Eighth Annual Graduate Research Retreat

Hosted by:

2014 HCS Graduate Studies Committee

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David Mackey (Chair Designate)  Laura Lindsey
Regina Vann Hickok (Secretary)  Kristin Mercer
Mao Huang (Student Rep.)  Reuben (Mark) Sulc
Joshua Blakeslee

Special thanks to GRR Organizing and Judging Committee

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Abigail Gerdes  Dr. John Cardina  Dr. Joseph Scheerens
Mao Huang  Dr. Douglas Doohan  Dr. Eric Stockinger
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Alexander Lindsey  Dr. Xiaofeng Zhuang
A **HUGE** Thank You to All of our Sponsors for Making This Retreat Possible!!!

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Session Overview

**Friday, February 21st, 2014, ATI Gym Facility, Wooster, Ohio**

2:30 - 3:00 pm Gather in ATI Gym Facility for Tour

3:00 - 5:30 pm Tour of Wooster CFAES (Research farms, projects, labs)

5:45 - 6:00 pm Welcome by Graduate Studies Chair, Dr. Joseph Scheerens

6:00 - 6:45 pm Dinner

6:45 pm Introduction – Dr. Joseph Scheerens

Guest Speaker – Micah Rosenblum, USDA Foreign Agricultural Service, Policy Coordination and Planning Staff, Washington D.C.

After dinner gathering- JAFB Wooster Brewery

**Saturday, February 22nd, 2014, ATI Gym Facility, Wooster, Ohio**

8:30 - 8:50 am Refreshments and poster viewing

8:50 - 9:00 am Welcome – Dr. Jim Metzger, HCS Interim Chair

9:00 - 11:00 am Oral Competition

11:00 - 11:30 am Guest Speaker – Shauna Brummet, President/CEO of BioHio Research Park

11:30 - 11:50 pm Lunch

11:50 - 12:55 pm Poster Competition Viewing

1:00 - 3:00 pm Oral Competition

3:00 - 3:30 pm ‘Get to Know’ the Faculty and Students

3:30 - 3:45 pm Announcement of Awards and Concluding Remarks
February 21, 2014

Dear Guests and Participants,

Welcome to the 8th Annual Graduate Student Research Retreat and Open House in the Department of Horticulture & Crop Science at The Ohio State University. Our event continues to grow and improve each year, primarily through the leadership and participation of our graduate students. We are pleased to once again showcase their talents, ingenuity, and creativity.

We are a large department housed in four buildings and two campuses, so we work hard to integrate all into one department with a common mission. This retreat is an example of our graduate students from both campuses pulling together to develop and enjoy the rewarding experience of scientific exchange and camaraderie.

Graduate education is a crucial mission of our Department and faculty. Our goal is to train the next generation of scientists who will be equipped to tackle critical plant-based issues in food security and safety as well as environmental sustainability. At this retreat you will experience the diversity, depth, and breadth of the science being pursued by our faculty and students. We are very proud of this remarkable group of graduate students. Our students have received prestigious university fellowships as well as college fellowships and OARDC awards, various external awards and achievements, and several of our international students have received awards from their home countries. We currently have 55 graduate students in our department, including 16 new students.

Enjoy your time, the interactions, and fellowship during this retreat. Ask questions, explore new ideas together, and stretch your minds!

Sincerely yours,

Dr. Jim Metzger
Professor and Interim Chair
Dept. of Horticulture and Crop Science
Dear Retreat Attendees,

We would like to welcome you to the 8th annual Graduate Research Retreat for The Ohio State University Department of Horticulture and Crop Sciences. Though sometimes it is difficult to find time away from our research, it is our hope that this weekend will be of value to both students and faculty as a time to focus on past, present, and future research and plans while interacting with members of our diverse Columbus and Wooster campuses. If you are considering graduate work at The Ohio State University, we hope that you can see the diversity of opportunities encompassed by the Horticulture and Crop Science department.

If you are currently a graduate student in H&CS, we are excited to welcome you to the Wooster campus at OARDC. This weekend will be filled with highlights of research being conducted in our department as well as presentations from invited guest speakers. As students with diverse backgrounds and experiences, we all find ourselves on an academic expedition filled by classes, experimental techniques, important lessons, and difficult challenges. We hope that through the presentations and conversations with students and faculty, both from within and outside our department, that your education and research will be enhanced. Our goal of supporting the education and research of current and prospective young scientists in H&CS has four central objectives:

- Rewarding excellence in research conducted and presented by students
- Encouraging interaction between graduate students and faculty
- Rewarding excellence in communicating science with peers
- Highlighting research activities and opportunities to students outside OSU and the general public

We would like to express our sincere gratitude to all of our sponsors for their generous donations. Without them, this retreat would not be possible. A huge thank you also goes to the retreat planning committee for their valuable time and effort in planning this event. If at any time you have any questions or suggestions as to how to improve this yearly event, please feel free to discuss them with any member of the planning committee. Better yet, join the planning committee for next year’s retreat! We hope you have a great weekend and wish you the best on your current and future work in the field of horticulture and crop sciences!

Thank you and welcome!

Amber Hoffstetter (Retreat Co-Chair)
Srimathi Bogamuwa (Retreat Co-Chair)
Lisa Robbins (Competition Chair)
*A Huge Thank You Goes to Regina Vann Hickok for her devoted time and effort into making this retreat possible*
Areas of Graduate Study

Crop Ecology, Management & Production (CEMP) –

Research projects in Crop Ecology, Management and Production are often designed to enhance the efficiency of agricultural practices, thereby maximizing productivity, extending the availability of valuable, shared resources, heightening commercial viability, and/or advancing social and societal interests. Clearly, plant-human, plant-animal, plant-plant and/or plant-environment interactions are seminal to production efficiency and CEMP research addresses these interactions at sub-cellular to landscape levels, especially within commercial contexts. CEMP research is conducted on existing crops from alfalfa to zucchini and yet to be commercialized plants (future crops). These current and emerging crops provide human and animal food, monetary value, an enormous range and quantity of raw products channeled to applications in medicine, industry and defense, and improve the health and beauty of natural and human landscapes. CEMP studies are conducted in semi-automated and fully climate-controlled indoor facilities providing all growth requirements, partially-enclosed/semi-controlled, and largely uncontrolled open field environments and in urban to rural settings. Sustainability is a defining characteristic of this research; its outcomes have wide-ranging local to global impact.

The HCS-Crop Ecology, Management and Production program is inspired by real-world issues and questions that lie at the edge of our understanding of cropping systems. Through their science and applications based on its discoveries, CEMP program members aim to help solve these issues and open new, knowledge-based frontiers. CEMP program members work in small, focused, discipline-specific teams; simultaneously they also contribute to the success of much larger multi-institutional and multi-disciplinary ones. As a consequence, the impact of the Group’s work is widely evident on farms and in laboratories, professional societies and organizations, homes, factories, and offices next door and throughout the world. Those with a stake in the use of land, water, genetic and other key resources – particularly as they may be directed to the management and production of food, industrial and floricultural crops – inform and learn from CEMP members.
Breeding & Genetics (BG) –

Crop breeding is the application of genetic theory to improve diverse traits of crops. In modern crop breeding, knowledge generated from a variety of research fields such as molecular biology, genomics, proteomics, and metabolomics are integrated to elevate crop yield and quality, beyond traditional breeding techniques. Recent release of genome sequences in diverse crops expedites genomic study for the traits of interests and help to breed for the traits of economic importance.

The HCS Breeding and Genetics program mainly emphasizes disease or pest resistance and end product quality. Research activity combines lab experiments and field evaluation. Interdisciplinary collaboration with Plant Pathology, Entomology, and Plant Molecular Biology and Biotechnology (PMBB) and international collaborations are encouraged.

Physiology, Biochemistry, & Molecular Biology (PBMB) -

Hypothesis-driven, basic and applied research in Physiology, Biochemistry and Molecular Biology is conducted to understand the molecular genetic mechanisms underlying many diverse plant processes. In HCS, this research encompasses aspects of combinatorial gene regulation developmental morphology, signal transduction processes, plant response to stress, the production metabolism and storage of secondary compounds, senescence, and plant metabolic engineering.

The HCS-Physiology, Biochemistry and Molecular Biology program uses a wide array of molecular, biochemical, physiological, developmental and genetic tools to decipher these processes. The genomic and proteomic “tool boxes” that we utilize allow us to sift through the entire complement of the 25,000 plus plant genes and their encoded proteins to identify the key players specifically affected by both internal plant signals and external environmental cues. We are using mutations and genetic fingerprinting strategies in combination with large mapping populations to identify genes affecting these plant traits. We are using “systems approaches” that involve interactions between traditionally separate disciplines such as the biosciences, physical sciences, mathematical/computational sciences, and engineering to address biological questions that until very recently were thought to be completely intractable. High throughput sequencing, expression profiling, and RNA, DNA, and protein interaction networking techniques are now integrated and allow us to discover new genes and new mechanisms. Research in the group of Physiology, Biochemistry and Molecular Biology is exciting work that regularly leads to novel discoveries about the underlying molecular basis of horticultural and agronomic traits that in the end we hope will benefit all of society!
Seed Biology (SB) –

Seed Biology is inherently interdisciplinary and the study of seed quality, health, viability and preservation is fundamental to nearly all plant research areas and to most aspects of sustainable crop production. Seeds provide 75% of the food consumed by humanity, and production of high-quality seed is the cornerstone of American and global agriculture. The specialized nature of the seed industry and the unique biology of seeds as life in suspended animation have given rise to seed biology as an important discipline. Seeds are vital as propagating units for the tree, landscape, flower, turf, vegetable, fruit, and agronomic crop industries. American and multinational seed companies are among the significant agricultural industries benefiting from advances in seed research and increased student training. Moreover, Seed Biology is an important component of international programs in agriculture and natural resources.

The HCS-Seed Biology program possesses academic breadth and is divided into the following six areas: Seed Production, Seed Quality, Seed Pathology, Seed Physiology/Biochemistry, Seed Genetics/Molecular Biology, and Weed Seed Ecology. Seed biology efforts are closely associated with the OSU/USDA Ornamental Plant Germplasm Center (OPGC). Research efforts in the program examine genetic, environmental and cultural effects on seed quality, the influence of dormancy on seed storage and the optimization of germination conditions for various native species and food crops using a variety of conventional and newer research techniques (e.g., non-destructive seed imaging techniques). The program has a strong teaching, and outreach/training component.
Turf Science & Management (TSM) –

Turf health and long term viability are essential components of the greater American landscape. Studies in turf science and management encompass a wide arena of production, installation and use issues important to sustainable maintenance of residential, commercial and public lawns and the aesthetics and function (playability) of golf course and athletic field turf. As in most areas of plant science, the scope of turf science and management studies range from basic to applied. Turf science and management studies are inherently interdisciplinary, involving expertise from the fields of plant pathology, entomology and natural resources.

The HCS-Turfgrass Science program examines important turf issues using physiological, horticultural and ecological approaches. Ongoing and recently completed projects include (have included) the physiological and morphological characterization of shade tolerant turf plants; the role of ultraviolet light and turfgrass pigmentation in turf stress responses; the development of improved strategies for the establishment of sustainable home lawns; the improvement of turfgrass water use efficiency; the efficient management of athletic fields; the playability of golf greens based on moisture and firmness values; the control of annual and perennial, grassy and broadleaf weeds in turfgrass; the efficacy and use of natural herbicides; the fate of pesticides and nutrients in the environment and golf course ecology.

Environmental Horticulture (EH) –

The impact of the “Green” industry on Ohio’s economy is substantial – larger than most other horticultural industries. Research in environmental horticulture involves a diverse range of plant materials from herbaceous annuals to woody perennials and addresses questions concerning the productivity, sustainability of production and quality of these materials using basic and applied genetic, cultural or physiological research techniques. Areas of study include plant reproductive biology, the efficient production of plant materials in nurseries and controlled environments, planting establishment concerns, the efficiency and sustainability of outdoor plantings, crop quality, and management, marketing and education strategies.

