst for Undergraduates. ROBEY T. BROOKS, WHITNEY K. HELMS, KRYSTAL D. HOLLEY, PRATIK P. PATEL and JEANNE L. KUHLE*, Department of Physical Sciences, Auburn University, Montgomery, AL 36124.

The ester functional group is ubiquitous and occurs in a wide variety of products ranging from fragrances, monomers, and plasticizers to common local anesthetics used to relieve the pain of burns, toothaches, earaches, cold sores, cuts, and abrasions. Although there are several

methods for the esterification reaction, most involve acidic conditions and the use of great quantities of organic solvents, thus generating waste which is expensive for industry to dispose of safely. The most common method to prepare esters has been the acid-catalyzed Fischer esterification reaction between an alcohol and a carboxylic acid. However, due to its dependence on an acid catalyst, it is limited to molecules which are not sensitive to acid. Also this Fischer esterification reaction does not always produce useful yields of ester product when the alcohol is tertiary because elimination byproducts can form. Therefore, a complimentary method has been developed which uses alkyl halides instead of alcohols and basic conditions instead of acid. These conditions produce higher yields due to a change to an alternative mechanism which does not involve an equilibrium process. An additional advantage of this method is the stereospecific inversion of configuration. Reaction progress was followed using TLC, and all products have been characterized using ^1H NMR, ^{13}C NMR, and FTIR to further enhance the learning experience for undergraduates.



Design and Development of Palladium-iron Bimetallic Electrocatalysts for Polymer Electrolyte Fuel Cells. JESICA R. PRICE^{1*}, RICHARD D. COOKS¹, MARK A. CUNNINGHAM², XIAOPING WANG³ and DEBORAH J. MYERS³, ¹Department of Biology, Berea College, Berea, KY 40404; ²Department of Chemistry, Berea College, KY 40404; ³Argonne National Laboratory, Argonne, IL 60439.

The path to more efficient energy sources for modes of transportation to replace the CO₂-emitting, low efficiency internal combustion engine, has led the Argonne National Laboratory of the U.S. Department of Energy to develop commercially competitive polymer electrolyte fuel cells (PEFCs). The purpose of this project is to design and develop bimetallic cathodic electrocatalysts for PEFCs with high electrochemical activity and high stability to replace more expensive platinum-based electrocatalysts. The bimetallic electrocatalysts reported in this study are composed of the precious metal palladium (Pd) and the base metal iron (Fe) fixed onto carbon support. The less expensive base metal, iron, is designed to comprise the core of the bimetallic alloy with a monolayer outershell consisting of palladium. The Pd-Fe electrocatalysts were synthesized by the impregnation method, utilizing Fe(NO₃)₂ and Pd(NO₃)₂ as metal precursors, producing bimetallic catalysts with a range of metal compositions. The precursor salts were reduced to the Pd-Fe bimetallic electrocatalyst in a dilute hydrogen atmosphere. Transmission electron microscopy, temperature programmed-reduction, and cyclic voltammetry using the rotating disk electrode were used to characterize the electrocatalysts' composition and particle size, reduction conditions for heat treatment, and catalyst stability and performance,

respectively. The bimetallic catalyst with a molar ratio of 30:70 (Pd:Fe), heat treated in regen gas at 620°C for 10 h, showed the highest activity of 65.31 mA/mg_{Pd} at 0.85 V. Further research will focus on maximizing catalyst performance by optimizing heat treatment conditions to minimize particle size with a core-shell morphology. The desired end result is a cost efficient bimetallic alloyed electrocatalyst that is cost efficient, has a high rate of oxygen reduction, a small particle size, and an activity of 440 mA/mg metal at 0.9 V (2010 DOE target).

COMPUTER & INFORMATION SCIENCE

Grid: The New Computational Infrastructure for 21st Century Data-Intensive Science. AKHTAR H. MAHMOOD, Department of Chemistry & Physics, Bellarmine University, Louisville, KY 40205.

Grid is the new IT infrastructure for 21st century science – a new computing paradigm that is poised to transform the practice of large-scale, data-intensive research in science. The Grid concept is “*as available as electrical power*”. The Grid will allow scientists worldwide to view and analyze huge amounts of data coming from the large-scale experiments in science. The Grid infrastructure can be perceived as a collection of “Virtual Organizations” (VOs), bringing together geographically and organizationally dispersed computational resources, such as CPUs, storage systems, communication systems, and data sources. The Grid is envisioned to be the next revolution to transform the internet and scientific computing. At Bellarmine University, we are planning to set up a Tier-3 grid site using the OSG (Open Science Grid) resources. OSG will allow physicists worldwide to view and analyze huge amounts of data flowing from the next generation of large-scale scientific experiments. Current status and developments in Grid Computing will be presented.

ENGINEERING

Estimation of Energy in the Winds at Madisonville, Kentucky. JANARDAN ROHATGI* and WILLIAM HOWARD MCGREGOR, Madisonville Community College, Madisonville, KY 42431.

