



THE OHIO STATE UNIVERSITY  
COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

## 2014 Achievements Edition

The Ohio State University South  
Centers include:

- Piketon Research and Extension Center
- Aquaculture Research and Development
- Business Development Network
- Endeavor Center for Business Incubation
- Horticulture Research and Education
- Soil, Water, and Bioenergy Resources

Hands on Horticulture Pages 1-2

Endeavor Center Update Page 3

SBDC Page 4

OCDC Pages 5-6

Ohio Aquaculture Program  
Highlights Pages 7-8

Aquaculture Research  
Achievements and Impacts 2014  
Pages 9-10

Recapping Best of ABC Program  
Pages 11-12

Horticulture Update Pages 13-19

Fruit Research & Extension Update  
Pages 20-21

Soil, Water, and Bioenergy  
Achievements Pages 22-26

# Hands-on Horticulture

## Extension Education Nurtures Senegalese Farming Future

**By: Brad Bergefurd, MS, Horticulture Specialist and Extension Educator**

Developing West Africa's food-production capabilities in an environmentally sustainable manner is important to ensure the continent's future food security, economic development and political stability. With sixty percent of people in Africa depending on agriculture, the people of Northern Senegal are poised to begin growing more of their own food, reducing reliance on imports, and creating a more sustainable future



based on self-reliance. An irrigation project by the World Bank created 1,400 hectares of newly irrigated land to be farmed by 243 farmers on small two-to-five-hectare plots. However, the availability of irrigated land solves only part of the problem. New farmers need a lot of technical and practical assistance to make sustainable agriculture a reality in Northern Senegal. Brad Bergefurd received funding from a \$1.1 million grant from the U.S. Agency for International Development (USAID) and Higher Education for Development (HED) and is providing training to Senegalese farmers.  
*(continued on page 2)*



Bergefurdt teaches village farmers how to adopt mechanical transplanting on their sub-Saharan vegetable farms Photos by Joe Kovach, OSU Entomology.

### **Hands-on Horticulture** *(continued)*

Purpose: The objective of the project is to implement state-of-the-art agricultural education and extension programs at the Université Gaston Berger (UGB), focused on enhancing sustainable agriculture in the fragile Sahelian agroecosystems of Africa. A main objective of this project is to establish the land grant model at UGB, incorporating extension and research into the traditional teaching role of the university. This project is an innovative way to export the land grant model to Sub-Saharan Africa and to support sustainable agriculture. Impact: The partners, the Ohio State University (OSU) and Université Gaston Berger (UGB), are creating pilot extension and outreach program with the Senegalese farmers working the newly irrigated land, troubleshooting problems, and conducting farm research on site. An immediate problem the farmers

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*Sixty percent  
of people in  
Africa depend on  
agriculture.*

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face is the amount of time it takes to plant up to five hectares. These plots of land are much larger than typical Senegalese farms. A farmer is able to transplant 15 plants per minute and about 9,880 tomato plants are needed for one hectare. Bergefurd immediately understood the challenges farmers were facing and recommended they adopt mechanical transplanting technology. The inexpensive device can plant 50 plants per minute, dramatically reducing the amount of time needed to fill a field. With a solution available, education was the next step. The partners purchased a transplanter and shipped it to Senegal. Field demonstration and trainings were held in 2014 at the UGB student farm as well as on village farms. Recognizing the tremendous impact this technology can have on the future of Senegal, representatives from the media, farmers associations and UGB, as well as politicians, 113 local farmers and 144 students were in attendance. Local farming organizations are planning to purchase additional transplanters, and working to establish a local transplanter dealer in the Saint-Louis region.





# Endeavor Center Achievements

**By: Ryan Mapes, Endeavor Center Manager**

The OSU Endeavor Center manager and staff of the affiliated programs at the Ohio State University South Centers continually engage community organizations to maintain awareness of changing needs in the regional entrepreneurial ecosystem and develop solutions to combat negative impact to the economy while promoting the regions resources and talents of the region. 2014 was once again a successful year for the Ohio State University Endeavor Center, its programs and its partners. Open since 2005, the 27,000 square foot business incubator has come to be recognized as a community leader in economic development, business training, and technological excellence.

Endeavor Center business programs and partners had another successful year. The technical assistance programs affiliated with or housed within The Endeavor Center include a Small Business Development Center, an International Development Center, the Ohio Cooperative Development Center and the Manufacturing Extension Partnership. All of these programs provide technical expertise and guidance to the small businesses housed in the incubator. In partnership with the Endeavor Center, the region's Small Business Development Center was chosen as the top performing SBDC within six states by the United States Small Business Administration (SBA). Partners proceeded to work on several projects at the Portsmouth Gaseous Diffusion facility. The Endeavor Center facility housed eighteen individual businesses which filled twenty-

seven office spaces throughout the year and operating at more than 100% of its original occupancy capability. In the last five years of operation, the Ohio State University Endeavor Center and its business partners have:

- Created more than 1,300 high-skill, high-wage jobs, adding more than 115 million dollars of direct economic activity to the local community.
- In cooperation with the Small Business Development Center of Ohio, sponsored or conducted 320 business workshops, training sessions and seminars with nearly 5,300 attendees – business owners, prospective entrepreneurs and ambitious employees seeking to improve the profitability of their businesses so they can grow and provide additional employment opportunities for those in the community.

In August, a partnership was formed with Community Action of Pike County to combat potential federal budget induced layoffs at the Portsmouth Gaseous Diffusion facility. Community Action Committee of Pike County received funding to create a temporary transition center to provide technical assistance for employees facing layoffs. In short time, the transition center was up and running in the Endeavor Center.

Also in 2014, the OSU Endeavor Center was chosen as The Ohio State University's nominee for the national C. Peter McGrath Community Outreach and Engagement Award. In October, the OSU South Centers director, Tom Worley, and Endeavor Center manager, Ryan Mapes, attended the national outreach and engagement award presentation in Edmonton, Alberta to learn more about the award process. The Endeavor Center staff is currently working with staff on main campus to prepare the presentation for the 2015 national award process.

# SBDC PROGRESS

**By: Brad Bapst, SBDC Director and Counselor**

The District 7 Small Business Development Center (SBDC) at The Ohio State University South Centers is an eight-person team including a Regional Director, six Certified Business Advisors® and an administrative program assistant. The District 7 SBDC Center also utilizes a unified delivery model to incorporate resources from other programming affiliated with the Ohio State University South Centers, including an International Trade Assistance Center, Manufacturing and Technology Small Business Development Center, Ohio Cooperative Development Center, Manufacturing Extension Partnership, and OSU Extension programs.