The objectives of the HCS-Environmental Horticulture program are to deliver a nationally recognized research program that benefits the nursery and greenhouse production and landscape industries. Research focuses on creating sustainable cultural practices that reduce impact on the environment, diversifying and improving plant selection, and understanding ornamental plant physiology.
**Weed Ecology (WE) –**

Weedy and invasive plants are important economic, environmental, and human health concerns in agricultural crops as well as in managed and natural ecosystems. Specific studies in weed ecology are diverse and wide-reaching. They include weed biology, competition, genetic diversity, and phenotypic plasticity; weed seed ecology (seed production, dormancy, dispersal, and seed banks); herbicide application technologies; alternative weed management methods for low-input and organic agriculture; development and spread of herbicide resistant weed biotypes; invasion ecology; and the ecological role of weeds in natural and managed ecosystems through their interactions with other species.

The HCS-Weed Ecology program works on basic and applied aspects of weedy and invasive plant biology and management. Much of our work focuses on understanding the ecological processes that make some plant species successful invaders, competitors, and colonizers. This information is applied to develop effective physical, cultural, biological, and chemical methods of management, with the ultimate goal of reducing economic, environmental, and health problems caused by weedy and invasive plant species. Because weedy and invasive species are common in so many environments, we interact with faculty and students from a wide range of disciplines, and often provide connections between the molecular and the field levels. Some of our work addresses weed management in conventional and organic systems that include grains, vegetable crops, fruit crops, and ornamental plants. Other work focuses on more global issues, including gene flow, dispersal, and spread of invasive plants in natural areas.
## Faculty Programmatic Interests

<table>
<thead>
<tr>
<th>Faculty Member</th>
<th>Loc.</th>
<th>Areas of Study</th>
<th>Crops</th>
<th>Specific Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barker, David</td>
<td>C</td>
<td>CEMP</td>
<td>Forages</td>
<td>Pasture ecology and sustainability; Grazing systems management</td>
</tr>
<tr>
<td>Bennett, Mark</td>
<td>C</td>
<td>CEMP, SB</td>
<td>Vegetables</td>
<td>Production system efficiency; seed quality and seedling establishment; chemical input reduction</td>
</tr>
<tr>
<td>Blakeslee, Joshua</td>
<td>W</td>
<td>PBMB</td>
<td>Cross-commodity</td>
<td>Membrane biochemistry and transport; Terpenoid and sterol metabolism; Abiotic stress responses</td>
</tr>
<tr>
<td>Cardina, John</td>
<td>W</td>
<td>WE</td>
<td>Cross-commodity</td>
<td>Ecology of natural and managed ecosystems; Environmental enhancement; Emerald ash borer</td>
</tr>
<tr>
<td>Chatfield, James</td>
<td>W</td>
<td>EH</td>
<td>Ornamental species</td>
<td>Secret/chadwick arboretum, Arboblitz, the economic value of the landscape, carbon sequestration</td>
</tr>
<tr>
<td>Cornish, Katrina</td>
<td>W</td>
<td>PBMB</td>
<td>Cross-commodity</td>
<td>Bio-based emergent materials; Natural rubber biosynthesis and production</td>
</tr>
<tr>
<td>Dami, Imed</td>
<td>W</td>
<td>CEMP</td>
<td>Grapes</td>
<td>Viticultural practices; Grape stress physiology; Cold tolerance; Wine quality</td>
</tr>
<tr>
<td>Danneberger, Karl</td>
<td>C</td>
<td>TSM</td>
<td>Turf</td>
<td>Turf maintenance; turf stress physiology; Teaching and extension</td>
</tr>
<tr>
<td>Doohan, Douglas</td>
<td>W</td>
<td>WE</td>
<td>Fruits and vegetables</td>
<td>Weed management strategies; Invasive species; Risk management; Food-borne pathogens</td>
</tr>
<tr>
<td>Finer, John</td>
<td>W</td>
<td>BG</td>
<td>Soybean, Cross-commodity</td>
<td>Transformation and gene expression; stress tolerance; pathogen resistance; Grain quality improvement</td>
</tr>
<tr>
<td>Francis, David</td>
<td>W</td>
<td>BG</td>
<td>Tomato</td>
<td>Bacterial disease resistance genes; Fruit quality; Plant architecture improvement; Tomato grafting</td>
</tr>
<tr>
<td>Gardner, David</td>
<td>C</td>
<td>TSM</td>
<td>Turf</td>
<td>Turf maintenance; turf stress physiology; Effects of light on turf performance; Weed and pest control; Agrichemical management</td>
</tr>
<tr>
<td>Grotewold, Erich</td>
<td>C</td>
<td>PBMB</td>
<td>Cross-commodity</td>
<td>Plant gene regulatory networks; Gene regulating mechanisms; Intercellular biology; Plant metabolic engineering</td>
</tr>
<tr>
<td>Harrison, Kent</td>
<td>C</td>
<td>SB, WE</td>
<td>Cross-commodity</td>
<td>Weed biology and ecology; integrated weed management in crops; weed seed dormancy and ecological determinants of survival</td>
</tr>
<tr>
<td>Jang, Jyan-Chyun</td>
<td>C</td>
<td>PBMB</td>
<td>Cross-commodity</td>
<td>Molecular mechanisms of sugar sensing and signal transduction; sugar-stress hormone crosstalk; sugar-responsive transcription factors</td>
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<tr>
<td>Jones, Michelle</td>
<td>W</td>
<td>PBMB, EH</td>
<td>Floral crops, Petunia</td>
<td>Floriculture post-harvest physiology; Molecular regulation of flower petal senescence</td>
</tr>
<tr>
<td>Jourdan, Pablo</td>
<td>C</td>
<td>BG, SB, EH</td>
<td>Herbaceous perennials</td>
<td>Seed testing; Seed improvement; Germplasm enhancement</td>
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<tr>
<td>Kleinhenz, Matthew</td>
<td>W</td>
<td>CEMP, SB</td>
<td>Vegetables, Cross-commodity</td>
<td>Integrated vegetable management strategies; Vegetable quality and its determinants; organic and local food production; food security</td>
</tr>
<tr>
<td>Lindsey, Laura</td>
<td>C</td>
<td>CEMP</td>
<td>Soybeans, small grains</td>
<td>Soybean and small grain sustainable cropping systems; Mineral nutrition; Grain quality</td>
</tr>
<tr>
<td>Loux, Mark</td>
<td>C</td>
<td>WE</td>
<td>Field crops</td>
<td>Weed management in field crops; reduced herbicide application via cultural improvement strategies; herbicide resistant weeds</td>
</tr>
<tr>
<td>Name</td>
<td>Dist.</td>
<td>Commodity</td>
<td>Cross-commodity</td>
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<tr>
<td>Mackey, David</td>
<td>C</td>
<td>PBMB</td>
<td>Plant immune system function; the role of RIN4 in plant immune responses; Plant defense and cell wall fortification; pathogen-driven modification of plant metabolism</td>
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<tr>
<td>Mathers, Hannah</td>
<td>C</td>
<td>EH</td>
<td>Nursery production management; weed control strategies; cold hardiness; ecology of trees in highway rights-of-way; carbon sequestration.</td>
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<tr>
<td>McHale, Leah</td>
<td>C</td>
<td>BG</td>
<td>Germplasm enhancement; Biotic stress responses; R-genes and cognate pathogen effector proteins; Grain quality</td>
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<tr>
<td>McMahon, Margaret</td>
<td>C</td>
<td>EH</td>
<td>Photoselective plastic films; season extension of greenhouse crops</td>
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<tr>
<td>Mercer, Kristin</td>
<td>C</td>
<td>CEMP, WE</td>
<td>Plant evolutionary ecology in agricultural systems; evolutionary responses to climate change; gene flow among plant communities</td>
<td></td>
</tr>
<tr>
<td>Metzger, James</td>
<td>C</td>
<td>PBMB, EH</td>
<td>Physiologic determinants of flowering; photoperiod phytochrome and floral induction; abiotic stress effects on yield and quality</td>
<td></td>
</tr>
<tr>
<td>Mian, Rouf</td>
<td>W</td>
<td>BG</td>
<td>Cultivar development; Insect and virus resistance</td>
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<tr>
<td>Miller, A. Raymond</td>
<td>W</td>
<td>PBMB</td>
<td>Fruit and vegetable chemistry and biochemistry; post-harvest quality; insect resistance; health-beneficial secondary products</td>
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<tr>
<td>Miller, Diane</td>
<td>W</td>
<td>CEMP</td>
<td>Bio-cultural diversity of apples; germplasm conservation; scab-resistant cultivar development; fruit quality improvement</td>
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<tr>
<td>Pasian, Claudio</td>
<td>C</td>
<td>EH</td>
<td>New crop production strategies; use of greenhouse temperature to control crop timing; Container greenhouse crop fertility</td>
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<td>Precheur, Robert</td>
<td>C</td>
<td>CEMP</td>
<td>Integrated crop management systems; cultivar evaluation for disease and insect resistance and environmental adaptation; pesticide residues</td>
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<tr>
<td>Regnier, Emilie</td>
<td>C</td>
<td>WE</td>
<td>Seed ecology and biology of weedy and invasive species; seed dispersal mechanisms; weed seed survival</td>
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<tr>
<td>Rhodus, Timothy</td>
<td>C</td>
<td>EH</td>
<td>Decision-support systems for use in management, marketing and education</td>
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<td>Scheerens, Joseph</td>
<td>W</td>
<td>CEMP, PBMB</td>
<td>The genetic, cultural and environmental determinants of fruit and vegetable quality; health-beneficial secondary products</td>
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<tr>
<td>Sneller, Clay</td>
<td>W</td>
<td>BG</td>
<td>Resistance to <em>Fusarium</em> head blight; Wheat quality; Cultivar development; statistics of large data sets</td>
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<tr>
<td>Stockinger, Eric</td>
<td>W</td>
<td>PBMB</td>
<td>Genetic control of cold acclimation and freezing tolerance in plants; the C-repeat Binding Factor cold response pathway</td>
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<tr>
<td>Street, John</td>
<td>C</td>
<td>TSM</td>
<td>Turf maintenance; weed control and fertilization in turf; sports turf management of sand root zones</td>
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<tr>
<td>Struwe, Daniel</td>
<td>C</td>
<td>EH</td>
<td>Nutrient and water use efficiency of container nursery crops; transplant survival and establishment; breeding and selection</td>
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<tr>
<td>Sulc, R. Mark</td>
<td>C</td>
<td>CEMP</td>
<td>Sustainable forage management systems; grazing season extension; integrated pest management in alfalfa</td>
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<tr>
<td>Thomison, Peter</td>
<td>C</td>
<td>CEMP</td>
<td>Cropping systems and ecophysiology; phenological responses to heat; grain quality</td>
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<tr>
<td>van der Knaap, Esther</td>
<td>W</td>
<td>PBMB</td>
<td>Molecular, developmental and genetic basis of tomato fruit morphology; genetic diversity of Solanaceous crops</td>
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</tr>
</tbody>
</table>
The Graduate Research Retreat is an opportunity not only to meet and interact among faculty, staff and graduate students, but also to explain our research, and to communicate science. A successful completion of an advanced degree is a multifaceted endeavor: initiate, execute, and summarize a research project, as well as communicate the research via poster and/or oral presentations to the scientific community.

This Retreat is a wonderful experience for the current graduate students to take part in the research competition. The posters and oral presentations will be critically evaluated by graduate students judges and faculty judges. Monetary prizes will be awarded to each first place and second place winners in each of six classifications: Oral Presentation for Masters Proposal, Oral Presentation for PhD Proposal, Oral Presentation for Masters, Oral Presentation for PhD, Poster Presentation for Masters, and Poster Presentation for PhD.