At the Madisonville Community College a wind measurement and recording system was installed in November 2005. The system consists of wind velocity, direction, and temperature sensors mounted on a tower at an elevation of 30 ft above ground. This is stand alone equipment powered by batteries. The velocity and direction are measured at an interval of every two seconds, then the average of every 10-minute intervals is stored in a chip. The stored data in the chip are analyzed using custom built software. This work presents the analysis of these data for a period of about 454 days. Some features that characterize this location are: mean speed at 30 ft elevation = 4.9 miles per hour; max wind speed gust (2-second) = 53 mph; speed ≥ 7 mph = 24%. Because 3-bladed medium- or large-sized wind turbines are at an elevation 120 ft or more, mean wind speed of 7 mph corrected (employing well known 1/7 power-law) to 120 ft

elevation would be about 8.54 mph (~ 4 m/s). That means about 24% of the time, one can expect at least ~ 4 m/s. This will be equivalent to a power density of about 40/m². Assuming a rotor diameter of 17-m and employing Betz's coefficient we will have power of approximately 5350 W. Using capacity factor of about 30% we may expect approximately 14,000 kWh per year. This work analyzes wind data for this site and gives an estimate of energy generation for different scenarios.

GEOGRAPHY

Accuracy Analysis of the 2005 Kentucky Land Cover Data Set Update. DEMETRIO P. ZOURARAKIS^{1*} and MICHAEL PALMER², ¹Kentucky Division of Geographic Information, Frankfort, KY 40601 and ²Sanborn, Inc., Ann Arbor, MI 48108.

The final accuracy statistical analysis for the Kentucky Landscape Census (KLC), National Land Cover Dataset (NLCD) update for 2005 is presented. The goal for the change map accuracy assessment was to both determine how well change was captured and to assess the accuracy of the change classification. Accuracy techniques have been developed and applied successfully when validating a single time period. Scaling the procedure to incorporate two time periods becomes a daunting task, where the number of samples grows to 450 (9 $\times$ 50). Given the KLC change detection product has 13 classes, the required sample size would be 8450 (13 $\times$ 13 $\times$ 50) samples. Since not all changes are logical within the NLCD land cover classification system, that number would likely be smaller, but the number of required samples is still much greater than for a single date accuracy assessment and probably not feasible under most time and budget conditions. To accomplish this task, validation was completed in two steps. First the 2005 change areas were assessed as a single date land cover map. Second, a change mask was assessed as a binary change/no change map. Change was captured with a success rate of 96%. While a deterministic result shows 58.8% classification accuracy, a representative fuzzy assessment of the classification shows a favorable overall classification accuracy of 79.9%. Critical issues with respect to reference data, sampling and class rarity have been addressed to provide a statistically valid accuracy statement of the KLC 2005 change map.

GEOLOGY

Fecal Microbe Distribution and Abundance Used as a Possible Proxy for Nutrient Source Identification in Eutrophic Wilgreen Lake, Madison County, Kentucky. THERESA A. AGUIAR* and WALTER S. BOROWSKI, Department of Geography and Geology, Eastern Kentucky University, 521 Lancaster Avenue, Richmond, KY 40475-3102.

Wilgreen Lake is a eutrophic lake that has been listed on the EPA's 303d list as nutrient impaired. Potential sources of this impairment are from humans, cattle manure and fertilizers. We suspect that the majority of nutrients originate from human sources. As a possible proxy for nutrient input, we test our hypothesis by examining fecal microbe distribution and abundance in the lake. We took

water samples at 19 sampling locations on 4 occasions. Sampling spanned 26 June to 15 August with the last 3 sampling events occurring at roughly two-week intervals. These samples were then processed using IDEXX methods, which count total coliform and *Escherichia coli* colonies. For sampling localities with microbial abundance that exceeded maximum sensitivity (>2419 cfu/100 ml), we performed dilutions of 1:4 or 1:10. Both total coliform and *E. coli* levels are elevated at sites adjacent to septic tank clusters. There is a gradual decline in microbial abundance distal to these populated areas and microbe levels are low in the third lake tributary that drains only cattle pasture. This strongly suggests that the source of microbial input is from septic systems; however, we cannot eliminate the possibility that fecal microbes are introduced into the lake via inflows, because of high microbial abundance in their waters. We plan on using Reverse-Transcription Polymer Chain Reaction (RT-PCR) techniques to distinguish between human and cattle sources of *Bacteroides* to potentially eliminate the inflows as a microbial source.

The "Anti-Museum": A Review of the Answers in Genesis Creation Museum. DANIEL PHELPS, Kentucky Paleontological Society, Lexington KY 40514.

The new Creation Museum near Petersburg, Kentucky was visited soon after it opened in May 2007. During its formative stages the Creation Museum christened itself "The Anti-Museum." Various displays and videos at the Anti-Museum were reviewed. These media show that the Anti-Museum is one of the weirdest accomplishments of the creationist movement. The Anti-Museum is unique because of its size and cost (\$27 million). The Anti-Museum's success or failure will gauge the market for old-fashioned "scientific" and Biblical creationism, especially at a time when Intelligent Design Creationism (IDC) is perceived as a more dangerous threat to science education. The Anti-Museum is projected to have had 250,000 visitors by November 2007. These attendance numbers are well beyond the most optimistic projections of Answers in Genesis. The Anti-Museum is no threat to science, but may hinder science education and the public's science literacy, both regionally and beyond.

Conodonts from Target Bedrock and Impact Breccias of the Haughton Impact Structure, Devon Island, Nunavut, Canada. WESLEY C. SMITH* and CHARLES E. MASON, Department of Physical Sciences, Morehead State University, Morehead, KY 40351; JOHN E. REPESKI, U.S. Geological Survey, MS 926A National Center, Reston, VA 20192; PAULA LINDGREN, Department of Geology and Petroleum Geology, University of Aberdeen, Aberdeen AB24 3UE, UK; JOHN PARNELL, Department of Geology and Petroleum Geology, University of Aberdeen, Aberdeen AB24 3UE, UK; and PASCAL LEE, Mars Institute, SETI Institute, and NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035-1000.