Regional partnerships are the primary source of referrals for the District 7 SBDC. The South Centers maintains formal agreements with three local universities for regional economic development collaboration. The SBDC also utilized formal Memorandums of Understanding with the Southern Ohio Procurement Outreach Center, the district's PTAC, and Pike County Community Action. These relationships help the region's entrepreneurs, business owners and small manufacturers with technical assistance and training.

The OSU South Centers SBDC Center also participated in multiple entrepreneurial focused events throughout the year such as: Aquaculture Boot Camp, Business Blog Talk, From Dream to Reality, and the Southern Ohio Agricultural and Community Development Foundation tobacco diversification initiative.

Aquaculture Boot Camp was a year-long training program serving the entire state of Ohio to develop new farmers and ranchers in the aquaculture industry. The program couples business planning and scientific technical assistance for the potential new aquaculture producers. The SBDC provided all-encompassing counseling to the business aspects of aquaculture operations.

Business Blog Talk is a weekly podcast that incorporates business resources and highlights entrepreneurial successes in our region. Over 10,695 listeners have tuned in from around the globe. This is a unique and innovative approach to communicate with our clients and partners about the services available and to share success stories that help market the businesses of OSU South Centers clients.

From Dream to Reality is a five-week course that meets twice a week and is designed to provide an opportunity to learn a variety of skills needed to own and operate a business. This course is offered two times per year through a partnership with the Pike County Community Action Agency.

The SOACDF tobacco diversification initiative is an annual program for agribusiness and next generation farmers to diversify from tobacco production into another profitable agricultural venture.

The OSU South Centers SBDC acted as a champion for the businesses in District 7, advocating on behalf of clients to help them attain their business goals. The counselors often assisted with open house planning, flyer development and new product launches for our clients. Assistance with press releases and advocating with local chambers and economic development organizations on the client's behalf continues to be a common practice.

The staff of the OSU South Centers SBDC continues to engage community organizations to maintain awareness of changing entrepreneurial needs in the region and develop solutions to combat any negative impact to the economy. Counselors volunteered time to serve as board members on several chambers of commerce, a regional board established to support economic development, and advisory boards for business organizations to increase awareness of business issues and identify solutions to problems.

## SBDC Achievements

The SBDC won the top performing center in the Columbus SBA District and was nominated for the multi-state 2014 SBA Small Business Development Center Service Excellence and Innovation award by the State Lead Center located within the Ohio Development Services Agency. The center was notified that it won this six-state regional award in April and was recognized by the SBA at the 2014 Small Business Awards Dinner in Grove City, Ohio.

In 2014 the OSU South Centers SBDC provided 4,509 one-on-one consulting hours to 378 clients. As a result, the clients started 25 new businesses, obtained \$22,094,068 in loans and other capital, helped create 179 jobs and increased sales by nearly \$20,387,492. The SBDC also provided 18 training sessions with 237 attendees. Training topics included general business management and growth principles, Microsoft Office products and social media outlets.



The 2014 Ohio Hops Conference.

## The Ohio Cooperative Development Center Recap

*By: Christie Welch, OCDC Program Manager and Brad Bergefurd, Horticulture Specialist and Extension Educator*

2014 was a year of growing cooperatives in Ohio and West Virginia. The Ohio Cooperative Development Center (OCDC) at the OSU South Centers

worked with new and emerging cooperatives related to local foods, farmers' markets, the wood industry, and others to help improve the economic status of cooperative members. The clients that received technical assistance and training from OCDC in 2014 reported that they created 26 jobs, retained 34 jobs, invested \$1.7 million in capital, and increased sales by \$98,000. These new and emerging cooperatives are having positive economic impacts on their local communities. Following are some highlights from a few of these cooperatives.

### The Ohio Hop Growers Guild officially incorporated in 2014



*Ohio Hop Growers Guild*

With the assistance of Brad Bergefurd, Horticultural Specialist at the OSU South Centers, Christie Welch and Tom Snyder of OCDC provided expertise and guidance to Ohio hop growers to determine the feasibility and lead the formation of the Ohio Hop Growers Guild (OHGG). OCDC provided technical assistance and information about the cooperative model for a group of hops producers looking to cooperatives to help grow the hops industry in Ohio. The group is working to plan for and meet the needs of the rapidly expanding Ohio craft brewing industry. The mission of the Ohio Hop Growers Guild is to unify, grow, educate, and protect the Ohio hops growing community; to increase sales of Ohio-grown hops through cooperative promotions, marketing, and

increasing industry awareness; and to monitor and assure a sustainable hops industry within the state of Ohio. The Guild is committed to the following objectives:

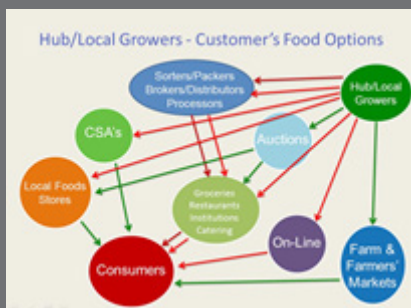
- 1) Advocating for Ohio-grown hops under an OHGG Seal of Quality, cooperatively marketing and promoting the OHGG brand to increase awareness of and demand for Ohio-grown hops.
- 2) Improving product quality, grower efficiency and profits through education and collaboration.
- 3) Leveraging combined purchasing power through voluntary joint-purchasing programs and access to resources.
- 4) Representing the independent producers, which include both general members and the board of directors. The interim Board of Directors includes Dave and Nina Volkman of Ohio Valley Hops, Maineville, Ohio; TJ Merrill of Paradune Brewing Farm, Belle Center, Ohio; Joseph Pellegrino of Mankato Farms, New Carlisle, Ohio; and Brad Bergefurd, OSU South Centers Horticultural Specialist, an ex-officio director representing academia. The Guild will be presenting at the 2015 Ohio Hops Conference on future Guild opportunities. *(Continued on page 6)*



***The Food Hub Network is:***

- Supporting regional food hub planning and executive boards/leaders
- Providing and/or connecting individuals to the needed technical assistance
- Developing and sharing grower training resources and business model templates
- Providing regional, state, and national networking opportunities

This food hub network group was formed in 2014. Participants include representatives of sixteen new and emerging food hubs and incubator farms, technical assistance providers, funding agencies, business development service centers, and educational institutions. The network's goal is to develop successful food hub models that produce, process, and market significantly more locally grown and/or locally processed food while creating new businesses and jobs for local communities.

**The Ohio Cooperative Development Center Recap** *(continued)***The Ohio and West Virginia Food Hub Network**

Many local communities want to significantly increase the production, processing, and marketing of locally-grown fresh food for their residents. However, to meet this growing demand, the production of locally-produced foods must increase. The question then becomes: How should we support the growing or expansion of growers and facilitate the local food-related value chain business expansions or start-ups in order to have major impact? To help address this need, Tom Snyder of OCDC worked with partners to form a food hub networking group. This group supports the development of growers and value chain businesses to meet the increasing demand for locally-produced foods.