Good luck to all of the participants!
HCS Graduate Retreat Competition Schedule
Saturday, February 22nd, 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract Category</th>
<th>Competitor</th>
<th>Abstract Student Judges</th>
<th>Abstract Faculty Judges</th>
<th>Presentation Student Judges</th>
<th>Presentation Faculty Judges</th>
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<tbody>
<tr>
<td>9:00</td>
<td>PhD Oral Data</td>
<td>Shan Wu</td>
<td>Hoffstetter</td>
<td>Robbins</td>
<td>Jourdan</td>
<td>Kleinhizen</td>
</tr>
<tr>
<td>9:15</td>
<td>MS Oral Proposal</td>
<td>Elias George Babimpyona</td>
<td>Bluck</td>
<td>Orchard</td>
<td>Kleinhizen</td>
<td>Jourdan</td>
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<tr>
<td>9:30</td>
<td>PhD Oral Data</td>
<td>Shaun Broderick</td>
<td>Hoffstetter</td>
<td>Robbins</td>
<td>Jourdan</td>
<td>Kleinhizen</td>
</tr>
<tr>
<td>9:45</td>
<td>MS Oral Data</td>
<td>Shouxin Li</td>
<td>Robbins</td>
<td>Bogamuwa</td>
<td>Doohan</td>
<td>McHale</td>
</tr>
<tr>
<td>10:00</td>
<td>PhD Oral Data</td>
<td>Alexander Lindsey</td>
<td>Hoffstetter</td>
<td>Robbins</td>
<td>Jourdan</td>
<td>Kleinhizen</td>
</tr>
<tr>
<td>10:15</td>
<td>PhD Oral Proposal</td>
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# 8th Annual HCS Graduate Retreat Competition Abstract Titles

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Abstract #1

Influencing rubber production in *Taraxacum kok-saghyz* roots by cold temperature, ethephon and jasmonic oil

Category: Poster Competition- PhD


*Department of Horticulture and Crop Science, Williams Hall, 1680 Madison Avenue, Wooster, OH 44691

**Molecular and Cellular Imaging Center, OSU/OARDC, Selby Hall, 1680 Madison Avenue, Wooster OH 44691

Natural rubber is one of the world’s important commodities and research on latex production is still continuing to benefit both the upstream and downstream industry. In *Hevea* rubber production, ethylene has been used to prolong latex flow for improved yield, and recently jasmonic oil applied to the tapping panel has shown the same result. The same methods may prove effective in other rubber-producing plants such as guayule (*Parthenium argentatum*) and Buckeye Gold dandelion (*Taraxacum kok-sagyz*). The objective of this study is to evaluate the use of hormonal stimulants on *Taraxacum kok-sagyz* in order to gain a better understanding of rubber particle production and the drying out of laticifers, which limits rubber yield. Treatments of ethephon and jasmonic oil were applied to the plants with environmental stimuli i.e. cold induction. Rubber per plant was measured using Accelerated Solvent Extraction (ASE) and changes in the laticifers were observed with near infrared (NIR) spectroscopy as well as by confocal and light microscopy. The initial results from three different experiments show that rubber increases in comparison to control: 1% ethephon application combined with 4°C temperature after three days yielded 81.3 mg/g in comparison to 76.4 mg/g; 1% ethephon in non-cold temperature after nine days yielded 143.8 mg/g in comparison to 92.46 mg/g; roots being left in 4°C for two months yielded 104.4 mg/g in comparison to 95.7 mg/g. The results indicate hormone applications combined with cold temperatures may increase rubber concentration which potentially helps TKS become a viable new source of commercial rubber.
Abstract #2

Application of genomic selection and QTL association mapping to breeding for resistance to rice blast and bacterial blight of Rice (*Oryza sativa* L.) in East Africa

Category: Oral Presentation Competition- Proposal- MS


Rice blast and bacterial blight are rice diseases causing yield losses ranging from 70%-80% and 50%-90%, respectively. Rice blast and bacterial blight resistance traits are both complex and this has caused their genetic improvement using traditional breeding methods to be very inefficient. Therefore, genome wide selection using DNA markers to model genome values may be a better approach for genetic improvement of rice varieties against these two devastating diseases. In this study we expect to develop genomic selection models for resistance to six isolates of rice blast, map QTL for resistance to bacterial blight of rice using association mapping, and developing genomic selection models for resistance to bacterial blight of rice. About 60 isolates of each pathogen (BB and RB) from different areas of East Africa will be collected and evaluated for their virulence and variability and the most six virulent and diverse isolates for both rice blast and bacterial blight will be used for genomic and QTL studies. A training population consisting about 180 USDA rice varieties and about 300 African rice varieties will be used, genotyping of these varieties using GBS markers as well as phenotyping will be done and the collected data will be used to map QTLs by association analysis and generate genomic selection models. This study does not only focus on current solving the rice blast and bacterial blight problems, but also useful in the future solving of these problems in the region.
Abstract #3

Isolation and evaluation of novel Agrobacterium strains for high efficiency transformation of soybean

Category: Oral Presentation Competition- MS Research

Kyle A. Benzle, DeeMarie Marty, Leah K. McHale, Brad W. Goodner, Kim R. Finer, Christopher G. Taylor, and John J. Finer

Department of Horticulture and Crop Science, The Ohio State University, Wooster, OH 44691 USA;
Department of Plant Pathology, The Ohio State University, Wooster, OH 44691 USA;
Department of Horticulture and Crop Science, The Ohio State University, Columbus, OH 43210 USA;
Department of Biology, Hiram College, Hiram OH 44234 USA;
Department of Biological Sciences, Kent State University, Canton, OH 44720 USA;

With a value of nearly $40 billion in annual US production, transgenic soybean (Glycine max) continues to be one of our most important agricultural products. Despite this importance however, the ability to introduce new genes of interest using Agrobacterium remains inefficient. Although the soil borne pathogen, Agrobacterium, is used to generate transgenic plants from a wide variety of species, very few stains are available and no strains have been selected specifically for transformation of soybean. For this research, we have isolated, selected and begun the disarming process (removing of oncogenes) of novel Agrobacterium strains based on transformation efficiency in various tissues of soybean and a model target plant, sunflower.

Novel Agrobacterium strains were isolated from rhizospheric soil collected from soybean fields throughout the country and from the crown galls of various plants in Ohio. Nine novel wild type strains and four know laboratory strains were subjected to transformation efficiency evaluation assays in soybean and sunflower using an introduced binary plasmid containing a gfp marker gene. In sunflower hypocotyl explants, the highest transformation rates were observed with a common laboratory strain, EHA105. Additionally, sunflower hypocotyls displayed a high degree of tissue specificity when using EHA105, with greater than 50% of GFP expressing foci located in vascular tissues. In soybean hypocotyl and cotyledon explants, and embryogenic tissues, a novel wild type strain, JTND, isolated from a soybean field gave approximately 10x higher transformation rates compared to the best preforming laboratory strain, EHA105.
Abstract #4

**P-body and stress granule localized tandem zinc finger proteins are involved in ABA and GA mediated growth responses**

**Category:** Poster - Non-competition

Srimathi P. Bogamuwa and Jyan-Chyun Jang

Processing-Bodies (PBs) and Stress Granules (SGs) are aggregations of cytoplasmic messenger RiboNucleoProtein (mRNP) complexes. One of the prominent proteins present in mammalian PBs and SGs is the Tandem CCCH Zinc Finger (TZF) protein. TZF can nucleate PB formation and trigger mRNA degradation. We have identified three seed specific TZF genes in *Arabidopsis thaliana*. While TZF6 is expressed in immature embryos, TZF4 and 5 are expressed in dry seeds and expression declines during seed imbibition. This leads us to hypothesize that TZF4 and TZF5 are ABA inducible and GA repressible because GA levels increase and ABA levels decrease during seed imbibition. Consistent with this hypothesis, gene expression analyses indicate that TZF4 and TZF5 are upregulated by ABA and downregulated by GA in a seed specific manner. Genetic analyses reveal that TZF4, 5, and 6 act as positive regulators for ABA- and as negative regulators for light- and GA- responses. Compared to the WT, *tzf4*, 5, and 6 KO plants show early and light-independent seed germination, which can be suppressed by exogenous ABA. Further analyses indicate that TZF4, 5, and 6 affect seed germination by controlling genes critical for ABA and GA response. TZF4, 5, and 6 can co-localize with both PB and SG markers. Specifically, TZF6 can be assembled into PBs and SGs in embryos with the induction of stress hormone methyl jasmonate under the control of native TZF6 promoter. Recent results of protein partner screen indicate that TZF4, 5, and 6 may work in concert with an ABA-dependent seed dormancy regulator. Together, these results suggest that TZF4, 5, and 6 play a pivotal role in ABA- and GA-mediated seed germination response through control of gene expression and protein-protein interaction.
Abstract #5

Early gene expression changes in pollinated petunia corollas

Category: Oral Presentation Competition- PhD Research

Shaun Broderick and Michelle Jones

Flower senescence is the final stage of development. Pollination accelerates this process in petunia and induces an ethylene burst. However, it is unclear if other signals precede ethylene biosynthesis and what gene networks are involved in early pollination signaling. To identify genes related to flower senescence, we created strand-specific, paired-end RNA-sequencing libraries from corollas of pollinated and unpollinated flowers at 12, 18, and 24 hours after pollination. Using Illumina sequencing, we generated nearly 0.5 billion reads that were de novo assembled into more than 161K contigs. By screening for putative open reading frames and contigs that had an ortholog hit ratio of 80% or more to tomato proteins we created a unigene library of 33K contigs. After obtaining expression profiles for these contigs, we identified 2,355 that were differentially expressed using DESeq2. Pollen tubes grow down the style and fertilize the ovary between 24-36 hours after pollination, but these data demonstrate that corolla genes are differentially expressed just 12 hours after pollination and at least 12 hours before fertilization, suggesting that a pollination signal precedes ethylene biosynthesis. To identify genes involved in this signaling, we used the weighted gene co-expression network analysis and identified three pollination-specific gene clusters (modules). Approximately 72%, 32%, and 21% of the DESeq2 differentially expressed contigs correspond to these modules. We used STRING to visualize these networks and identify important genes that have a putative role in pollination signaling. Further analysis of these genes will identify key genes that will increase flower longevity in horticultural crops.
Abstract #6

Regulatory Change in Tomato CLAVATA3 (CLV3) by an Inversion Leads to Fasciated Fruit

Category: Poster Competition- MS

Yi Hsuan Chu and Esther van der Knaap

The diversity of tomato fruit shapes can be traced back to the selection outcomes from the domestication of the crop. Two genes, LC and FAS, control locule number, which leads to flat and enlarged fruits. In previous studies, LC was hypothesized to be an ortholog of WUSCHEL and FAS is caused by ~294 kb inversion in the first intron of YABBY2 gene. YABBY is proposed to control locule number, however, we hypothesized that the promoter of a SlCLV3 gene is disrupted by this large inversion and therefore may control locule number as well. AtWUSCHEL and AtCLV3 in Arabidopsis impact the signaling pathway in the first step of floral development, controlling the identity and the size of meristem via a feedback loop regulatory system. However, there are few studies about the development of the tomato fruit and how LC and FAS contribute to larger fruit size. To confirm whether SlCLV3 is involved in the control of locule number, we knocked down the gene using RNA interference in wild type tomatoes and complemented the mutation using a genomic construct in the fas NIL. The results demonstrated that SlCLV3 plays a more prominent role than YABBY2 gene in increasing the locule number and floral organs. To further elucidate the role of FAS and LC in floral meristem development, we identified groups of significantly differentially expressed genes in an RNA-seq data set by isolating meristems and floral buds of near isogenic lines. We are investigating the co-expressed tomato genes with genes controlling the SAM development in Arabidopsis. Additionally, we would like to further explore the expression pattern of CLAVATA3 and WUSCHEL during plant growth and floral development to understand how the development of stem cell enlargement relates to more locules in tomato fruit. This work is funded by NSF-IOS 0922661.
Abstract#7