Samples of carbonate bedrock ($n = 5$) near, and melt breccia clasts ($n = 31$) within the Haughton impact

structure (Tertiary), Devon Island, Canada (75.2°N Lat.; 89.4°W Long.) yielded 95% recovery of conodonts. This study is the first to examine conodonts from Haughton Crater, which provide new data on the impact and its thermal history. Most of the target bedrock samples produced conodonts that are indicative only of Late Ordovician age (for some, a Silurian age is possible), which is consistent with the Allen Bay Formation (Upper Ordovician-Lower Silurian) as mapped in the area. Most of the samples of clasts from breccias also fall within this age range; however, some contain faunas of latest Early to earliest Middle Ordovician age, consistent with the ages of some of the underlying units, e.g., the Eleanor River Fm., displaced as ejecta and as parts of the central uplift. Conodont color alteration index (CAI) values in the regional bedrock are about 1.5, indicating minimum post-depositional, long-term heating in the approximate range of 50–90°C. Some samples contain conodont elements having higher CAI values - up to 4. Some of these samples also contain co-occurring conodonts having several different CAI values, and some of the elements in these samples display surface features characteristic of the effects of contact with hydrothermal conditions. These surface features, and the co-occurrence of multiple within-sample CAI values, are another of the many indicators of hydrothermal activity associated with the impact. Conodonts may provide some additional constraints on some of the thermal history parameters of this event. For example, one larger carbonate clast (~25 cm × 20 cm × 10 cm) was split into two samples, the outer edges and the center of the clast, which were processed separately. CAI of conodonts in the outer sample range from 3.5 to 4, whereas most elements from the inner part of the clast range from 2 to 3, demonstrating the insulation effect of the poor heat conductivity of rock. Splits of these two samples processed by one of us (PL) using biological marker maturity parameters (pregnane/sterane and tricyclic terpane/hopane) also showed this insulation effect. Additional results of this study include: 1) confirms the use of chemical biomarkers for thermal maturation, 2) correlation of Devon rocks with Greenland, and 3) discovery of a new species of the rare conodont genus *Wandellia*.

Establishment of an Undergraduate Research Program for the NASA Haughton-Mars Project. MEGAN E. ENNIS^{1,2*}, CHARLES E. MASON¹, JAMES W. ATWOOD² and WESLEY SMITH¹, ¹Department of Physical Sciences, Morehead State University, Morehead, KY 40351; ²Department of Space Science, Morehead State University, Morehead, KY 40351.

The NASA Haughton-Mars Project (HMP) base camp is located on the rim of the Haughton impact crater on Devon Island in the Canadian High Arctic. Dr. Pascal Lee established HMP as a Mars analog site in 1997. The focus of this project is to develop a funded, nationally competitive HMP undergraduate research program, which will allow undergraduates to participate in this exciting, fieldwork-based geology, and planetary science research program.

During the 2006 HMP field season the PI and one MSU undergraduate (Wesley Smith) worked on a collaborative project on biomarkers with Dr. John Parnell and his research group from Aberdeen University in Scotland. Here we utilized the conodont color alteration index or CIA to check results of chemical biomarkers taken from melt breccia clasts by Dr. Parnell's research group. Our study, using CIA of conodonts, gave the same temperatures reached by the melt breccia clasts as the chemical biomarkers thus corroborating the results of their study. Also, in this study besides such things as the discovery of new conodont species, an insulation effect was noted between the inner and outer parts of the large melt breccia clasts. During the 2007 HMP field season two MSU undergraduate students, Megan Ennis and James Atwood, accompanied the PI. Megan's primary project was to collect large melt breccia clasts from around the crater to examine the insulation effect noted in the 2006 study. James' primary project was to work with Dr. Lee in the development of a plan for a SETI antenna site at HMP.

HEALTH SCIENCES

Extended Longitudinal Studies of Family Size and the Human Sex Ratio. ARCHANA LAKKARAJU* and ELMER GRAY, Department of Agriculture, Western Kentucky University, Bowling Green, KY 42101.

As the fourth study over a span of about 40 years, this study further characterizes the human sex ratio of families of students enrolled at Western Kentucky University. Student respondents provided data on the parental, present, and projected generation. Survey results permitted calculations of average family sizes and sex ratios which were used in comparisons with results of the previous studies. Average numbers of children were 4.04, 2.58, and 2.45, and secondary sex ratios (males: 100 females) were 102, 108, and 141; respectively, for the parental, present, and projected generations. Average family size decreased progressively during the period of study. Secondary sex ratios ranged from 97 to 108 males: 100 females. Gender composition of the first two and three children influenced parities in two ways, namely preference for both genders and preference for males. Results of the present and previous studies indicated that the most desired families consisted of two children, both genders, and the male born first. Realization of this preference would contribute toward a balanced sex ratio. Other preferences included more male than female children. Overall, sex ratios for desired families in the four studies ranged from 133 to 141 males: 100 females. Attainment of these results would imbalance the human sex ratio creating social discord.

Plate Waste – What Head Start Students Won't Eat. SUSAN TEMPLETON* and MARTHA MARLETTE, Human Nutrition Research, Kentucky State University, Frankfort, KY 40601.