***Sharing Best Practices with Policy Makers***

In addition to assisting new and emerging cooperatives in Ohio and West Virginia, OCDC has been working with WVU College of Law to help research cooperative statutes throughout the United States. The results of this research will be shared with policy makers in West Virginia to consider when looking to update the state's statutes on cooperatives. While the WV state legislature made some updates to the regulations in 2014, the types of groups that can choose the cooperative model are limited to agricultural based enterprises. Expanding the cooperative model to other industries would encourage the formation of additional cooperatives in West Virginia.

## OSU South Centers has made some changes and welcomes:

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# Ohio Aquaculture Extension Program Highlights

**By: Laura Tiu, PhD, Director Ohio Aquaculture Extension Program**

2014 was a banner year for the Aquaculture Extension Program (AEP) as it was the second year of our Aquaculture Boot Camp Project (see accompanying article). The team spent much of the year serving the needs of our Intensive, Intermediate and Introductory aquaculture clients with personal consultation, conferences, workshops, tours, and email and phone support.

In addition to Aquaculture Boot Camp, the Extension Team coordinated three well-attended workshops in 2014. The first, a workshop in Toledo, Ohio, was a collaborative effort with the North Central Regional Aquaculture Center and the Ohio Aquaculture Association. Many of the presentations from that workshop are available here. In April, we partnered with Kentucky State University and the Kentucky Department of Agriculture to conduct an Aquaponics Workshop with a trip to Food Chain in Lexington, KY. In October, the team organized a Recirculation Aquaculture Workshop at the OSU Newark Campus which included a tour of a local RAS system in Frazeeburg, Ohio. The year finished off with an October Bus Tour of Farms to four farms in Ohio and an ethnic market that sells live fish in Columbus, OH.

Aquaculture Specialists presented information at multiple workshops throughout the year including Aquaculture

America in Seattle, Washington; Washington, D.C.; and the Farm Science Review. Specialists also traveled to China with the Ohio Soybean Council and the Soy Aquaculture Association, and to Germany with the Ohio Bioproducts Innovation Center to explore their aquaculture industries and explore opportunities for collaboration.

*(continued on page 8)*



Aquaculture Boot Camp Class of 2014.





Aquaculture Boot Camp visits Food Chain in Lexington, Kentucky.



Tilapia farm in Indiana.



4-H training in Washington, D.C.



The 2014 Soy-Aqua Bus Tour visited Fresh Harvest Farms in Richwood, Ohio.

## Ohio Aquaculture Extension Program Highlights *(continued)*

Multiple groups, both local and international (Pakistan, Israel, and Albania), enjoyed tours of the Aquaculture Research Center. Over forty individuals participated in our First Friday Aquaculture Tour program where on the first Friday of each month, participants register to tour the Aquaculture Center and learn first-hand about our research and Extension programs. Two local schools participated in tours and several K-12 teachers attended STEM training on using aquaculture and aquaponics in the classroom.

Aquaponics continues to be a hot topic this year and an aquaponics list serve was created to enhance the flow of information. Additionally, aquaculture and horticulture specialists at the South Centers teamed up to build the Center's first aquaponics system. So far, we have successfully produced Russian kale, red lettuce and mizuna in the system using both tilapia and yellow perch. Additional research will be conducted in 2015 to further refine the project. Webinars are becoming a growing method of sharing information. We conducted two webinars in 2014 on aquaponics marketing and species selection for aquaponics.

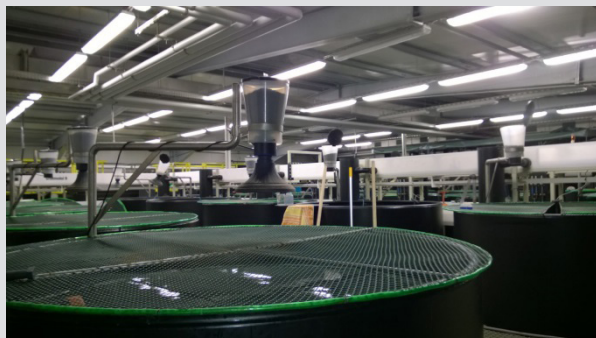
Finally, a series of aquaculture videos was produced and is available on our website, [southcenters.osu.edu](http://southcenters.osu.edu). For additional information on any of our programs, feel free to visit our website or contact us directly.



Tilapia feeding at Ripple Rock Farms in Frazesburg, Ohio.



Laura Tiu at an aquaculture research farm in China.



Aquaculture research center in Bonn, Germany.



# Aquaculture Research Achievements and Impacts 2014

*By: Hanping Wang, PhD, Senior Research Scientist*

**Summary of Achievements:** In 2014, in collaborations with the Ohio Agricultural Research and Development Center Molecular and Cellular Imaging Center (MCIC), University of Wisconsin-Stevens Point, Lincoln University of Missouri, the Ohio Soybean Council, Battelle, and several international institutions, we accomplished ten research studies and projects including the 3-year on-farm on-station tests of improved yellow perch vs. local unimproved fish; published four journal articles and eight proceedings abstracts; received two grants; trained eight graduate students, post-doctoral fellows and scholars; completed/submitted seven new grant proposals; and made 8 presentations at international conferences.

**O'GIFT (Ohio Genetic Improvement of Farmed-fish Traits) Program:** The O'GIFT program is expected to increase aquaculture production of perch, bluegill and largemouth bass by 35-50% through the development of genetically improved broodstocks for producers.

On-farm and on-station tests of improved yellow perch in ponds: The 3-year project of the on-station and on-farm tests of genetically improved yellow perch was completed on three sites in two states using both separate rearing and communal rearing methods. This is an important step for commercialization of genetically improved strains. The testing results showed improved fish exhibited 27.6% - 42.1% higher production, and 25.5% - 37.5% higher growth rates, while having 12.3% - 27.8% higher survival than local strains, on the average, across the three sites.

Performance test of OSU improved perch vs. Bell perch in Recirculating Aquaculture System (RAS): Two strains, 500 fish of each, were provided by Bell Aquaculture. OSU provided 500 fish from its genetically improved line. Each strain was tagged with visible implant elastomer color tags, and stocked to each of the two 6'x6' round recirculating

tanks and a 10' x 5' round tank with flow-through water, and communally raised in the same density/environment for an accurate comparison. After the 6-month test, OSU genetically improved lines outweighed Bell perch strains by 43.6% on average. This result shows OSU improved perch not only significantly grow faster in pond conditions, but also in recirculating tank systems. The 43.6% improvement can potentially save perch farmers as much as 43.6% of the grow-out time in both pond and recirculating tank systems. (Continued on page 10)



One of the pond testing sites.