Utilizing GIS to Develop maps of American Viticultural Areas, Vineyards, and Wineries in Ohio

Category: Poster Competition - MS

Abigail Gerdes and Imed Dami

The wine industry is expanding in Ohio, but research on best vineyard locations is limited. Growers evaluate multiple influential climatic attributes and consider American Viticultural Areas (AVAs) when establishing a vineyard or selecting cultivars, however, comparing relative importance of these factors can be difficult. By creating a multi-criteria decision making (MCDM) system to analyze attributes, geographic information systems (GIS) can compile the data and produce useful maps. My research objectives are, (i) to delineate AVAs, (ii) map locations of vineyards and wineries, and delineate current vineyards in Ohio, and (iii) establish a multi-criteria ranking system to help predict vineyard site suitability. This presentation focuses on progress made towards objectives one and two. Objective one was accomplished by using descriptions provided by the Alcohol and Tobacco Tax and Trade Bureau (TTB) of the location of AVA vertices in order to determine the boundary of the AVAs. In ArcGIS, a map layer was created to show the coordinates and boundaries of the five Ohio AVAs. Objective two was accomplished by establishing the coordinates of commercial vineyards and wineries in Ohio and creating an ArcGIS map layer. Objective three will be done by using a MCDM system to assess relative importance of climatic variables. We have found reports of 135 vineyards and 128 wineries in Ohio. However, only just over 30-percent and 50-percent of vineyards and wineries respectively are located within Ohio AVAs. This is an area of needed growth for Ohio viticulture; establishing new AVAs will benefit the Ohio grape industry.
Abstract #8

Conservation of Begonia germplasm through seeds: characterization of germination and vigor in different species

Category: Poster Competition- MS

Steven Haba, Fernanda Brunetta Godinho, Pablo Jourdan, & Mark Tebbitt

*Begonia* is one of the largest genera of angiosperms, with over 1500 species distributed throughout tropical and subtropical regions; it is also a very important ornamental group of plants. This genus is a priority for conservation and germplasm development at the Ornamental Plant Germplasm Center which currently holds approximately 200 accessions, maintained mostly as clonal plants. In an effort to expand germplasm work in seed storage of *Begonia*, and in response to a scarcity of published information about begonia seed biology, we initiated a project to develop baseline information about germination, dormancy, vigor, and longevity of begonia seeds. We selected six species from diverse environments - and for which we had abundant seed - and compared their germination patterns, optimum temperature, tolerance to stresses, and dormancy. Because of the extremely small size of begonia seeds (ca. 200um) we adapted germination and viability testing protocols typical of *Arabidopsis* research, to develop relatively efficient protocols for seed studies. Seeds are now routinely germinated on 1% agar plates; Tetrazolium testing is possible after treatment with sodium hypochlorite. We have determined that begonia seeds are desiccation-tolerant (orthodox), require light for germination (photoblastic), and appear to lack any strong dormancy and be much more tolerant to stresses than *Arabidopsis*. Preliminary results indicate that *Begonia* species differ in their germination pattern, vigor, and potential dormancy that may be related to environments in native habitats. In general, these observations bode well for the long-term storage of *Begonia* germplasm in seed banks.
Abstract #9

Experimental Method development of rubber membrane isolation and membrane sub-fractions

Category: Poster Competition- PhD

Eun Hyang Han, Wenshuang Xie, Zhenyu Li, Katrina Cornish, and Joshua Blakeslee

Natural rubber (NR) is a vital strategic resource with innumerable industrial usages. Because of this, global natural rubber demand has increased steadily over the past decade. The United State imports the vast majority of its natural rubber from Southeast Asia. Natural rubber is produced almost entirely from a single plant species, the para rubber tree (Hevea brasiliensis), which is grown extensively in this region. However, both limited production space, as well as decreased rubber production due to loss of trees to fungal pathogen, have combined with increased global demand to lead to a precipitous elevation of rubber price. Without development of alternative rubber producing resources, the U.S. will face a NR shortfall within a decade. To help establish an alternative rubber source, we are working to define the biochemical mechanisms of rubber production using Parthenium argentatum (guayule) as a model alternative rubber producing species. Rubber is cis-1,4-polysisoprene and is produced in unilamellar vesicle, the rubber particle (RP). Previous data has suggested that proteins involved in rubber synthesis are embedded in the membrane of the particle. However, due to the unique characteristics of the RP, isolation of its membrane and membrane sub-fractions have proven difficult. To further study of the proteins involved in rubber synthesis, we have optimized methods to isolate both RP membranes and protein rich membrane microdomains. Through targeted proteomic analysis of these fractions, we will gain an increased understanding of the characteristics of the RP membrane and rubber transferase protein(s)/complex, leading to increased productivity of NR.
Using Genotyping-by-Sequencing to Identify QTL for Important Traits of Soft Red Winter Wheat

Category: Poster Competition- PhD

Amber Hoffstetter, Antonio Cabrera, Clay Sneller

Next generation sequencing technology, such as genotyping-by-sequencing (GBS), reduces genotyping costs allowing breeders to genotype increasing numbers of lines. By coupling GBS with genome-wide association study (GWAS) QTLs associated with economically important traits of soft red winter wheat can be identified. Our objective was to use these tools to identify potential QTL for grain yield, fusarium head blight resistance (FHB), flour yield (FY), and softness equivalence (SE) in a set of elite lines from the Ohio State wheat breeding program. We used subsets of data derived from 470 lines with high heritability for each trait genotyped with 33K GBS markers (28K DArTs and 6K SNPs). The GWAS results were trimmed removing markers with greater than 5% missing data and/or a minor allele frequency of less than 10%. LD was done between significant markers \( p<0.0005 \) within and across traits to eliminate redundancy for a genomic region. We identified QTL that may be of breeding importance, with \( R^2 \) values ranging from 11-38%. Four FHB QTL, 9 quality QTL, and 14 QTL for GY. The QTL with the largest effect reduced FHB by 1.76%. For quality, the largest effect QTLs increased FY and SE by 0.37% and 0.67% respectively. Overall environments for GY the QTL with the largest effect was found in Wooster to increase GY by 129.6 kg ha\(^{-1}\). By using marker assisted selection we could improve these traits for Ohio in soft red winter wheat.
Abstract #11

Improve production of grafted tomato seedlings by optimizing light and humidity during healing

Category: Oral Presentation Competition - Proposal - PhD

Bizhen Hu and Matthew Kleinhenz

Fresh market tomato production is a large and lucrative industry. Grafting is used to improve tomato production by combining attributes of a rootstock variety (disease resistance, abiotic stress tolerance, or increased yield), with a scion variety having desirable fruits. Currently, wider use of grafting is limited by the lack of information on production of grafted tomato seedlings. Defining the environmental conditions that promote rapid graft healing will make use of grafted plants economically efficient. Commonly used conditions for healing grafted tomatoes are in darkness and continued in low light for about one week, with nearly saturated humidity. However, scientists argue that adequate light may be more favorable and saturated humidity may not be necessary for healing grafted tomatoes. Our objective is to evaluate the effects of light and humidity on healing grafted tomato seedlings, and explore two potential physiological healing mechanisms. Methods include: first, develop a reliable method to evaluate graft healing by monitoring vascular reconnection using dye and measuring plant regrowth; and second, evaluate the healing of grafted tomatoes under a range of light and humidity levels to investigate the effects of light and humidity on graft healing; and third, two potential physiological mechanisms will be tested by monitoring photosynthesis, water transpiration, and healing of grafted tomato seedlings exposed to different light and humidity conditions. The results will provide research-based guidance for optimum light and humidity management for grafted tomato production, and thus facilitate a wider adoption of grafting that will benefit the industry.
Abstract #12

Lipid and hormonal regulation of salt stress responses in rice roots

Category: Oral Presentation Competition- Proposal- PhD

Chengsong Hu and Joshua Blakeslee

Rice is produced all over the world and is the primary food grain for more than fifty percent of the world’s population. Unfortunately, however, rice production is increasingly affected by soil salinization, resulting in yield losses, lost revenues, and decreased global food security. Salt stress responses involve perception of the abiotic stress, followed by response (hormonal production/transport, gene induction, etc.), and finally by adaptive growth. Phosphatidic acid (PA), a lipid signaling molecule and important component of plant membranes, has been linked to early salt stress perception and downstream responses. Recent research has shown that PA binds protein phosphatase 2A (PP2A) and functions in PP2A-mediated regulation of multiple hormone response pathways, including transport of the phytohormone auxin. While the bulk of this work has been done in Arabidopsis, we hypothesize that similar mechanisms are conserved in monocot crops. This research will (i) characterize the role of lipid signaling in regulating PP2A activity in response to salt stress in rice roots; and (ii) characterize the role of lipid signaling in altering auxin transport following salt stress. By defining the mechanisms involved in early salt stress perception and the resultant signaling cascades in rice, the project will develop rice as a model system for investigating the biochemical basis of salt stress responses in monocot roots. Further, the research will identify key resistance traits (for example, the ability to re-allocate hormone pools following abiotic stresses) useful as targets for either breeding or genetic engineering approaches designed to increase monocot production in saline environments.
Abstract #13

Genomic selection for wheat (Triticum aestivum L.) yield and yield stability

Category: Poster Competition- PhD

Mao Huang, Antonio Cabrera, and Clay Sneller

Hexaploid wheat (Triticum aestivum L.) is one of the most important cereal crops. Yield is an important trait for wheat, but selection for yield is challenged by genotype by environment (G×E) interactions. Therefore, yield stability should be emphasized in variety development. Studies have shown that genomic selection (GS) as a selection strategy could significantly increase gain from selection per unit time. However, G×E complicates the GS efficiency. Our objectives were to evaluate the relative efficiency of GS for yield, test weight (TW), and trait stability, and to assess the G×E pattern. Phenotypic data from 274 breeding lines across 14 environments and genotypic data from 13,287 SNP markers were used in the analyses. Trait stability was estimated using regression and Additive Main Effects and Multiplicative Interaction (AMMI) models. The results showed that 1) heritability for yield and TW were relatively high; 2) the G×E pattern indicated two environments with questionable data and were excluded from subsequent analyses; 3) yield was independent from AMMI estimated yield stability; 4) GS accuracy for yield (r=0.34) and yield stability (r=0.32-0.44) are similar, whereas for TW (r=0.66) is higher than for TW stability (r=0.07 to 0.43). To the best of our knowledge, this is the first study to apply GS on trait stability. Our results indicated that GS could be used to improve these traits, and to select for lines with both high and stable yield. These findings are directly applicable to wheat breeding programs in Northeastern U.S.
Abstract #14

Hybridization between *Taraxacum kok-saghyz* and *T. officinale*

Category: Oral Presentation Competition- PhD Research

Brian Iaffaldano, John Cardina, and Katrina Cornish

*Taraxacum kok-saghyz* (TK) is a species of dandelion which can produce substantial amounts of high quality rubber in its roots; however, TK competes poorly with weeds. In order to overcome this shortcoming, there is interest in developing transgenic, herbicide resistant TK germplasm. The potential release of such germplasm raises the question of transgene introgression into the ubiquitous weedy relative of TK, the Common Dandelion, *T. officinale* (TO). In order to evaluate this risk, controlled crosses between the two species have been conducted. As the weedy TO exhibits obligate apomixis, its pollination of TK is the most likely avenue of hybridization. To this end, unidirectional crosses were conducted and progeny were evaluated with a complement of molecular markers. Of these progeny, 23% proved to be the result of true hybridization rather than induced selfing. Hybrids generally exhibited a range of traits characteristic of TO. The apparent dominance of this phenotype may be due to multiple chromosome set contributions by polyploid TO pollen donors. Approximately 70% of hybrids have demonstrated the inheritance of a full complement of apomixis genes from TO. While the inheritance of apomixis will prevent backcrossing and preclude introgression, it may also allow adaptive hybrids to reproduce while being held in a constant state of heterosis. Overall, this research demonstrates that hybridization between TK and weedy TO is possible under controlled conditions. To determine the potential ecological impact of such hybridizations, the ability of hybrids to form under realistic conditions and the fitness of hybrid populations must be determined.
Abstract #15