The Head Start Program provides breakfast and lunch (morning) or lunch and snack (afternoon) for students in

their half-day program. To determine the actual benefit students receive from these meals, uneaten food was collected from 644 plates after 169 meals (58 breakfasts, 87 lunches, and 24 snacks) served to 114 four-year-olds at a local Head Start Center. Individual leftover food items were separated and weighed. A sample plate was also collected at each meal. Before and after photos were taken of each plate, and compared to sample plate photos to improve initial serving size estimates; initial servings were also adjusted to reflect additional helpings taken. Plate waste was calculated by comparing leftovers to total amount given for each food item. Percent of waste varied by food group and meal, and by which program (morning or afternoon) the student attended. Overall waste was high: meat substitutes (eggs and beans) 65%, vegetables 64%, mixed dishes 51%, fruit 49%, grain items 43%, dairy items 41%, and meats 40%. All food group pairings except dairy-grains, fruit-mixed dish, grains-meat, meat substitutes-vegetables, and dairy-meat were significantly different ($P < 0.05$). Breakfast had higher waste for dairy products (49%), lunch had higher waste for fruit (57%), and snack lower waste for grains (49%), all significant at $P < 0.001$. Overall lunch waste was significantly higher for afternoon students, 60% vs. 47% for morning students ($P < 0.001$). Many children are not consuming enough to receive the full benefit because they do not find the meals appetizing or have eaten before coming to school.

Weight Status, Eating Habits, and Activity Patterns of Kentucky State Fair Attendees. MARTHA MARLETTE* and SUSAN TEMPLETON, Human Nutrition Research, Kentucky State University, Frankfort, KY 40601.

Kentucky ranks seventh highest in the nation in obese adults, and third in overweight children. KSU Nutrition and Health Research Staff measured body fat percentage by bioelectrical impedance analysis (BIA) for 941 adults and measured height and weight to calculate Body Mass Index (BMI) for 115 boys and girls under age 21 during the eleven (11) days of the 2007 Kentucky State Fair. Each participant also completed a survey on diet and physical activity habits and received counseling on how to manage their diet and exercise in order to achieve/maintain a healthy weight. Both BMI and BIA were classified by age and gender standards. BMI results indicated 65.8% of girls and 55% of boys were Normal, 20.5% of girls and 20% of boys were At Risk of Overweight, and 11% of girls and 25% of boys were Overweight. BIA values indicated 46.9% of females and 49.7% of males were Healthy, 25.6% of females and 27.4% of males were Overfat, and 16.3% of females and 21% of males were Obese. These data indicate that more males than females were obese. When compared with At Risk and Overweight children and Overfat and Obese adults, Normal children and Healthy adults reported more frequent positive behaviors including exercise and fruit consumption ($P < 0.001$), and less frequent negative behaviors such as TV viewing/video game usage, eating at fast food restaurants ($P < 0.001$), breakfast skipping ($P <$

0.05), and skipping of other meals ($P < 0.01$). More encouragement of proper diet and exercise habits is needed for all ages.

The Effect of Flavonoids on the Changes of Zinc and Copper Concentrations in Tissues of Rats. FREDERICK N. BEBE and MYNA PANEMANGALORE, Nutrition and Health Program, Kentucky State University, Frankfort, KY 40601.

The consumption of purified flavonoids as dietary supplements increases the possibility of toxicity at high levels. It is, therefore, important to assess safe levels of flavonoids for humans, and also determine if they interact with essential trace metals. The objective of this study was to determine the effect of administering different levels of a flavonoid mixture and determine changes in the concentration of zinc and copper in tissues of rats. Male SD rats (150–175 g, 6/group) were fed the AIN-93 diet. A mixture of equal amounts of flavonoids, quercetin, rutin and catechin, were fed at 5, 25, 50, 100 and 200 mg/kg bw (Groups: CON, FM5, FM25, FM50, FM100, FM200) in 0.1% PEG orally for 30 days. There was a significant reduction in copper retention in all tissues especially at high levels (100 and 200 mg/kg bw) of flavonoid exposure. In the liver, Cu declined by an average of 15% and 23% in the higher FM groups compared to the CON; in the kidney, the decline in Cu retention ranged from 6% to 44%. In the small intestines and the small intestinal mucosa, Cu retention declined significantly at higher levels of flavonoid exposure: FM100 (35 and 17%) and FM200 (58 and 26%), respectively, compared to CON. The changes in Zn concentrations in the liver and kidney of the FM groups were less significant than that of Cu. These data together with previous data suggest that high level consumption of flavonoids could compromise Cu homeostasis in tissues. (USDA, Evans Allen Grant # KYX-50-03-17H)

Tolerance of Cadaver Spines: Can Traction Force Cause a Ruptured Disc? CHARLES BARRETT JR.*, BENJAMIN RAY and DAVID PORTA, Department of Biology, Bellarmine University, Louisville, KY 40205.