OSU genetically improved perch. Photo by Kenneth Chamberlain.

## Aquaculture Research Achievements and Impacts 2014 *(continued)*



OSU improved line vs Bell Aquaculture Perquiman strain.  
Photo by Beth Rigsby, OSU South Centers.



OSU improved line vs Bell Aquaculture Chopbank strain.  
Photo by Beth Rigsby, OSU South Centers.

**Genomic sequence and tool development:** In collaboration with OARDC MCIC, we completed restriction-site associated (RAD)/DNA sequencing of five strains of yellow perch to develop single-nucleotide polymorphisms (SNPs) and identify genomic diversity of those strains for further improved perch growth. We also completed RNA sequencing of males and females in yellow perch to identify genes associated with sex dimorphism and sex determination, and developed a all-female yellow perch population using improved fish. The all-female population should be able to grow 50% faster than unimproved regular mixed populations. In addition, we completed RAD/DNA sequencing of white and black crappie to develop SNPs and identify genomic diversity of those species for a future crappie breeding program.

**Improvement of egg hatching rate for industry:** In 2014, we completed a project on determining efficacy of formalin, iodine, and sodium chloride in improvement of egg hatching rate and fry survival prior to the onset of exogenous feeding in yellow perch. The study revealed that formalin was a more effective disinfectant to improve the hatching rate and survival to first feeding fry of yellow perch than iodine and sodium chloride. To improve the hatching rate, a concentration of 150 to 250 mg L<sup>-1</sup> for 30 min is recommended to disinfect the eggs of yellow perch daily from the beginning to the eyed stage. The results have been published in *Aquaculture Research* and will be used by fish farmers to improve the egg hatching rate and fry production of yellow perch.

**Yellow Perch Breeding:** Multiple improved lines of yellow perch have been developed, and over one-million genetically improved fish have been distributed to fish farms. Three male populations with a female genotype have been created, which could produce fast-growing all-female populations for the aquaculture industry. Three projects related to sex-control and breeding were completed and three manuscripts on these projects are in preparation or in revision.

**Bluegill Breeding:** Three experiments related to sex-control and genotypes by environment interaction on sex ratio were completed. The findings on effects of temperature and genotype on sex determination and sexual size dimorphism of bluegill sunfish have been published in *Aquaculture*, a prestigious international journal. The results from these experiments provide a valuable base for developing all-male broodstock for bluegill, which could grow 35-50% faster than mixed populations.

**Soy-Aqua Research Initiative:** In collaboration with the Ohio Soybean Council and Battelle, two projects have been completed in 2014. The first study, comprised of five major experimental phases, was conducted to develop indirect criteria to improve residual feed intake (RFI) of soybean diets (SBD) in yellow perch for selective breeding. With the high cost of feed for animal production, genetic selection for animals that metabolize feed more efficiently could result in substantial cost savings for fish producers. The current study showed that the weight loss during the feed deprivation period and the weight gain during a subsequent period of re-feeding are linked to variations in RFI in yellow perch. Such traits could be used as indirect criteria for improving RFI in fish through selective breeding.

*(Continued on page 11)*





Soy-Aqua Research Team. Photo by Kenneth Chamberlain

## Aquaculture Research Achievements and Impacts 2014 (*continued*)

In the second study, a modified soybean meal (MSBM) containing high protein and lower levels of anti-nutritional factors (ANFs) relative to regular soybean meal was evaluated as an alternative for fishmeal in the diet of yellow perch with significant success. Higher growth performance and feed utilization was observed for 50% replacement of fish meal (FM) by MSBM fed groups compared to 100% replacement of FM by soybean meal and MSBM fed groups. Modified soybean meal with high protein and low ANFs has considerable potential as an alternative to fishmeal in aquafeed.

**Aquaculture Genetics and Breeding Laboratory:** This is the first lab of its type in the Midwest and is crucial to the success of the O'GIFT program and the improvement of farmed-fish traits. In this lab, genetic relatedness charts and genetic pedigrees of selected broodfish have been constructed for breeding programs for the past years. Family identification technology using DNA for selective breeding in yellow perch and bluegill has been established. Genotyping 900 fish from the breeding center for constructing genetic relatedness charts for the breeding program was finished in 2014. The data generated from the lab in 2014 has contributed to fourteen papers in prestigious international journals and proceedings, including twelve published in 2014.

**International training program:** Leading research in aquaculture genetics and breeding at OSU South Centers has attracted more than twenty scientists and international scholars to work in the aquaculture research center and genetics lab at Piketon. In 2014, the lab trained eight visiting Ph.D. students, post-doctorial researchers and international scholars from four countries. These individuals significantly contributed to the aquaculture program's success at the OSU South Centers.



## Recapping the best of the Aquaculture Boot Camp program in 2014

**By: Estefania James, MS, Program Assistant**

After twelve months of hard work and commitment, nineteen Aquaculture Boot Camp (ABC) recruits graduated on December 13, 2014. The Ohio State University South Centers served as the main venue for the training sessions.

The aquaculture boot camp program offered an integrated training with “3-I” levels: Intensive, an in-depth level involving immersion in a year-long hands-on training and mentoring program; Intermediate, a mid-level involving participation in a variety of learning activities; and Introductory, a general level where sharing of information is the goal.

These participants punctually attended ABC sessions the second Saturday of each month to learn the fundamental concepts of aquaculture and business planning to successfully run an aquaculture business.

One of the unique features of this program was learning by doing with the technical guidance of the OSU aquaculture instructors and the Ohio Aquaculture Association mentors. There were many topics covered in the ABC program:

species selection, systems selections, species biology, site selection, water quality, fish and fresh water prawn stocking and harvesting, processing, recirculating aquaculture systems, and fish health, among others.

Each training session was followed by an evaluation in order to identify their pre- and post-perceptions of learning. These evaluations helped the instructors to improve and adjust the content for the future classes. *(continued on page 13)*



Aquaculture Boot Camp participants.



## Recapping the best of the Aquaculture Boot Camp Program in 2014 *(continued)*

In addition to the monthly session evaluations, mid and final evaluations were conducted to assess the overall performance of the program. The results and the findings of the data collected from the classes of 2013 and 2014 will be published in mid-2015.

Piketon, the ABC headquarters, was not the only training location. These students had the opportunity to visit and meet experienced fish farmers. There were three off-campus training sessions. The first was at Kentucky State University in the Division of Aquaculture. Charlie Shultz was a special instructor for the Aquaponics workshop in April 2014.



In August, the ABC intensive class met Dr. Dave Smith at his aquaculture operation, Freshwater Farms of Ohio, in Urbana to learn about marketing and processing with the collaboration of Angela Caporelli from the Kentucky Department of Agriculture.