Hydroponic Growth of *Taraxacum kok-saghyz*

Category: Poster- Non-competition

Stephen Kopicky, Sarah K McNulty, and Katrina Cornish

*Taraxacum kok-saghyz* (or Kazak dandelion) is being evaluated as a domestic rubber crop due to the high quality rubber it produces and its adaptation to a wide range of environmental conditions. Although the Kazak dandelion is considered to dislike “wet feet”, struggling to grow in saturated soils, hydroponic methods were utilized to observe dandelion growth and rubber synthesis in a controlled setting. Using half strength lettuce nutrient solution, dandelions were grown in a 6 by 8 fully randomized hydroponics system for ten weeks. The system provided constant aeration through ceramic stones and a timed cycle for draining and refilling. All 6 groupings received the same concentration of nutrients, except for magnesium sulfate which was varied by 1 mM, 4 mM and 8mM concentrations. Magnesium is a key activator in the synthesis of natural rubber. Using cuttings from a single seed lot, root and rosette growth rates could be observed and correlated with rubber yields. Preliminary data indicate that there was not an increased correlation in rubber yield from the 1 mM to 8 mM magnesium solutions, but rather that phenotype may be a more important yield factor. Jagged leaf characteristics produced the largest rosette and root systems compared to other phenotypes. Categorizing samples by phenotype may provide a better understanding of the effect of magnesium ions once harvesting and rubber quantification is completed. The use of hydroponics resulted in the successful growth of *Taraxacum kok-saghyz* and showed that many factors affect plant growth and rubber production in this species.
Abstract #16

Improving Freezing Tolerance of Cold-Sensitive Grape Cultivars Using Abscisic Acid

Category: Oral Presentation Competition- MS Research

Shouxin Li and Imed Dami

Grape and wine industries in colder regions such as Ohio have been expanding rapidly and demand for premium wine grapes has also increased. However, several popular cultivars are sensitive to freezing temperatures below -20°C. The goal of this study was to improve freezing tolerance of sensitive grape cultivars using abscisic acid (ABA). The objectives of this research are to: 1) evaluate the response of greenhouse- and field-grown wine grape cultivars to exogenous ABA, 2) characterize the changes of freezing tolerance, water content, and soluble sugars in bud tissues of greenhouse- and field-grown vines in response to exogenous ABA. In the field, we evaluated the effect of exogenous ABA on freezing tolerance and optimum timing of ABA application of *Vitis vinifera* ‘Pinot gris’. ‘Pinot gris’ grapevines were treated with 400mg/L ABA at different stages of development (veraison, post-veraison and post-harvest). The application of ABA did not affect yield components or fruit composition, but caused early leaf abscission, advanced bud dormancy, decreased bud water content, and eventually increased freezing tolerance. Greenhouse experiments showed that ABA caused desiccation of buds which was associated with increased freezing tolerance. Ultimately, the findings of this project are valuable to grape producers to provide another tool for freeze protection and to the scientific community for better understanding of the mechanisms of freezing tolerance.
Abstract #17

Screening for resistance to *Xanthomonas gardneri* among core collections of *Solanum lycopersicum* and *S. pimpinellifolium* accessions and detection of QTL controlling resistance in a backcross population.

Category: Oral Presentation Competition- PhD Research

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Bacterial spot of tomato is caused by four *Xanthomonas* species. Recently, *X. gardneri* became a dominant component of epidemics in Brazil, the United States, and Canada. Damage in Ohio’s processing tomato crop was estimated at 7.8 M in 2010. Few chemicals are effective against bacterial spot, thus the use of resistant varieties is an important component of the strategy to reduce disease. In order to develop lines resistant to *X. gardneri* a two step approach was taken: (i) Identify sources of resistance, (ii) describe the genetic control of the resistance. A processing tomato germplasm collection and the *S. pimpinellifolium* core collection were screened for resistance. The wild accessions LA2533 showed Hypersensitive Response, low level of disease under field conditions, and a significant decrease in bacterial populations supported in inoculated leaves. A backcross (BC) population was developed with LA2533 as the donor parent and OH2641, an elite line from the Ohio breeding program, used as recurrent parent. The genetic of the trait was studied using selective genotyping approach. BC₁S₁ individuals were genotyped with 204 SNP markers, and BC₁S₂ families were evaluated under field conditions. Three genomic regions were associated with resistance. Regions on chromosome 4 and 8 originated from the elite parent. Resistance on chromosome 11 originated from LA2533 and accounted for 38% of the phenotypic variation. These results are currently being used to develop breeding strategies for resistant varieties.
Abstract #18

Isolation and Characterization of Medicinal Compounds from Burdock

Category: Poster Competition - PhD

Yun Lin, Lisa Robbins, Bizhen Hu, Joseph Scheerens, Joshua Blakeslee

Burdock is a biennial herb that is consumed in several Asian and European countries. Additionally, burdock has been utilized in multiple cultures as either an external or internal medicine. In the U.S., burdock leaves have traditionally been used by the Amish community to heal burns. Outside of the Amish community, burdock has been used to treat a variety of medical applications including: inflammation, cancer and skin infections. Little is known, however, about the either the functional compounds present in burdock or their mechanisms of effect. Our research aims to isolate and identify the bioactive compounds from burdock, investigate the ability of compounds to combat burn-relating pathogens in model systems, and determine the bioavailability of identified bioactive compounds to microbial cells. To this end, we have optimized extraction methodology to isolate overlapping functional classes of potentially bioactive compounds, and have generated preliminary metabolite profiles. HPLC analysis indicated that phenols, specifically hydrocinnamic acids, are present in both freeze-dried and fresh burdock roots. Additional GC-MS sample analysis of 4 different solvent extracts identified several solvent-specific unique peaks in both root and shoot tissues. Finally, preliminary screening of burdock extracts for the presence of phytosterols via LC-MS/MS identified significant quantities of sitosterol, cholesterol and stigmasterol. Current studies are focused on identifying individual component peaks isolated in our GC-MS and HPLC studies, as well as assaying the bioactivity of burdock extracts and identified compounds (beginning with the sterols identified above) on burn-related micro-organisms.
Abstract #19

Plant Density and Planting Date Effects on Drought-Tolerant Maize Hybrid Physiology

Category: Oral Presentation Competition- PhD Research

Alexander J. Lindsey, Peter R. Thomison, Allen Geyer, and Rich Minyo

Climatic models have shown precipitation events may become more sporadic as global temperatures rise causing greater incidence of drought events. Ohio growers have started using modern drought-tolerant maize (Zea mays L.) hybrids to manage for drought events, but little is known about the fitness of these hybrids in the Eastern Corn Belt. The objectives of this study were to: i) determine yield advantages/disadvantages of drought-tolerant hybrids over susceptible hybrids; and ii) quantify physiological differences that may contribute to drought-tolerance. Our null hypotheses were: i) there is no difference in yield; and iii) there is no physiological difference between the drought-tolerant and susceptible hybrids. A field study was conducted in 2012 and 2013 at Wooster, Hoytville, and South Charleston, OH. The experimental design was split-plot (whole plot: plant density, five levels; sub-plot: hybrid, four levels) with four replications. Two planting dates were established at each site (May, June). Physiology was measured using an Infrared gas analyzer, and grain yield was collected at physiological maturity. Analysis was conducted using pre-planned contrasts (alpha=0.1). A 5-7% yield advantage was observed with the drought-tolerant hybrids at three sites, but a 2% yield penalty was only observed at one site. Decreased transpiration rates and increased photosynthetic efficiency was observed in drought tolerant hybrids. In conclusion, growers are more likely to see a small yield benefit from using these hybrids in Ohio environments than a yield penalty. The differences in transpiration and photosynthetic efficiency in the tolerant hybrid may be the physiological traits contributing to drought tolerance.
Abstract #20

Cold-Induced Rubber Production in *Taraxacum kok-saghyz*

Category: Poster- Non-competition

Sarah K. McNulty, Griffin M. Bates, and Katrina Cornish

*Taraxacum kok-saghyz* (Buckeye Gold Dandelion) is being investigated and developed to be a domestic replacement for imported natural rubber in commercial applications. While Buckeye Gold rubber is of high quality, comparable to *Hevea* natural rubber, increases in rubber yield are desired to hasten its emergence as a commercially viable crop in the United States. Post-harvest conditions were studied to gain an understanding of the importance of harvest time, storage temperature and root size on rubber biosynthesis. Cold temperatures in storage can induce plants to as much as double the amount of solid rubber and latex in the plant roots. This method significantly increases the rubber content in 30 to 60 days depending on harvest season, root size and storage condition. Cold-induction of rubber is most effective in larger roots, with smaller roots unable to increase rubber in the same manner. The season of harvest affects the time and maximum of the peak in rubber quantity with fall-harvested roots having a peak rubber content at 60 days and spring harvested roots having a peak at 30 days. Inulin, a storage carbohydrate, rapidly decreases in cold storage with the increase in latex and rubber. Cold storage post-harvest also allows enough roots to be harvested and stored to provide feedstock for rubber extraction through the winter months when in-field harvesting is not possible in Ohio.
Abstract #21

The Use of Novel Microbial Inoculums for Plant Growth Promotion in Greenhouse Bedding Plants

Category: Oral Presentation Competition- Proposal- MS

Scott Menicos and Michelle Jones

The commercial floriculture industry relies heavily on chemical inputs for the production of containerized ornamental plants. These inputs include petroleum derived fertilizers, pesticides, and growth regulators. In recent years, there has been a push to decrease the amount of chemical inputs used in the floriculture industry to lessen environmental impact and decrease crop loss. We propose the use of novel plant growth promoting rhizobacteria (PGPR) in these production systems to achieve these goals. PGPR stimulate plant growth through phytohormone manipulation and enhancement of nutrient uptake. PGPR also act as biocontrol agents, antagonizing plant pathogens. Several novel strains of PGPR have been isolated and characterized through research at the OARDC. Some of these novel bacterial strains contain the 1-aminocyclopropane-1-carboxolate (ACC) deaminase gene. ACC deaminase degrades the ethylene precursor, ACC, which leads to a reduction in plant ethylene levels. Ethylene is involved in plant stress responses, including flower senescence and abscission. We propose to study the use of novel microbial inoculums in growth promotion capacity in several greenhouse bedding plants with varying levels of ethylene sensitivity. The efficacy of our novel bacterial strains as biocontrol agents against the foliar pathogen, Botrytis, will also be examined. Additionally, we will investigate the effect of novel microbial inoculation on abiotic stress tolerance in regards to ethylene accumulation associated with the postproduction environment. The proposed research will be instrumental in the development of novel bacterial inoculums and the elucidation of the underlying mechanisms of plant growth promotion in regards to ethylene.
Abstract #22

Gene expression analysis and phenotypic evaluation of the tomato fruit weight 11.3 near isogenic lines.