Vertebral Axial Decompression (VAX-D®) is a treatment for low back pain from herniated discs. It consists of a traction machine that stretches the back to decompress the spine. A patient typically undergoes 15 cycles of tension (up to 75 lbf) and relaxation (20 lbf) in one 45-minute treatment. A 2003 case study published in the Mayo Clinic Proceedings described a man who supposedly suffered a ruptured L5-S1 disc from VAX-D treatment. There were no force plots provided and no concomitant injuries described. This series of experiments attempted to replicate the noted injury by applying traction force to 8 dissected embalmed cadaver spines (6 females age 55–83 and 2 males age 55 and 84). The L-1 vertebra was potted using Easy-Flo 60 polyurethane casting resin and fixed in place. A winch applied traction force to the pelvis through an in-line force transducer

(Omega DLC 101-5K). The transducer signal was fed to a PC equipped with InstruNet World Win32 software which plotted the force over time. Traction force was increased over 5–10 seconds until gross failure was detected. The potting failed in two specimens (at 128 and 218 lbf.). In the remaining six, the failure force ranged from 195 to 270 lbf and no isolated ruptured discs were produced. Three tests resulted in sacral fractures (avg. 237 lbf) and three resulted in vertebral fractures (avg. 226 lbf.) with associated ligamentous injuries. These results do not support the notion that a properly used traction machine would cause an isolated ruptured disc.

PHYSICS & ASTRONOMY

Development of a G/T Elevation Profile of the Morehead State University 21 Meter Space Tracking System and Radio Telescope. MEGAN E. ENNIS*, BENJAMIN K. MALPHRUS, JEFFERY KRUTH and JAMES W. ATWOOD, Department of Space Science, Morehead State University, Morehead, KY 40351.

The Morehead State University 21 Meter Space Tracking Antenna and Radio Telescope is a medium aperture centimeter-wave length radio telescope designed to permit the investigation of a wide variety of radio sources at different frequencies, using L-Band, S-Band, and Ku-Band, and also to provide space tracking services for satellite telecommunication applications. The performance of this instrument as a radio telescope is highly dependent upon the antenna's radio frequency (RF) performance characteristics. Primary among these are antenna gain and system temperature. This study of determining the antenna gain and system temperature will be accomplished primarily using only the L-Band, which operates on a frequency range from 1.4–1.7 GHz and Ku-Band (11.2–12.7 GHz) and may eventually expand to cover S-Band. The antenna gain is a measure of the directivity and the telescope's ability to convert radiation energy to output energy (and vice versa via the theory of antenna reciprocity). While it is difficult to directly measure antenna gain or system temperature, a characteristic known as G/T (often referred to as the antenna figure of merit) can be empirically measured. Antenna gain can be determined by integrating under the antenna radiation pattern. System temperature can be numerically derived from the antenna gain and G/T measurements. The value of G/T serves as a predictor of the instrument's ability to detect and measure characteristics of distant astronomical sources. The initial results of G/T measurements at L- and Ku-Band are presented, as well as initial measurements of G/T verses elevation angle (elevation profile) made using radio sources.

Evidence of New Subatomic Particles With Heavy Quarks. AKHTAR H. MAHMOUD, Department of Chemistry & Physics, Bellarmine University, Louisville, KY 40205.

Particle accelerators collide matter and antimatter head-on, and the energy released from this collision recreates the

primordial universe, on a small scale for very short times. At a few microseconds after the Big Bang, a host of subatomic particles known as charmed baryons populated the universe, which soon decayed into protons and neutrons, the primary constituents of the nucleus of the ordinary atom. The mass spectroscopy of subatomic particle provides crucial clues about the structure of Baryons in the early universe. In recent years, both the CLEO experiment at CESR (Cornell Electron Storage Ring) and the BABAR experiment at SLAC (Stanford Linear Accelerator Center) have reported the evidence of several new charmed baryons. These intense high energy collisions convert energy into matter inside the detector at the femtoscale level, creating new types of matter with the heavy charm quark. Evidence of new subatomic particles from the CLEO and the BABAR experiments will be presented.

PHYSIOLOGY & BIOCHEMISTRY

The Role of Transforming Growth Factor Beta Receptor I (TGF β RI) Variants in Cell Proliferation During Development of Uterine Cervical Neoplasia. DIANA LAMPE*, JAMES SCHAEFER, ALLISON FOERTSCH, STEVEN PFEIFFER, LARRY DOUGLASS and JULIA CARTER, Wood Hudson Cancer Research Laboratory, Newport, KY 41071.

Cervical cancer (CxCa) is the second most frequently diagnosed cancer in women worldwide. Human papilloma virus (HPV) is necessary but not sufficient for CxCa development. Transforming growth factor-beta (TGF- β) inhibits normal epithelial cell growth but promotes mesenchymal cell growth. Decreased TGF- β is associated with cancer initiation. Increased TGF- β is associated with cancer invasion and metastasis following epithelial to mesenchymal transition (EMT). TGF β RI is a key element in TGF- β signaling. Here, we studied two germline variants in TGF β RI, Int7G24A and TGF β RI*6A. We hypothesized that TGF β RI variants cause decreased TGF- β signaling resulting in increased proliferation in normal cervix and increased susceptibility to cervical cancer. To test this hypothesis, formalin-fixed, paraffin-embedded tissues from four stages of CxCa progression were stained immunohistochemically using a monoclonal mouse antibody to Ki 67 (MIB-1) to detect proliferating cells. Proliferation was determined semiquantitatively (1+, 2+, 3+). Variant status in 96 patients was determined using DNA extraction, polymerase chain reaction, gel electrophoresis, and capillary electrophoresis. Cell proliferation increases significantly during CxCa progression ($P = 0.0001$). Nearly 62% of patients without CxCa did not carry either of the variants. In contrast, 59% of the women with invasive CxCa were TGF β RI variant carriers. Cell proliferation was higher in normal tissue from variant carriers compared to normal tissue from wild type patients. Cell proliferation was significantly increased in tumors from wild type CxCa patients compared to the variant carriers. These preliminary data suggest that TGF β RI variant carriers are more susceptible to CxCa initiation but that EMT may occur more frequently in tumors of non-carriers.