And finally, in October, boot campers met Steve Van Gorder from Fresh-Culture Systems, Inc. who taught the Recirculating Aquaculture Systems workshop in Newark, Ohio.

One of the greatest lessons learned in boot camp was that both instructors and students learned from each other and sharing was the key element to succeed in the development of their business plans.

Even though we are not offering the ABC intensive class in 2015, there will be three workshops available: The OAA annual meeting in January, an Aquaponics workshop, and a Marketing and Processing workshop. We would like to encourage new and beginning fish farmers who want to learn about the program to visit our website at <http://go.osu.edu/abc> and sign up in the ABC intermediate program to be informed of new training opportunities and industry updates.

The ABC program was a marvelous success thanks to the teamwork of the Aquaculture, Business Development and OSU South Centers teams, along with the Ohio Aquaculture Association. We also look forward to reapplying for new funds through the USDA to continue working to increase the numbers of new and beginning fish farmers in the State of Ohio.

We appreciate everyone's effort and dedication. Because of your help, Aquaculture Boot Camp has been an extremely successful program.



Aquaculture Boot Camp class of 2014. Photo by Sarah Strausbaugh, OSU South Centers.

# 2014 Horticulture Research and Extension Achievements

**By: Brad Bergefurd, MS, Horticulture Specialist and Extension Educator**

## Urban food hub organized and formed in 2014

A food hub to strengthen the local food system and increase access to healthy food in the Cincinnati area was formed in 2014 with support from the OSU South Centers Horticulture program, the OSU Direct Marketing Team and the Ohio Cooperative Development Center. The goals of the food hub are to increase organic vegetable production, sustain the food hub effort by developing and organizing training for farmers, and by creating family sustaining jobs in Greater Cincinnati. This effort began with the development of an incubator urban farm in April 2012, with an additional 100 acre farm leased and cultivated in 2014. In 2014, the incubator farm employed 20 people and 400 families purchased shares for a weekly Community Supported Agriculture Harvest box program. Our Harvest Cooperative aggregates produce, and supplies various retail and wholesale outlets. Our Harvest Cooperative is partnering with Cincinnati State's newly launched Sustainable Agriculture Management Program which was spun off from the Specialty Crop Apprenticeship Training program started by OSU South Centers in 2013 where students come to the urban farm weekly for their practicum.

## \$100,000 Specialty Crop Block Grant received to explore new hop processing, plant propagation and production techniques

Thanks to a grant from the Ohio Department of Agriculture, the State of Ohio, and the United States Department of Agriculture, Ohio hop research and Extension education have increased. Brad Bergefurd as the projects Principle Investigator, and co-Investigators Mary Gardiner of the Department of Entomology and Sally Miller of the Department of Plant Pathology are leading this hops project to further support the growth of the expanding Ohio hops industry and craft brewing industry. Ohio's brewing industry is booming! Legislation in 2013 allows Ohio's craft brewers to invest more money into their breweries, increasing the demand for Ohio-grown hops. Over 140 licensed Ohio



beer manufacturers and thousands of home brewers send an estimated \$30 million in hops purchases and related jobs out of Ohio by purchasing the flowers of the hop plant, called hop cones or "hops" from out-of-state. Hops are a main ingredient in beer manufacturing, providing a bitterness that balances the sweetness of the malt sugars and a refreshing finish. Based on the increased interest from brewers in buying Ohio grown hops, Ohio farmers are investing in hops production. This project is providing the research based production guidelines for insect and disease management, irrigation and fertilization needed to produce Ohio hops in an ecological and economically sustainable manner. Further, Ohio growers are left without economical methods for post-harvest processing of hops that suit brewers' needs and meets food safety guidelines. These are the critical priorities being addressed to move the hops industry forward. This project is expanding Ohio's specialty crops research in hop production and is providing education and research focused on addressing Ohio hop production and processing issues that are impacting profitability of Ohio hop farmers, including plant nursery production, pest management, processing technology and grower education. *(continued on page 15)*

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Participation was high during the 2014 Wooster and Piketon field days. Photos by Chelsea Smith, OSU.

## 2014 Horticulture Achievements *(continued)*

### Horticulture program receives grant to conduct a three-year high tunnel training program

From field research the OSU South Centers began in 1996 and continues today, Ohio has faced an explosion of high tunnel production by mostly new producers due to conservation program incentives and an uptick in local foods and urban agriculture. High tunnels are a way to extend the season for fruit and vegetable crops. There is continued need for education at the beginner and advanced levels of pest management and production. Grafting techniques that add horticultural diversity and combat soil borne diseases, plus the introduction of a new fact sheet series on tomatoes has been incorporated into a three-year high tunnel training initiative, part of an \$886,643 USDA National Institute of Food and Agriculture (NIFA) grant. Brad Bergefurd is a co-principle investigator on this project.

Ohio has a huge demand for integrated pest management (IPM) training regarding high tunnels, with a mix of hundreds of existing seasoned operators needing advanced training, and a recent influx of almost 300 new growers requiring basic training due to the popularity of the Natural Resources Conservation Service EQIP High Tunnel initiative. The university-based and on-farm based training program that began at Piketon in April 2014 is for new and advanced growers, Extension Educators and Specialists who want to learn about high tunnel IPM and production management. This training program is comprised of a combination of on-site educational modules and experiential "in-tunnel" learning showing practical application.

### Over 350 attend first annual Ohio Hop Growers Conference

We organized and taught the 1st annual Ohio Hop Growers Conference in Wooster, OH at the OSU OARDC campus on February 13th, 2014. With over 350 attendees, this workshop was a huge success! Brad Bergefurd was the Conference Moderator for the day-long conference and began the day with an overview of the hops industry in Ohio and the opportunities for Ohio farmers to grow for the ever-expanding Ohio Craft Brewing Industry. Other educators for the day (and topics) included: Andy Pax (beginner's advice from an established grower), Chelsea Smith (pests and beneficial arthropods), USDA Farm service agency, Fulya Gurel (diseases and virus control and management in hops), Jason Channels (Ohio Department of Agriculture: food safety regulations and requirements for hops processing and sale), Dan Kamburoff (Irrigation design, setup, operation, fertigation and management for hops) and Eric Stockinger (Malting barley research and production opportunities in Ohio). A post-conference craft brewery tour was conducted at JAFB brewery in Wooster. The second annual Ohio Hop Conference will be held in partnership with the Ohio Craft Brewers Annual Conference on February 5 and 6, 2015 at the OARDC campus.



High yields and brewing quality characteristics have been achieved with Ohio Hops. Photo by Thom Harker, OSU South Centers.



The first of three high tunnel trainings was taught at OSU South Centers in Piketon, Ohio in April and May 2014. Photo by Charissa McGlothlin, OSU South Centers.