Category: Poster Competition- MS

Qi Mu, Zejun Huang, Manohar Chakrabarti, Esther van der Knaap

Tomato (Solanum lycopersicum) fruit size and shape have changed dramatically during the domestication process. The size and shape of produce is crucial to yield and quality, as well as for producers and consumer preferences. More than 30 QTLs related to tomato fruit size and shape have been identified, among which there are only two fruit weight genes—CNR (FW2.2) and SlKLUH (FW3.2) that have been cloned. Identifying the genes underlying fruit weight QTLs can help clarify the molecular mechanism for fruit development, and provide evolutionary insights of the domestication, as well as identify valuable agronomic traits that can be utilized in crop production. The fw11.3 is an important QTL controlling tomato fruit weight. Fine mapping and association analysis has placed fw11.3 into a 13-kb region and one candidate gene, ORF2. However, further study on this gene and its function needs to be conducted. We hypothesize that ORF2 is the underlying gene for fw11.3. In this study, the complementation test showed that ORF2 can recover the phenotype and a putative function of the enlarged fruit is due to increased cell size. RNA-seq analysis showed that unlike the other fruit size/shape genes, ORF2 is expressed most highly in fw11.3 NIL in the columnella tissue during the later stage of fruit development. Moreover, phenotypic evaluation suggested that besides the fruit size differences, ORF2 can also alter the plant structures. The future work will be focused on gene expression profile and gathering more phenotypic data accompanied with fruit enlargement. This research is funded by NSF IOS 0922661.
Abstract #23

New Evidence for Multiple Glyphosate-Resistance Mechanisms Within a Population of Common Ragweed.

Category: Oral Presentation Competition- PhD Research

Jason T. Parrish, Mark M. Loux, David M. Mackey, Leah K. McHale, Doug Sammons, Dafu Wang, Elizabeth L. Ostrander, Dana A. d'Avignon, Xia Ge, Philip Westra, Christopher R. Van Horn, Andrew T. Wiersma

Common ragweed (*Ambrosia artemisiifolia*) is a weed problem in many places throughout the world. Though it seldom dominates the landscape, common ragweed seems to be able to exploit diverse habitats. The genetic diversity may also play a role in the development of herbicide-resistant biotypes. Studies were conducted to determine the mechanisms of resistance to glyphosate in an Ohio ragweed population, including 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene sequencing, EPSPS enzyme immunoblot and activity/inhibition assays, $^{31}$P-nuclear magnetic resonance (NMR) studies of glyphosate-treated tissues, and whole-plant absorption and translocation studies using $^{14}$C-labeled glyphosate. The molecular basis for resistance is still unclear. The gene coding for EPSPS has a high mutation rate in common ragweed, but typically does not code for an altered amino acid sequence in the glyphosate-binding area. Sequencing experiments have located alleles of EPSPS coding for amino acid substitutions at a position known to be important for glyphosate resistance. It is not known whether these alleles are translated into a functional EPSPS protein. An immunoblot assay with common ragweed total soluble protein showed a single plant from this same glyphosate-resistant population with increased EPSPS expression. $^{31}$P-NMR data shows efficient uptake of glyphosate into the cell and no vacuolar sequestration in this glyphosate-resistant population, with lower sugar-phosphate accumulation relative to glyphosate-susceptible common ragweed plants. Similarly, no reduced absorption or translocation of $^{14}$C-labeled-glyphosate was ascertained over 48 hours, though subjective evidence from other experiments indicates some sort of non-target-based mechanism could contribute to glyphosate resistance in a large or minor way.
Abstract #24

Genome wide association study for partial resistance to *Phytophthora sojae* in soybean plant introductions from South Korea

Category: Poster Competition- MS

Rhiannon Schneider, Anne Dorrance, and Leah McHale

The oomycete pathogen *Phytophthora sojae* causes the economically devastating disease, Phytophthora stem and root rot of soybean, one of Ohio’s most important crops. This disease can be managed through the planting of resistant varieties. Resistance to *P. sojae* follows one of two mechanisms of inheritance: single-gene mediated, race-specific resistance conferred by *Rps* genes or multi-genic, quantitative (partial) disease resistance. While *Rps* genes provide complete resistance against specific races of *P. sojae*, no single *Rps* gene is effective against all races. Widespread deployment of *Rps* genes has placed high selection pressure on *P. sojae* such that the pathogen population has evolved into new, virulent races. In contrast, partial resistance is controlled by multiple genes, each contributing a small proportion of the plant’s resistance, theoretically resulting in slower pathogen evolution and adaptation. Due to the low-level resistance provided by each locus, this resistance is considered more durable. South Korea has been proposed as the origin of the soybean-*P. sojae* interaction and Plant introductions (PIs) from S. Korea may represent novel sources of partial resistance. The main objective of this study was to identify loci controlling partial resistance to *P. sojae* in a population of 1,392 PIs from S. Korea. To do so, we have utilized genotypic information of >20,000 markers from the Soy50KSNP chip in a genome-wide association study. This work facilitates soybean breeding by identifying germplasm that may be a source of alleles for improvement of partial resistance as well as identifying markers suitable for selection of the trait.
Abstract #25

Effect of Drum Priming using 24-Epibrassinolide on Physiological Potential of Bell Pepper (*Capsicum annuum* (L.)) Seeds

Category: Poster- Non-competition

Clíssia B. da Silva, Mark A. Bennett, Pablo Jourdan, Julio Marcos-Filho

Bioregulators such 24-epibrassinolide are phytohormones considered as candidates to induce seed physiological and biochemical changes in various species. In this way, they possibly can favor seed performance during germination and seedling establishment. This study was performed to evaluate the combination of the drum priming technique with 24-epibrassinolide in bell pepper seeds. Seeds were evaluated for germination and vigor (germination first count, seedling emergence, vigor index, and seedling length). The SVIS® software (Seed Vigor Imaging System) software was used to determine the vigor index and seedling length. Treatments consisted of controlled seed hydration with 24-epibrassinolide (10-8 M) or water (control) followed by drying at 32 °C and 30% RH to reach the initial moisture content. Drum priming combined with 24-epibrassinolide has shown more advantages than drum priming using only water. Primed bell pepper seeds with 24-epibrassinolide have produced better seedling development, expressed primarily by improved vigor index and seedling length.
Abstract #26

Type I and Type IV Circumallergenic Guayule Natural Rubber Thin Films

Category: Poster- Non-competition

Jessica Lauren Slutzky and Katrina Cornish

Natural rubber latex from the Brazilian rubber tree, Hevea brasiliensis, is commonly used to make thin film barrier applications in products such as condoms, medical gloves, and dental dams. Type I latex allergy sensitization and subsequent allergic reactions to Hevea natural rubber latex products have created an industry demand for thin film barriers that are circumallergenic (circumvent the allergic response), and have addressed this need using synthetic polymers produced from non-sustainable resources such as petroleum. Both Hevea and synthetic thin film products are prone to causing Type IV contact dermatitis allergies, attributed to residual thiazoles, thiurams, and carbamate accelerators.

We have developed circumallergenic natural rubber thin films, utilizing natural rubber latex from the plant species Parthenium argentatum, commonly referred to as guayule. Guayule latex is circumallergenic to Type I allergy, because its proteins do not cross react with Hevea associated allergic proteins. For the first time, our guayule latex films were cured with the accelerators diisopropyl xanthogen polysulphide (DIXP) and zinc diisononyl dithiocarbamate (ZDNC) which also render the films non-inducers of Type IV allergies. DIXP is consumed during the vulcanization process, and skin tests have shown that ZDNC does not cause dermal reactions or delayed contact hypersensitivity, thus eliminating Type IV allergy sensitization.

Guayule natural rubber latex thin films have mechanical properties superior to those previously reported. For example, a 0.15 mm thick film had a tensile strength of 35.95 MPa, and elongation to break of 2080%, and a modulus at 500% of 1.58 MPa. The aforementioned films are well above the ASTM standards for surgical gloves and are suitable for many dipped thin film applications.
Abstract #27

The role of *OVATE* in regulating the patterning of tomato ovary

Category: Oral Presentation Competition- PhD Research

Shan Wu, Neda Keyhaninejad, Hyunjung Kim and Esther van der Knaap

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The final shape and size of plant organs result from coordinated cell proliferation and expansion along different axes. How higher order tissue growth is linked to the subcellular events such as cytoskeleton activity is not fully understood. Tomato accessions vary in fruit shape from flat to round to very elongated and obovoid. The shape of many elongated and all pear-shaped tomato varieties is controlled by a mutation in the *OVATE* gene. *OVATE* is a member of the Ovate Family Proteins (OFPs) and the family is thought to encode transcriptional repressors based on previous findings. To investigate how *OVATE* regulates organ growth, we developed the Near Isogenic Lines that differ at the *ovate* locus. Analysis of cell morphology in the ovary revealed that the elongated shape was due to altered cell division pattern. We performed a Yeast 2 Hybrid screen using the full-length *OVATE* protein as bait. To our surprise, *OVATE* interacts with Tonneau1 Recruiting Motif (TRM) proteins, which are a part of a protein complex regulating the formation of preprophase band and cortical microtubule (MT) array organization, and not with transcription factors as expected. This result suggests that *OVATE* may affect cell proliferation through binding to MT-associated proteins. We also mapped a suppressor of the *ovate* mutation (*sov1*) and identified another member of the family, *SIOFP20*, as the best candidate gene in the region. Our findings are starting to shed light on the role of *OVATE* in organ patterning and provide insights into fundamental aspects of plant growth.
Abstract #28

Crossability and Cytogenetics of interspecific interploid crosses in *Phlox* subsection *Divaricatae*

**Category: Oral Presentation Competition- PhD Research**

**Peter Zale and Pablo Jourdan**

Ploidy differences have previously been considered a barrier to interspecific hybridization in the genus *Phlox* L, but this was determined from few attempts at interploid crosses that used a limited subset of polyploid taxa. The objective of this study was to determine chromosome counts and DNA content (genome size) of selected taxa, to evaluate crossability among species of similar and different ploidy in *Phlox* subsection *Divaricatae*, to confirm hybridity using chromosome counts, flow cytometry, and Sequence Related Amplified Polymorphism (SRAP) markers with the goal of facilitating future breeding endeavors and development of new hybrids. *Phlox florigana*, *P. pulcherrima*, and *P. villosissima* were tetraploid (2n=4x=28) and 2C genome size ranged from 21.85–26.58 pg. *Phlox divaricata*, *P. drummondii*, and *P. pilosa* were diploid (2n=2x=14) and genome sizes ranged from 9.78–12.55 pg. Interploid crosses were successful when tetraploids served as the female parent in crosses with diploid, perennial species, but could only serve as the male parent in crosses with the diploid, annual *P. drummondii*. Interploid crosses resulted in the formation of aneuploid F\(_1\) progeny with \(n=2x-1=13\), \(n=2x-2=12\) and \(n=2x-3=11\) chromosomes, and genome sizes intermediate to parental taxa that ranged from 17.28 – 17.78 pg. SRAP markers also confirmed hybridity of interploid crosses. Aneuploid hybrids were functionally sterile and exhibited low to no pollen staining, and sib and parental backcrosses were unsuccessful. This study demonstrates successful interploid crosses among *Phlox* taxa, but indicates that further development of hybrids may only be possible through ploidy conversion or via unreduced gametes among F\(_1\) progeny.
Abstract #29

Interaction between soybean promoter regulatory elements and a leading intron stimulates gene expression

Category: Oral Presentation Competition- PhD Research

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In plants, introns can influence gene expression by intron-mediated enhancement (IME). However, little is known about the intron-mediated enhancement mechanisms since only a few plant introns have been extensively studied. In this research, synthetic promoters containing variants of promoter elements and introns were constructed and introduced into lima bean cotyledons and soybean hairy roots. The synthetic promoter showed very high activity, only if the native leading intron was included, indicating that interesting interactions may exist among intron-containing sequences and other components of the promoter region. Partial deletions of the leading intron demonstrated that a 222 bp intronic sequence significantly contributed to very high gene expression. Additional intron variants were generated to further understand the interaction between the intronic sequences and specific promoter sequences. Intron variants with a monomeric or trimeric repeat of this 222 bp intronic sequence, gave almost twofold higher expression compared to the original intron, which further demonstrated that the 222 bp intronic sequence contributed to intron-promoter interaction enhancement. The 222 bp intronic sequences may contain splicing enhancers that interacted with the promoter elements to increase gene expression during gene transcription and intron splicing process. This study will better our understanding of IME mechanisms, establish an efficient validation system to study the role of intronic elements in gene expression regulation and expand the utility of introns for regulating gene expression in transgenic soybean.
Abstract #30