The Importance of Different Regions of the Face and Temperature in Eliciting the Human Diving Reflex. SAM WEIGEL* and THOMAS E. BENNETT, Department of Biology, Bellarmine University, Louisville, KY 40205.

The diving response is characterized by bradycardia, decreased cardiac output, increased arterial blood pressure, redistribution of regional blood flow, and perhaps an active contraction of the spleen. Holding one's breath alone is enough to trigger the diving response, but several other factors, when stimulated simultaneously with apnea, cause the response to be much more pronounced. A previous study (Shuitema and Holm, 1988) showed that the forehead and eyes are key in eliciting the diving reflex; however they failed to take into account varying temperatures and the role of gender. It is the goal of this study to take these factors into account as well as to monitor O₂ saturation during the diving reflex. Ten males (age 20–21) and ten females (29–31) will be participating in this study. Six areas of the face were isolated (forehead, eyes, ears, cheek, nose, and mouth) using wet towels and tested with and without apnea at three temperatures (0–3, 20–23, and 35–38°C). Resting heart rate with and without apnea was recorded as controls. A digital physiograph system (BIOPAC Systems, Inc.) was used to record heart and respiration rates and a pulse oximeter (NELCOR, Inc.) was used for O₂ saturation. A disk thermometer (Yellow Springs Instruments) was placed in the wet cloth to monitor stimulus temperature. Early results show that low temperatures on the eyes with apnea produce the strongest reflex and males are more pronounced than females. O₂ saturation change was minimal. (This study was approved by the IRB of Bellarmine University.)

Salivary Testosterone and Dehydroepiandrosterone (DHEA) as Predictors of Vocal Register in Adolescent Male Singers. WESLEY THOMAS*, THOMAS E. BENNETT, ALEXANDER T. SIMPSON and WILLIAM J. TIETJEN, Departments of Biology and Music, Bellarmine University, Louisville, KY 40205.

During puberty, hormones direct the growth and development of the larynx causing the characteristic 'voice drop' in males. The deepness of the voice and lower pitch frequencies directly correlate to the increased size of the larynx. As the vocal chords elongate, range descends and registers redevelop. The final size of the larynx after maturation reflects the hormonal environment and target organ sensitivity during puberty. A previous study (Harries et al. 1997) failed to show a correlation between salivary testosterone level and fundamental frequency in vocally untrained 13–15 year old boys. The goal of this study is to assess the relationships among androgenic hormones, morphologic parameters, and the vocal register in late adolescent males with formal vocal training. Sixteen males (age 16–19) attending a summer vocal program participated in this study. To control for diurnal fluctuations subjects were tested in one hour sessions in the afternoon. Salivary samples, collected at the beginning, middle and end of the session were pooled

and analyzed for testosterone and DHEA with commercial enzyme immunoassay kits (Salimetrics, LLC). Height, weight, neck length, and neck circumference (2 locations) were taken and a health assessment questionnaire completed. Each subject's singing voice was digitally recorded and vocal register was determined following a series of vocal warm-up exercises. Vocal range and fundamental frequency were determined using computer software (Sound Forge). Preliminary analysis of the data suggests several relationships among the measured variables. (This study was approved by the IRB of Bellarmine University.)

PSYCHOLOGY

Pilot Comparison of the Aptitude Subscales of the Scholastic Abilities Test for Adults and the Wechsler Adult Intelligence Scale-III. ASHLEY KIRK* and SEAN P. REILLEY, Department of Psychology, Morehead State University, Morehead, KY 40351.

Recent empirical data from large scale surveys of college students indicate marked growth among the rates of students entering colleges with learning disabilities relative to nearly twenty years ago. Psychoeducational tests are commonly used during the screening and diagnostic process for evaluating students for learning disorders when they present for evaluation. One of these measures, the Scholastic Abilities Test for Adults (SATA), is commonly used as an aptitude-ability discrepancy screener and is approved by the Educational Testing Board as a qualified achievement instrument. During the development stages of the SATA, preliminary correlations were reported between like aptitude scales of the SATA and the Wechsler Adult Intelligence Scale-Revised in a small sample of students ($n = 35$). No published studies have evaluated the current status of the psychometrics of the SATA, despite its usage. The present study reports pilot data concerning the validity of the aptitude scales of the SATA using the current version of the Wechsler Scales, the Wechsler Adult Intelligence Scale-III. Correlations of a smaller magnitude emerged for all three SATA aptitude scales relative to those reported using the WAIS-R. Ability-achievement discrepancies were calculated to evaluate the ability of the SATA to detect potential needs of students for follow-up testing for learning disorders. The sensitivity of the SATA to detect a learning problem was found to be low (50%). The results are discussed in relation to future needs for research evaluating the psychometrics of the SATA and its utility as a screening measure. Research supported by a grant from KY EPSCoR.

The Ability of the Wender Utah Rating Scale to Differentiate Among Mixed Symptoms of Major Depression, Anxiety Disorders, and AD/HD. CASSIE M. WATKINS* and SEAN P. REILLEY, Department of Psychology, Morehead State University, Morehead, KY 40351.

Attention Deficit/Hyperactivity Disorder (AD/HD) is a prevalent disorder with high rates of co-morbidity with psychiatric disorders such as mood and anxiety disorders.