# OHIO MARKETMAKER RECEIVES \$4,000 NATIONAL AWARD FROM FARM CREDIT SERVICES

**By: Brad Bergefurd, MS, Horticulture Specialist and Extension Educator**



A post-conference tour was conducted at JAFB brewery in Wooster. Photo by Brad Bergefurd, OSU South Centers.

Ohio MarketMaker was named second runner-up at the 2014 Farm Credit MarketMaker Innovation Awards announced at the National Value Added Agriculture Conference held May 13-15, 2014 in Baltimore, Maryland. Brad Bergefurd, Charissa McGlothlin, and Julie Moose of The Ohio State University accepted the \$4,000 award on behalf of the Ohio MarketMaker program, "Expanding MarketMaker Visibility, Value, and Usage by Reaching Local Communities through Local Ohio State University Extension Educators." This honor applauds outstanding efforts to improve state-wide MarketMaker programs and expand MarketMaker's online database of food industry and market data through the National MarketMaker Partners Network. Gary Matteson, Vice President of Young, Beginning, Small Farmer Programs and Outreach, represented Farm Credit at the awards and acknowledged the ingenuity of each program. "We are pleased to support and recognize the worthy efforts of this year's Innovation Award winners," said Matteson. "It is gratifying to see their good ideas brought to life and spread among other members of the MarketMaker community. Their contributions are helping MarketMaker accomplish their goals to connect producers to markets and improve consumers' access to fresh, healthy, local foods." Ohio MarketMaker embarked on a campaign to actively engage and support the efforts of local Extension educators to produce customized marketing resources. Ohio's marketing campaign successfully linked area growers with countless new markets to pursue, while educating both the producers and consumers about the advantages of the tool.



Ohio Hop Grower Andy Pax of Heartland Hops describes his farming operation. Photo by Brad Bergefurd, OSU South Centers.



Photo (L to R): Julie Moose, Charissa McGlothlin, Gary Matteson of Farm Credit, and Brad Bergefurd.



# STRAWBERRY WINTER PROTECTION TECHNIQUE SAVES THOUSANDS IN CROP LOSSES FROM POLAR VORTEX

**By: Brad Bergefurd, MS, Horticulture Specialist and Extension Educator**

Thanks to a grant from the Ohio Vegetable and Small Fruit Research and Development Program, strawberry winter protection techniques researched for Ohio conditions proved to help keep strawberry growers from experiencing total crop losses during the 2014 polar vortex event with several episodes of -10°F temperature conditions. Without protection, strawberry blooms can be injured at temperatures of 10°F. Strawberry yields were reduced throughout Ohio from the sub-zero polar vortex events, however, farms that had adopted the row cover protection systems researched at Piketon ended up protecting a percentage of their crop from total loss. Farms also have adopted the row cover treatments to protect their sensitive strawberry blooms from frost and wind-borne advective freeze events in the spring of 2014. Growers that adopted these winter protection techniques reported up to 40% higher yields than unprotected strawberry crops.

## \$165,000 grant received for Urban Agriculture Development

Thanks to the city of Dayton Community Development Block Grant for \$165,000, Principle Investigator Brad Bergefurd along with Co-Investigators Tony Nye (Ag/NR Educator, Clinton County Extension) and Suzanne Mills-Wasniak (Ag/NR Educator, Montgomery County Extension) are leading this two-year urban agriculture development project which will greatly expand their previous urban agriculture initiatives across the city of Dayton. This project further explores new uses for over six thousand vacant lots within the Dayton city limits as a part of the "Vacant to Vibrant" Urban Agriculture Project. The City of Dayton and the Ohio State University Extension Montgomery County, Clinton County and the OSU South Centers program areas, Agriculture and Natural Resources and the Expanded Food and



Nutrition Education Program, are major partners in this endeavor. The marketing plan is producing vegetables for the area's Middle-Eastern ethnic population on vacant lots, thus helping to eliminate a Dayton area "food desert."

The Vacant to Vibrant project expanded the number of vacant lots developed as food production units in 2014. Two major benefits

from the project are that vacant lots are given a new environmentally sustainable life and purpose and that the city, neighborhood, Extension, and culturally diverse groups collaborate to make a positive difference for the city of Dayton. Secondary benefits are: an underserved population is able to produce and have access to fresh local ethnic produce, refugee partners learned English and agricultural and marketing job skills, and limited resource participants learned to combine the use of ethnic and local food for healthy nutritional choices. *(continued on page 18)*



Row cover treatments on test at OSU South Centers. Photo by Thom Harker, OSU South Centers.



High quality fruit is harvested from properly protected strawberry crops. Photo by Brad Bergefurd, OSU South Centers.



Four acres of southern Ohio strawberries covered with floating row covers. Photo by Brad Bergefurd, OSU South Centers.



Urban agriculture sites are used for tours and training of new and refugee urban farmers. Photo by Suzanne Mills-Wasniak, OSU Extension.

## \$165,000 grant received for Urban Agriculture Development *(continued)*



Dayton Job Corps volunteers helped construct raised beds at the urban ag sites in 2014. Photos by Suzanne Mills-Wasniak, OSU Extension and Brad Bergefurd, OSU South Centers.

## Specialty Pumpkin Grant Received

**By: Brad Bergefurd, MS, Horticulture Specialist and Extension Educator**

Thanks to a grant from the Ohio Vegetable and Small Fruit Research and Development Program, the Ohio State University South Centers Horticulture program has been researching pumpkin crops for over 20 years. This pumpkin research and extension program has explored new production methods that have been implemented on Ohio farms to add to the profitability of Ohio pumpkin enterprises. Pumpkins, gourds and winter squash are a big cash crop for Ohio. Ohio ranks third in pumpkin production in the United States, harvesting over 10 million pumpkins off of 6,100 acres, and generating over 15 million dollars in 2013.

One area of on-going research is the evaluation of new pumpkin germplasm or varieties that are in the testing stages or that will be soon entering the market. OSU South Centers have tested new selections to see how they perform under Ohio growing conditions and if they have the traits necessary for the wholesale and retail fall crops market, which, according to the National Retailers Association, is the second most decorated season of the year--second only to the Christmas holiday season. To view the results of pumpkin research performed in Ohio, visit our web site at: [southcenters.osu.edu/horticulture/vegetables/pumpkins](http://southcenters.osu.edu/horticulture/vegetables/pumpkins).



Color data is collected from the pumpkins on test. Photo by Thom Harker, OSU South Centers.



Thom Harker and Wayne Lewis, collecting fruit yield and quality data from 2014 pumpkin trials. Photo by Ryan Slaughter, OSU South Centers.