Sequencing and comparative analysis of chloroplast genomes in *Taraxacum* and downstream applications

Category: Oral Presentation Competition- PhD Research

Yingxiao Zhang, Wenshuang Xie, and Katrina Cornish

The chloroplast is a semi-autonomous organelle with its own genetic information. The high copy number and prokaryotic expression system of chloroplast genomes allow high levels of multigene expression by chloroplast engineering, an ecofriendly genetic engineering approach with lower risk of transgene escape. Additionally, chloroplast genomes evolve more slowly than nuclear genomes, making them a valuable resource for studying evolution, as well as interspecific introgression and intraspecific differentiation. In this project, chloroplast genomes of two *Taraxacum* species have been sequenced and characterized, namely Kazak dandelion (*Taraxacum kok-saghyz*, TK, Buckeye Gold), one of the best potential crops for domestic rubber production, and common dandelion (*T. officinale*, TO), an ubiquitous weedy relative of TK. Flanking sequences for TK chloroplast engineering have been identified via chloroplast gene annotation and used for vector construction designed to improve herbicide resistance and rubber yield. Moreover, comparative analysis revealed genome diversity and similarities among TK, TO and other members in the Asteraceae family; utilizing this information, DNA barcode regions for genetic differentiation have been identified. To investigate gene flow potential between TK and TO, chloroplast-specific markers have been discovered, which can be used as maternal indicator to detect gene flow pathways. The availability of TK and TO chloroplast genome sequences will facilitate the improvement of TK by the establishment of a chloroplast engineering system, as well as provide essential information to understand the potential ecological risks associated with the use of transgenic TK on farms.
Abstract #31

Improvement of Sunflower Transformation through the Use of Cotyledon Explants from Mature Seeds

Category: Oral Presentation Competition- PhD Research

Zhifen Zhang and John J. Finer

A reliable and efficient transformation protocol is not available for routine gene characterization and manipulation in sunflower. In order to use biotechnological tools for improvement of sunflower, sunflower transformation protocols must first be developed and optimized. A sunflower line RHA280 was identified as having high response to shoot induction, with an average of over 80 induced adventitious shoots obtained from each cotyledon explant. This study aimed to develop and optimize sunflower transformation using cotyledon explants from this line. Sonication Assisted Agrobacterium-mediated Transformation (SAAT) was evaluated to improve the transformation efficiency, and a green fluorescence protein gene was used as a reporter gene to monitor transgenic cell proliferation and shoot development. Imbibition of dry cotyledons in liquid shoot induction medium for 1 d seemed to enhance susceptibility to SAAT, by softening the dry cotyledon, leading to better wounding. For the selection of transgenic cells, applying antibiotic (hygromycin) immediately after co-cultivation of the explants with Agrobacterium, instead of waiting 5 d, increased the frequency of transgenic shoot production. Additionally, use of hygromycin at 15 mg/L, applied directly after co-culture, yielded over 20% explants with transgenic shoots. Given the difficulty in shoot elongation and shoot rooting from cotyledon explants, a micrografting approach was developed for the recovery of transgenic shoots, with a micrografting success rate over 30%.
Abstract #32

Regenerating Transgenic *Taraxacum kok-saghyz* from Hairy Root

Category: Poster Competition- PhD

Lu Zhao, Zhenyu Li, Carlos M. Hernandez-Garcia, John Finer and Katrina Cornish

Department of Horticulture and Crop Science, The Ohio State University-OARDC
1680 Madison Ave, Wooster, OH 44691, zhao.670@buckeyemail.osu.edu, li.3427@osu.edu, hernandez-garcia.1@buckeyemail.osu.edu, finer.1@osu.edu, cornish.19@osu.edu.

*Taraxacum kok-saghyz* (TK) is a promising model plant for studying rubber metabolism, because it can produce high quality rubber and it is amenable to genetic modification. Hairy root induction mediated by *Agrobacterium rhizogenes* can rapidly generate stably transformed root tissue, which has been intensively used as a reliable tool for gene analysis and promoter assessment in soybean. Nevertheless, hairy root induction creates composite plant in which the transformed roots attach on non-transformed aerial part of plant, making the sustained maintenance more challenging. Preliminary result confirmed that the TK hairy root system has been established. This study aims to regenerate homogeneous transgenic TK from the transformed hairy root segments. To achieve this goal, five different regeneration mediums supplemented with phytohormones and cytokinins of different ratios were tested for the TK regeneration efficiency. The ratios are selected to induce either callus or shoot growth. The results indicate that two types of mediums are capable of regenerating transgenic TK from hairy root segments. These two mediums targets on callus induction and shoot emergence, respectively. TK regeneration in which callus stage has been circumvented has higher survival rate, while most of the plantlets regenerated from calli experienced a high rate of death due to hyperhydricity. TK regeneration from hairy root has reduced the time required for transformants generation compared to *A. tumefaciens*-mediated transformation. After early transgene determination of hairy root, the successfully transformed root segments can be maintained to regenerate homogeneous transformants, providing an encouraging alternative transformation approach for TK and other plant species.
Appendix: 2014 Poster / Oral Presentation Competition

General Information and Eligibility

Competition Eligibility:
- Graduate Students enrolled and receiving funding from the HCS department either autumn term 2013 or spring term 2014.
- Students who participated in previous Graduate Research Retreat competitions are required to report additional or different data.
- Students may submit to more than one category if unique data is reported in each.
- Proposal submissions can only be from students admitted summer 2013 or later.

Competition Categories:
- Poster Competition - MS
- Poster Competition - PhD
- Oral Presentation Competition – Proposal – MS
- Oral Presentation Competition – Proposal – PhD
- Oral Presentation Competition – MS Research
- Oral Presentation Competition – PhD Research
- Non-competition Poster – Post Doctorates, Staff, Lab groups, or Student Research

Monetary Awards:
- There will be an award given for 1st and 2nd place for each category (excluding the non-competition poster category).
  1st Place: $200.00
  2nd Place: $100.00

Poster Competition
- Students may submit an abstract and poster into the following categories:
  Poster Competition - MS
  Poster Competition - PhD
- Cash prizes will be awarded to the two highest scores within each category (a total of four awards).
- The presenting student has submitted both an abstract and abstract submission form by February 3rd, 2014.
- Scores are based on the abstract (25% of the total score) and the poster (75% of total score).
- Posters (in PDF format) must be submitted by 5:00pm on February 10th, 2014.
- Student presenters are required to be at their posters during the scheduled poster viewing session, on Saturday, February 22nd, 2014.
- Posters must be available for set up by 7:00 PM on Friday, February 21st, 2014.
Appendix: 2014 Poster / Oral Presentation Competition (Cont.)

Oral Presentation Competition
- Students may submit an abstract into one of the following categories:
  - Oral Presentation Competition - Proposal – MS
  - Oral Presentation Competition - Proposal – PhD
  - Oral Presentation Competition - MS research
  - Oral Presentation Competition - PhD research
- Cash prizes will be awarded to the two highest scores within each category (a total of eight awards).
- The presenting student has submitted both an abstract and abstract submission form by February 3rd, 2014.
- Scores are based on the abstract (25% of the total score) and the oral presentation (75% of the total score).
- Judging will consist of a 10 minute oral presentation followed by 3 minutes for questions.

Non-competition Poster Category
- Submitting a non-competition poster is encouraged for either a graduate student in the HCS department, who does not meet the competition eligibility requirements or cannot attend the retreat, or a graduate student who is associated with HCS, but is not funded by the HCS department. We also encourage any Post Doctorate, staff member, or lab group to present any of their research which they are able to share.
- The presenting Post Doctorates, Staff, Lab groups, or Student(s) may submit an abstract for their posters by February 3rd, 2014.
- Cash prizes will NOT be awarded for this category.
- Post Doctorates, Staff, Lab groups, or Student presenters are required (unless excused) to be at their posters during the scheduled poster viewing session, on Saturday, February 22nd, 2014.
- Posters must be available for set up by 7:00pm on Friday, February, 21st, 2014.
**Abstract Evaluation: Poster Competition, MS/PhD**
2014 Horticulture & Crop Science Graduate Research Competition

Abstracts are limited to a maximum of **250 words**.
(25% of the total score)

Presenter name: __________________________________________

1. **Purpose of study** (5 points)
   _______
   **Consider the following when scoring:**
   a. What problem does this work attempt to solve?
   b. Is the problem/objective/hypothesis clearly stated?
   c. Is the importance of the problem/research clearly stated?
   d. Is the main argument established? What is the main argument/thesis/claim?
   If 5 points were not awarded, please explain: __________________________

2. **Design and Methodology** (5 points)
   _______
   **Consider the following when scoring:**
   a. Approach: Does the theoretical and/or methodological perspective seem appropriate?
   b. Do the procedures of inquiry seem adequate to support the study’s objective?
   c. Are the instruments/sources/materials appropriate to this inquiry?
   If 5 points were not awarded, please explain: __________________________

3. **Results and conclusions** (5 points)
   _______
   **Consider the following when scoring:**
   a. Are the results clearly stated?
   b. Does the interpretation seem clear and justifiable?
   c. Do the conclusions seem valid and/or realistic?
   If 5 points were not awarded, please explain: __________________________

4. **Implications and significance** (5 points)
   _______
   **Consider the following when scoring:**
   a. Does this research hold theoretical significance in its field?
   b. Does this research have practical application in the subject area?
   c. What are the implications of the results?
   d. How does this work add to the body of knowledge on the topic/field?
   If 5 points were not awarded, please explain: __________________________

5. **Overall Quality** (5 points)
   _______
   **Consider the following when scoring:**
   a. Is the abstract presented in a professional manner?
   b. Is grammar and spelling correct throughout the abstract?
   If 5 points were not awarded, please explain: __________________________

6. **Word limit deduction** (-3 points)
   _______
   a. Exceeded maximum of 250 words.

**Additional Comments** (use back, if necessary):

*Abstracts will be judged on the first 250 words.*
Abstract Evaluation: Oral Presentation – Proposal – MS or PhD
2014 Horticulture & Crop Science Graduate Research Competition
Abstracts are limited to a maximum of 250 words.
(25% of the total score)

Presenter name:________________________________________

1. Purpose of study (5 points) __________
   Consider the following when scoring:
   a. What problem does this work attempt to solve?
   b. Is the problem/objective/hypothesis clearly stated?
   c. Is the importance of the problem/research clearly stated?
   d. Is the main argument established? What is the main argument/thesis/claim?
   If 5 points were not awarded, please explain:________________________________

2. Experimental design (5 points) __________
   Consider the following when scoring:
   a. Is the design appropriate to address the experimental objective?
   b. Approach: Does the theoretical and/or methodological perspective seem appropriate?
   If 5 points were not awarded, please explain:_____________________________

3. Experimental methodology (5 points) __________
   Consider the following when scoring:
   a. Do the procedures of inquiry seem adequate to support the study’s objective?
   b. Are the instruments/sources/materials appropriate to this inquiry?
   If 5 points were not awarded, please explain:__________________________

4. Implications and significance (5 points) __________
   Consider the following when scoring:
   a. Does this research hold theoretical significance in its field?
   b. Does this research have practical application in the subject area?
   c. Are potential outcomes addressed?
   If 5 points were not awarded, please explain:_____________________________

5. Overall Quality (5 points) __________
   Consider the following when scoring:
   a. Is the abstract presented in a professional manner?
   b. Is grammar and spelling correct throughout the abstract?
   If 5 points were not awarded, please explain:_____________________________

6. Word limit deduction (-3 points) (_______)
   a. Exceeded maximum of 250 words.

Additional Comments (use back, if necessary):

*Abstracts will be judged on the first 250 words.
Abstract Evaluation: Oral Presentation Research, MS/PhD
2014 Horticulture & Crop Science Graduate Research Competition

Abstracts are limited to a maximum of 250 words. (25% of the total score)

Presenter name:________________________________________

1. Purpose of study (5 points)  
   Consider the following when scoring:
   a. What problem does this work attempt to solve?
   b. Is the problem/objective/hypothesis clearly stated?
   c. Is the importance of the problem/research clearly stated?
   d. Is the main argument established? What is the main argument/thesis/claim?