Symptoms of AD/HD overlap with aspects of depression and anxiety, and the latter have been shown to produce false positives on AD/HD screening measures. Thus, accurate diagnosis of AD/HD can be complicated especially when symptoms of other psychiatric disorders are present. The current study examined the ability of the short form of the Wender Utah Rating Scale (WURS) to differentiate between mixed symptoms of Major Depressive Disorder, Anxiety Disorders, and AD/HD at a subclinical level. The WURS is a unique empirical instrument for evaluating adults' retrospective reports of childhood AD/HD. In particular, WURS scores can be used to accurately differentiate adult groups without AD/HD or psychiatric disorders, and those with either AD/HD, or Major Depression. Because comparative psychiatric data are lacking for anxiety symptoms for most AD/HD instruments, and none have addressed co-morbidity issues, the present study was conducted. Extensive psychosocial, AD/HD and psychiatric rating scale data were inspected and four subclinical groups were identified (AD/HD with Anxiety and/or Depression, Anxiety without AD/HD, Anxiety + Major Depression without AD/HD, and Control). It was predicted and found that the AD/HD group and the mixed Anxiety and Depression group scored significantly higher on the WURS relative to the control group. In addition, the AD/HD group had significantly higher WURS scores relative to all other groups. Research supported by a Morehead State University Undergraduate Research Fellowship and KY EPSCoR.

The Relationship of Substance Abuse Symptoms on the Psychiatric Diagnostic Screening Questionnaire and Substance Abuse Subtle Screening Inventory-3. JARED DILLON* and SEAN P. REILLEY, Department of Psychology, Morehead State University, Morehead, KY 40351.

Substance abuse is a serious, highly prevalent problem, especially among college-age adults. Current empirical data indicates nearly half of students nationwide engage in binge drinking which is associated with a variety of academic, interpersonal, legal, and medical and psychiatric problems. In addition, an estimated 1,700 students die in alcohol related deaths annually. Self-report scales are commonly used as part of national screening outreach to identify high risk students, and as part of psychotherapy to gauge the severity and breadth of substance abuse symptoms. One particularly promising measure for a college population is the Psychiatric Diagnostic Screening Questionnaire (PDSQ). The PDSQ screens for symptoms of the most common DSM-IV-TR based disorders found in clients who present to outpatient psychotherapy. Data for this measure, however, are lacking for its substance abuse scales. In this study, the relationship between the alcohol and substance abuse subscales of the PDSQ and SASSI-3 were investigated. In a sample of three hundred undergraduates, it was predicted and found that moderate to strong correlations emerged between the SASSI-3 and both the PDSQ Alcohol abuse subscale ($r = 0.60$) and the PDSQ Substance abuse subscale ($r = 0.58$). These results

are discussed in relation to use of the PDSQ for identifying students with potential substance abuse problems. Research supported by a Morehead State University Undergraduate Research Fellowship and a prior grant from KY Statewide EPSCoR.

Discriminant Validity of the Adult AD/HD Self Report Scale-v1.1 (ASRS-v.1.1) in a College Population. JESSICA E. HILL* and SEAN P. REILLEY, Department of Psychology, Morehead State University, Morehead, KY 40351 and WARREN LAMBERT, Somerset Community College, Somerset, KY 42501.

Attention Deficit/Hyperactivity Disorder (AD/HD) affects an estimated 8-million adults, including 2% to 8% of the college population. AD/HD rating scales are commonly used for screening and diagnosis of AD/HD in adults. However, many AD/HD rating scales are expensive, time consuming to administer and score, and contain questions which are more child-focused in their symptom context. To address these problems, the World Health Organization (WHO) published the Adult AD/HD Self Report Scale-v1.1. The ASRS-v1.1 is a free, publicly available AD/HD rating scale which assesses the DSM-IV-TR symptoms of AD/HD using questions with adult symptom contexts. To date, there are limited data concerning the validity of the ASRS-v1.1 for use in screening and evaluation in a college population. The purpose of this study was to evaluate the ability of the ASRS-v1.1 to differentiate between college students with and without self-acknowledged AD/HD. Large scale survey data ($n > 1000$) was collected from students enrolled at a 4-year university and at a regional community college. Students reporting an existing diagnosis of AD/HD ($n = 44$) were identified and demographically matched with those without any positive history of significant AD/HD symptoms. Multiple diagnostic indicators in the survey data external to the ASRS-v1.1 were used to confirm group status. Using independent samples *t*-tests, it was predicted and found that ASRS-v1.1 scores from AD/HD students were significantly higher than for students without AD/HD. Research supported by prior grants from KY EPSCoR and the Institute for Regional Analysis and Public Policy at Morehead State University.

SCIENCE EDUCATION

Development of Biotechnology Courses to Enhance Aquaculture and Biology Programs and Recruit Students to Kentucky State University. LI LU¹*, KIRK W. POMPER¹, KARAN KAUL², NARAYANAN RAJENDRAN² and JAMES TIDWELL³, ¹Community Research Service, Land Grant Program, Kentucky State University, Frankfort, KY 40601; ²Carver Hall, Kentucky State University, Frankfort, KY 40601; ³Division of Aquaculture, Land Grant Program, Kentucky State University, Frankfort, KY 40601.