# Aquaculture and Horticulture Programs Conduct First Ohio Aquaponics Research

**By: Laura Tiu, PhD, Director of Ohio Aquaculture Extension and Brad Bergefurd, Horticulture Specialist**

## Introduction

Aquaponics is a growing area of interest for Ohio citizens in both urban and rural areas driven by the demand for locally grown food. The OSU Aquaculture and Horticulture Programs have received multiple requests for information each week. Seventy-five percent of current Aquaculture Boot Camp participants, new and beginning farmers, expressed interest in aquaponics. Additionally, multiple internal requests for information have been received from the College of Agriculture Engineering, the OSU College of Medicine, Ohio Sea Grant, and the College of Food, Agricultural, and Environmental Sciences. Unfortunately, unbiased Ohio research-based data to share with the interested clients has been limited. To address this, an OSU Extension Innovation grant was received to develop and construct a research/demonstration-scale aquaponics system at the OSU South Centers. The system, in operation since October 2013, was used for training and available for touring to the over 300 visitors that visited the OSU South Centers in 2014.

## Methodology

In June 2013, a demonstration-scale system was constructed in a glass greenhouse at the OSU South Centers. The system consisted of a 500-gallon tank for rearing the fish, a biofilter for solids removal and nitrification, and three shallow water rafts, 3' x 5' x 6", for supporting floating raft culture (Figure 1). Rafts were made from 1 inch Styrofoam board. Holes were drilled in the Styrofoam to support small net pots for germination and growth of various plant species. Water flowed from the fish tank, through the biofilter and rafts, and was collected in a sump where a small pump returned the water to the fish tank.

One small air pump also provided oxygen to the fish tank. A small amount of water (approximately 10 gallons) was added daily to accommodate for evaporation, leaks and plant uptake.

Water parameters were measured throughout the trials. Dissolved oxygen, temperature and pH were measured daily, while ammonia, nitrate, hardness and alkalinity were measured weekly. The system was operational on July 13, 2013 and a three week break-in period was initiated. Twelve 4-5 inch tilapia and one bluegill were stocked into the system on July 13, 2013. Fish are fed to satiation daily, approximately 1 oz. of fish food (approximately 1% bw). Three fish jumped out of the tank before seeds were planted.

## Results

### Phase I – Fall 2013

Phase one was designed to compare the effect of three commonly used growing media (Figure 2), expanded clay pellets, expanded shale, and potting soil, on production of two leafy greens, mizuna and red leaf lettuce, in a six-week growing trial. Nine tilapia and one bluegill were stocked into a 500 gallon tank and fed to satiation on a daily basis.

Seeds were placed directly on the media in net pots on August 22, 2013. The majority of the seeds germinated on day two. By week three, plant growth had slowed (Figure 3). It was hypothesized that this may be due to not enough nitrates being generated by the small number of fish in the system, given the nitrate level remained at zero. Because of the lack of nutrients, the plants were small and discolored.

Water quality tests showed a system pH of around 8. While this is fine for fish, plants prefer a pH under 7 and had difficulty synthesizing what nutrients were there. Plants were harvested on October 3, 2013 after 6 weeks of growth.

Additionally, weaknesses in the system were identified. Water levels need to be constantly maintained so that gravity could move the water. There were several locations where this could break down. The system design needed to be upgraded to reduce the chance of overflow, back-up, etc. The Styrofoam rafts also needed modifying with smaller holes so that the net pots stop dropping through and the plants are at a more appropriate water level.

### Phase II – Winter 2013/2014

With a system redesign complete, the same experiment was repeated for phase two. On October 12, 2013, approximately twenty-five pounds of small yellow perch (2-3 inch) were stocked into the 500-gallon tank and fed to satiation. Net pots were seeded with red leaf lettuce and mizuna on November 1, 2013. Hydrochloric Acid (Muriatic acid) was added as needed to the water to control pH. Plants germinated and were (*continued on page 20*)

## Aquaculture and Horticulture Programs Research *(continued)*

growing slowly, when a fish kill occurred on November 22, 2013. It was determined that high ammonia levels were the cause of the fish kill. Plants continued to grow in the system and were harvested December 12, 2013.

### Phase III – Spring 2014

The experiment was repeated for a third time in the spring. The system was restocked with approximately forty pounds of yellow perch (3-6 inch) on March 25, 2014. On April 3, 2014 float trays with the three media were seeded with mizuna and red leaf lettuce. Plants were harvested May 1st. In this trial, the plants failed to germinate or grow well due to the salt and mineral build-up on the media.

### Production Results (combined from all phases)

Media	Species	Production (ounces/sq.ft.)
Styrofoam float tray	Mizuna	19.11
Styrofoam float tray	Red leaf lettuce	11.44
Expanded Shale	Mizuna	1.15
Expanded Shale	Red leaf lettuce	8.15
Hydrocorn	Mizuna	1.21
Hydrocorn	Red leaf lettuce	7.44

### Discussion

In this demonstration-scale system, the Styrofoam float trays filled with soilless potting mix performed the best in all the trials. The expanded shale and Hydrocorn both accumulated minerals and salts that inhibited the germination of seed and slowed growth. Red leaf lettuce performed most consistently in the system with mizuna performing well only in the Styrofoam float trays. The Styrofoam float trays with soilless potting mix are a good option for these small hobby-scale systems as they are inexpensive and readily available.

There were quite a few steep learning curves associated with this system, including system design, construction, operation and water quality balance. A lot was learned and shared with numerous clientele. The interest in aquaponics continues to grow and The Ohio State University should be prepared to offer research-based information to the public. Continued investment into the industry is warranted.

### Future Plans

Two new varieties of mini-head lettuce, Dagoon and

Rhazes, will be produced on a rotational basis with one float bed being harvested every two to three weeks. Data will continue to be collected from the system and educational tours will continue. For future trials, we will no longer utilize the rock media because of salt mineral buildup but continue to use the Styrofoam float trays with soilless potting mix. We are considering getting some backup power as a recent power outage resulted in a fish kill. Options for water treatment, such as a reverse osmosis system, are being explored.



The OSU South Centers Aquaponic demonstration system. Photo by Thom Harker, OSU South Centers.



Net pots with Hydrocorn (L) and Expanded Shale (R). Photo by Thom Harker, OSU South Centers.



Three aquaponic media demonstrated side-by-side. Photo by Thom Harker, OSU South Centers.



# 2014 Fruit Research and Extension Progress

**By: Gary Gao, PhD, Small Fruit Extension Specialist and Associate Professor**

Polar vortexes in 2014 wreaked havoc on fruit production in many parts of the United States. Ohio was no exception. Our fruit research and Extension programs at OSU South Centers have been set up to deal with many challenges that growers face every day. From trials of cold hardy Polish blackberry cultivars; to high tunnel production of blackberries, raspberries and blueberries; to blackberry production on rotatable cross trellis; to primocane bearing blackberries; and to super cold hardy wine grape cultivars, we are doing what we can to help fruit growers in Ohio. With ever-changing weather conditions in Ohio and beyond, the production of high value crops, such as blackberries, blueberries, raspberries, and even wine grapes, will need to be placed under protected structures so that a consistent crop can be produced and harvested every year. We also started exploring new "super berries" for Ohio growers.