If 5 points were not awarded, please explain:________________________________

2. Design and Methodology (5 points)  
   Consider the following when scoring:
   a. Approach: Does the theoretical and/or methodological perspective seem appropriate?
   b. Do the procedures of inquiry seem adequate to support the study’s objective?
   c. Are the instruments/sources/materials appropriate to this inquiry?

If 5 points were not awarded, please explain:________________________________

3. Results and conclusions (5 points)  
   Consider the following when scoring:
   a. Are the results clearly stated?
   b. Does the interpretation seem clear and justifiable?
   c. Do the conclusions seem valid and/or realistic?

If 5 points were not awarded, please explain:________________________________

4. Implications and significance (5 points)  
   Consider the following when scoring:
   a. Does this research hold theoretical significance in its field?
   b. Does this research have practical application in the subject area?
   c. What are the implications of the results?
   d. How does this work add to the body of knowledge on the topic/field?

If 5 points were not awarded, please explain:________________________________

5. Overall Quality (5 points)  
   Consider the following when scoring:
   a. Is the abstract presented in a professional manner?
   b. Is grammar and spelling correct throughout the abstract?

If 5 points were not awarded, please explain:________________________________

6. Word limit deduction (-3 points) (_______)
   a. Exceeded maximum of 250 words.

Additional Comments (use back, if necessary):

*Abstracts will be judged on the first 250 words.
**Poster Competition Evaluation – MS and PhD**

2014 Horticulture & Crop Science Graduate Research Competition

(75% of the total score)

**Presenter name:** __________________________________________

1. **Appearance of the poster display** (15 points)
   Consider the following when scoring:
   a. Attractively displayed in color, neatness, and timely display.
   b. Clarity: sufficient space between items.
   c. Text, figures, tables, and photos labeled and large enough to view from 3-4’ away.
   d. Title, author(s), and college affiliation and location cited at top in bold.
   e. No spelling errors; literature and scientific or trade names properly cited.

   If 15 points were not awarded, please explain: ______________________________

2. **Poster organization and preparation** (20 points)
   Consider the following when scoring:
   a. Has concise and easy to locate highlights of research project.
   b. Highlights of research/outreach project concise and easy to find.
   c. Introduction: covers previous literature, objectives and/or hypothesis to be tested. Rational and significance of the proposed studies, in regards to agricultural, food, or environmental issues, should be presented.
   d. Methods and Materials: covers enough detail but not too much verbiage. Includes detail of the experimental design and research approach, and an outline of the methods/techniques used.
   e. Results and Discussion: overall results are clearly presented.
   f. Tables and Figures: appropriate quality, size, and number.
   g. Colored photos: important to show results with pictures.
   h. Conclusions/summary statements are included and valid.
   i. Literature Cited: only key citations listed.
   j. Poster is concise, logical, and self-explanatory.

   If 20 points were not awarded, please explain: ______________________________

3. **Originality and Merit** (20 points)
   Consider the following when scoring:
   a. Originality of research study: innovative project.
   b. Previous results appropriately cited in introduction and discussion.
   c. Objectives or hypothesis were clearly stated.
   d. Work was well-conceived and properly executed.
   e. Appropriate methods and experimental design to test hypothesis.
   f. Conclusions are supported by the presented data.
   g. Statistics used to evaluate data (if applicable).

   If 20 points were not awarded, please explain: ______________________________

4. **Knowledge and Presentation** (20 points)
   Consider the following when scoring:
   a. Student’s enthusiasm of subject area.
   b. Student’s knowledge and competence in subject area.
   c. Ability to answer questions from judges.

   If 20 points were not awarded, please explain: ______________________________

**Additional Comments** (use back, if necessary):
Oral Presentation Evaluation – Proposal – MS / PhD
2014 Horticulture & Crop Science Graduate Research Competition
(75% of the total score)

Presenter name: ____________________________________________

1. Presentation preparation and organization (15 points) _________
   Consider the following when scoring:
   a. Attractively and clearly designed in color, neatness, and readability.
   b. Introduction: Covers objectives and/or hypothesis to be tested and rational and significance of the proposed studies in regards to agricultural, food, or environmental issues.
   c. Methods and Materials: Includes sufficient detail of the experimental design and research approach, and an outline of the methods/techniques used.
   d. Tables and Figures: appropriate quality, size, and number.
   e. Anticipated contribution statements are included and valid.
   If 15 points were not awarded, please explain: ____________________

2. Oral Communication skills (20 points) __________
   Consider the following when scoring:
   a. Demonstrated comfort with presentation of research.
   b. Held interest of audience.
   c. Voice clear and of adequate volume.
   d. Eye contact with judges and audience was appropriate.
   e. Used slides to enhance vocal explanations of research.
   f. Provided a well-reasoned rationale of research.
   g. Went into appropriate detail of experimental design and methods.
   h. Synthesized current and previous research in discussion.
   i. Provided an overall cohesive presentation of main themes and goals of research.
   If 20 points were not awarded, please explain: ____________________

3. Originality and Merit (20 points) __________
   Consider the following when scoring:
   a. Originality of research study: innovative project.
   b. Subject is of importance, significance, and interest to HCS/field of study.
   c. Previous results appropriately cited in introduction and discussion.
   d. Objectives or hypothesis were clearly stated.
   e. Work was well-conceived.
   f. Appropriate methods and experimental design to test hypothesis.
   If 20 points were not awarded, please explain: ____________________

4. Knowledge and Presentation (20 points) __________
   Consider the following when scoring:
   a. Student’s enthusiasm of subject area.
   b. Student’s knowledge and competence in subject area.
   c. Presentation of research highlights to judges (10 minutes max).
   d. Ability to answer questions from judges.
   If 20 points were not awarded, please explain: ____________________

Additional Comments (use back, if necessary):

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## Oral Presentation Evaluation - MS / PhD Research

2014 Horticulture & Crop Science Graduate Research Competition

(75% of the total score)  

**Presenter name:______________________________**

### 1. Presentation preparation and organization (15 points)

Consider the following when scoring:

a. Attractively and clearly designed in color, neatness, and readability.

b. Introduction: Covers objectives and/or hypothesis to be tested and rational and significance of the proposed studies in regards to agricultural, food, or environmental issues.

c. Methods and Materials: Includes sufficient detail of the experimental design and research approach, and an outline of the methods/techniques used.

d. Results and Discussion: overall results are clearly presented and integrated into existing research.

e. Tables and Figures: appropriate quality, size, and number.

f. Conclusions/summary statements are included and valid.

If 15 points were not awarded, please explain:_____________________________

### 2. Oral Communication skills (20 points)

Consider the following when scoring:

a. Demonstrated comfort with presentation of research.

b. Held interest of audience.

c. Voice clear and of adequate volume.

d. Eye contact with judges and audience was appropriate.

e. Used slides to enhance vocal explanations of research.

f. Provided a well-reasoned rationale of research.

g. Went into appropriate detail of experimental design and methods.

h. Clearly brought forward key results and explained slide tables and graphs well.

i. Synthesized current and previous research in discussion.

j. Provided an overall cohesive presentation of main themes and conclusions of research.

If 20 points were not awarded, please explain:_____________________________

### 3. Originality and Merit (20 points)

Consider the following when scoring:

a. Originality of research study: innovative project.

b. Subject is of importance, significance, and interest to HCS/field of study.

c. Previous results appropriately cited in introduction and discussion.

d. Objectives or hypothesis were clearly stated.

e. Work was well-conceived and properly executed.

f. Appropriate methods and experimental design to test hypothesis.

g. Conclusions are supported by the presented data.

h. Statistics used to evaluate data (if applicable).

If 20 points were not awarded, please explain:_____________________________

### 4. Knowledge and Presentation (20 points)

Consider the following when scoring:

a. Student’s enthusiasm of subject area.

b. Student’s knowledge and competence in subject area.

c. Presentation of research highlights to judges (10 minutes max).

d. Ability to answer questions from judges.

If 20 points were not awarded, please explain:_____________________________

**Additional Comments** (use back, if necessary):
**Department of Horticulture & Crop Science**  
**2014 Graduate Research Retreat – Evaluation Form**

1. Please select one of the following categories to describe your participation in the research retreat.

<table>
<thead>
<tr>
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<th>Guest</th>
<th>Faculty</th>
<th>Grad Student/PostDoc/Visiting Scholar</th>
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2. How did you learn about the retreat?

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3. Was this retreat held at a desirable time?

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<th>Yes</th>
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4. Was there sufficient opportunity to interact with faculty/graduate students?

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5. If you attended last year’s research retreat, do you believe this year to be an improvement over last year? *Why or why not?*

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6. Should we continue to alternate between Columbus and Wooster campuses in future retreats?

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7. Do you feel any changes should be made in the format of the competition? *If so, what?*

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For the next group of questions, please answer on a 1 to 5 scale, with 5 being most positive.

7. Was the experience in Wooster enjoyable and productive?  
8. Did the poster and oral presentations provide a good overview of research conducted in our department?  
9. Did the on-campus Friday evening after-dinner activity enhance the retreat?  
10. How satisfied are you with the outcome of this retreat?  
11. If you stayed overnight, were you satisfied with the accommodations?

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12. Any additional comments or suggestions for the committee?

13. (Optional) Name_____________________________E-mail/phone_____________________

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Contact Page: GRR Organizing Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Field of Interest</th>
<th>Advisor</th>
<th>E-mail</th>
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<tbody>
<tr>
<td>Amber Hoffstetter</td>
<td><strong>Wheat Breeding</strong></td>
<td>C. Sneller</td>
<td><a href="mailto:Hoffstetter.2@osu.edu">Hoffstetter.2@osu.edu</a></td>
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<tr>
<td>Srimathi Bogamuwa</td>
<td><strong>Molecular Biology</strong></td>
<td>J.C. Jang</td>
<td><a href="mailto:Bogamuwa.1@osu.edu">Bogamuwa.1@osu.edu</a></td>
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<tr>
<td>Lisa Robbins</td>
<td><strong>Wine Flavor Chemistry</strong></td>
<td>J. Scheerens</td>
<td><a href="mailto:Robbins.210@osu.edu">Robbins.210@osu.edu</a></td>
</tr>
<tr>
<td>Grace Bluck</td>
<td><strong>Agronomy</strong></td>
<td>L. Lindsey</td>
<td><a href="mailto:Bluck.9@osu.edu">Bluck.9@osu.edu</a></td>
</tr>
<tr>
<td>Shaun Broderick</td>
<td><strong>Molecular Biology</strong></td>
<td>M. Jones</td>
<td><a href="mailto:Broderick.38@osu.edu">Broderick.38@osu.edu</a></td>
</tr>
<tr>
<td>Abigail Gerdes</td>
<td><strong>Viticulture</strong></td>
<td>J. Dami</td>
<td><a href="mailto:Gerdes.16@osu.edu">Gerdes.16@osu.edu</a></td>
</tr>
<tr>
<td>Mao Huang</td>
<td><strong>Field Crop Breeding</strong></td>
<td>C. Sneller</td>
<td><a href="mailto:Huang.823@osu.edu">Huang.823@osu.edu</a></td>
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<tr>
<td>Debora Liabeuf</td>
<td><strong>Vegetable Breeding</strong></td>
<td>D. Francis</td>
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