Biotechnology impacts human health, medical diagnosis, forensics, pharmaceuticals, nutrition, the environ-

ment, and agriculture. Training in biotechnology and molecular biology techniques is critical for students who wish to pursue careers in the life sciences and agriculture. The biotechnology industry in the U.S. and Kentucky has also almost doubled in the past few years creating new jobs for Kentucky's college graduates. In 2005, a USDA 1890 Institution Teaching and Research Capacity Building Grant was funded with the objectives to 1) support the instruction and development of two courses, "Understanding Biotechnology" and "Advanced Techniques in Biotechnology," 2) enhance laboratory experiences of the course "Cell Biology" with molecular techniques, 3) support individual undergraduate student research projects in biotechnology, and 4) support recruitment of undergraduate Biology and Aquaculture Master's students at KSU through high school recruiting visits, a biotechnology website, and increased KSU biotechnology library holdings. Over 30 students have already participated in classes supported by this grant. In the course "Understanding biotechnology," students extract DNA from plant and aquaculture species, and conduct techniques such as Southern blotting, Western blotting, PCR, bacterial transformations, and reporter gene screening. Molecular marker techniques to examine genetic relationships in the Annonaceae family have been conducted by students in the class and will be discussed. A web site was created to promote the KSU biotechnology program and can be found at <http://biotech.kysu.edu/>.

Online Courses: Are Students Learning? JOHN G. SHIBER, Division of Health Sciences, Kentucky Community & Technical College System – Big Sandy District, Prestonsburg, KY, 41653.

One hundred fifty-nine community college students enrolled in 106 courses from 12 general study areas from Fall-2006 to Fall-2007 were surveyed about their online credit course experience. Most found the course presentations easy to understand and were able to successfully complete all course requirements, but only 41% said they felt they had learned as much in this format as they would have in a regular classroom, i.e., 59% believed they would have learned better with traditional instruction. Math had the highest dropout rate and only 31% said they had learned better online. Communication, philosophy, information technology and business had even lower percentages on this point. Nearly half the respondents judged online tests as difficult-very difficult - 74% of math and 64% of science students judged them as such. Math students repeatedly commented that math belongs in the classroom. An average of 33% of all participants experienced technical difficulties with online classes, but most course grades were A, B and C. The majority said their courses were well-suited for online delivery and that they would take more online courses. The overall responses and comments suggest, however, that students may be trading off actual learning for convenience, especially in math but also in philosophy, communications,

business, science, and information technology courses and that some courses are not appropriate for online learning and should not be offered in that format to all students. Further research along these lines, along with establishing certain criteria for accepting students into online programs and reviewing testing protocol, is encouraged.

ZOOLOGY

A Survey of Amphibians and Reptiles within a Constructed Wetland and Restored Stream Corridor in Campbell County, Kentucky. JEFFREY GOESSLING* and JOHN W. FERNER, Department of Biology, Thomas More College, Crestview Hills, KY 41017; PAUL KRUSLING, Scott High School, 5400 Old Taylor Mill Road, Taylor Mill, KY and SCOTT FENNELL, Center for Applied Ecology, Northern Kentucky University, Highland Heights, KY 41076.

A survey of amphibians and reptiles was conducted in a stream corridor restoration project from May to September 2007. The site included a restoration along about 2000 feet of the Mook Road Tributary of Three Mile Creek at the Bentwood Condominiums in Wilder, Campbell County, Kentucky. The restoration project was done between June and November 2003 and included stabilization of stream banks, construction of stream riffle complexes, restoration of stream sinuosity, creation of two stormwater detention wetlands, enhancement of an existing pond and enhancement of 25 acres of riparian woodland. A total of seven visits were made to the site between 2 May and 20 September 2007 for from one to two hours per visit. A total of six amphibian and seven reptile species were observed in the habitats within this conservation area, including the wetlands, pond, stream, fields and slopes. Two species of reptiles represent new geographic records for Campbell County: the common musk turtle (*Sternotherus odoratus*) and the red-eared slider (*Trachemys scripta elegans*). The design of the physical features in this restoration project was found to provide a successful corridor for colonization of the newly created wetlands by amphibians and reptiles from surrounding habitats.

Initial Studies of Ventral Eversible Gland Function in Velvetbean Caterpillars, *Anticarsia gemmatilis* (Lepidoptera: Noctuidae). ANTHONY J. LENTZ, Department of Biology, Bellarmine University, Louisville, KY 40205.

A ventral eversion gland was discovered in the prothorax of velvetbean caterpillars (*Anticarsia gemmatilis*), a pest of soybeans and other plants in the southeastern United States. While such glands have been reported in a few other Noctuidae, only the fall armyworm (*Spodoptera frugiperda*) has been studied in depth (by Marti and others at USDA) and no function was determined. Glands were removed from 7 to 10-day old, cold-anesthetized velvetbean caterpillars to examine the impact on larval life cycle, onset of pupation and larval defensive response. Pilot studies suggest that larvae

without glands (1) pupate zero to two days sooner than intact larvae, (2) have comparable weight gain and survival, and (3) exhibit behavioral defenses similar to larvae with glands when provoked in simulated attacks.

There is no evidence suggesting that these glands function in defense. Exploratory studies comparing the effect of gland removal on pupation of velvetbean caterpillars and the fall armyworm are underway.



Barney, Robert J. 2008. "Abstracts of Some Papers Presented at the 2007 Annual Meeting of the Kentucky Academy of Science." *Journal of the Kentucky Academy of Science* 69(1), 69–87.

[https://doi.org/10.3101/1098-7096\(2008\)69\[69:aosppa\]2.0.co;2](https://doi.org/10.3101/1098-7096(2008)69[69:aosppa]2.0.co;2).

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