## High Tunnel Production of Blackberry and Raspberries:

With the support of a specialty crop block grant from Ohio Department of Agriculture and excellent craftsmanship of our research support staff at OSU South Centers, we built two demonstration high tunnels. One was for blackberry production while other one was for raspberry production. Both tunnels are designed to take snow load and are classified as four-season tunnels.

There has been quite bit of work done on high tunnel raspberry production by Dr. Eric Hanson, professor and Extension specialist at Michigan State University. Season extension, yield increases, and fruit quality improvements have resulted from protection of high tunnels. Preliminary results from our own high tunnel demonstration work have been quite positive. We will continue this research for several years. There is also an excellent free publication from Cornell University. More information: <http://www.fruit.cornell.edu/berry/production/pdfs/hightunnelsrasp2012.pdf>



Blackberry production under high tunnel at OSU South Centers in Piketon. Photo by Ryan Slaughter, OSU South Centers.

Blackberry high tunnel production also deserves a serious look. Four-season high tunnels can provide much needed winter protection that blackberry floricanes need to produce a crop year after year. Our preliminary results are quite encouraging. Earlier fruit production, consistent production, and fuller berries are some of the main benefits of high tunnel blackberry production. We have seen successful commercial production of blackberries under high tunnel in Ohio. Growers are encouraged to try blackberry high tunnel production on a small scale since high tunnels, though less costly than greenhouses, can be quite expensive.

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A high tunnel for raspberry research at OSU South Centers in Piketon, Ohio. Photo by Ryan Slaughter, OSU South Centers.



## A “Super Berry” Grant:

We are very pleased to have received a specialty crop grant from Ohio Department of Agriculture to work on “super berries.” Some of the new super berries are Aronia berries, Chinese goji berries and elderberries. Blackberries, blueberries and raspberries are also classified as super berries. It is worth noting that there are approximately 1,000 acres of Aronia berries planted in Iowa. There is even a Midwest Aronia Growers Association. Aronia berry juice seems to be getting quite popular as a health drink. It is consumed in small quantities, more like a nutrient supplement vs. fruit juice.

Elderberries are getting very popular, especially in Missouri. About 100 acres of elderberries have been planted there. I tried elderberry jam for the first time when I attended the Great Lakes Expo in Grand Rapids, Michigan in December 2014. It was very tasty! Elderberries can also be used in baked goods. I was told that elderberries make excellent red wine. It is too early to tell what the marketing potential is for elderberry wines or elderberries yet. Do not go out and plant hundreds of acres of elderberries yet.

We will also test Chinese goji berries for their viability in Ohio as a cash crop. I have tasted dried Chinese goji berries and really like them. I drank goji berry tea and liked it as well. Goji berry tea is more Chinese than American though. Dried Chinese goji berries can be purchased from Chinese grocery stores. The Chinese Goji berries I tasted are really sweet. When I visited a new blueberry farm last year, one grower had me taste a few goji berries on her farm. I was surprised that it had more of a peppery taste. There might be a huge variation in taste and growth characteristics. Stay tuned for more information.

**Wine Grape Research and Extension:** With many thanks to the Ohio Grape Industries Committee (OGIC), we get to continue our wine grape research and Extension program at OSU South Centers. Dave Scurlock and Gary Gao also oversee the grape insect research and Extension for Ohio.

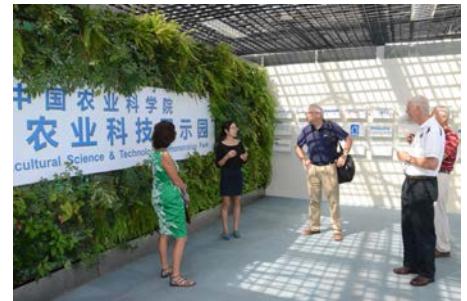
Out of a few wine grape cultivars we tested at OSU South Centers in Piketon, ‘Regent,’ a red wine grape cultivar, survived the polar vortexes the best. We planted this cultivar under two different training systems. ‘Regent,’ a European and American hybrid, has more European ancestry than American, and makes an excellent red wine. Some growers have planted this cultivar on a small scale. We hope to see more of this cultivar in Ohio!

## We Went Global!

Dr. Tom Worley and Dr. Gary Gao applied for and were awarded a USDA Scientific Cooperation Exchange Grant with the Chinese Ministry of Agriculture under the leadership of Dr. Mark Erbaugh. Other project members were Pam Bennett, Mike Hogan, and Dave Scurlock. We toured many urban farms in Beijing, Zhengzhou, Nanjing, and Shanghai in August 2014 in China. Tom and Gary also made presentations and provided technical advice to Extension professionals, university professors and farmers in China.



Dave Scurlock, demonstrates techniques of pruning and training young grapevines at OSU South Centers in Piketon March 2014. Photo by Gary Gao.



We toured the Chinese National Agricultural Science and Technology Demonstration Park in Beijing, China. Photo by Gary Gao.



In September, we also hosted a group of six Chinese Extension leaders through the USDA - Chinese Ministry of Agriculture Scientific Cooperation Exchange Program. Photo by Beth Rigsby.



The delegation also toured OARDC Western Branch in South Charleston. Photo by Gary Gao.



# 2014 Soil, Water, and Bioenergy Resources Program Achievements

**By: Rafiq Islam, PhD, Soil and Water Specialist**

The Ohio State University South Centers Soil, Water, and Bioenergy Resources program provides science-based applied knowledge, education and tools to regional, national and international clientele on sustainable management practices and agroecosystem services.

## RESEARCH AND TECHNOLOGY TRANSFER

### Development of tools and technology

#### Ecosystem services (SOM) calculator

Farmers, educators and energy industry personnel need a simple and easy-to-use tool in order to understand how agricultural management practices influence agroecosystem services. We have developed the “ecosystem services calculator” for clientele, based on the impacts of energy feedstock production and stover removal under different management practices. The calculator predicts soil organic matter build-up and C trading, greenhouse gas emissions (e.g. CO<sub>2</sub>), nitrogen fertilization, and overall soil health. The tool also helps to calculate the revenue from residue sales. This tool has been loaded on the Soil, Water and Bioenergy website (<http://www.southcenters.osu.edu/soil>) and was accessed worldwide, with more than 500 downloads. The tool is ready to convert into software for commercial use by farmers, educators, NRCS staff and other clientele. We are working with the OSU Licensing and Technology Department for technology transfer and commercialization of the calculator.

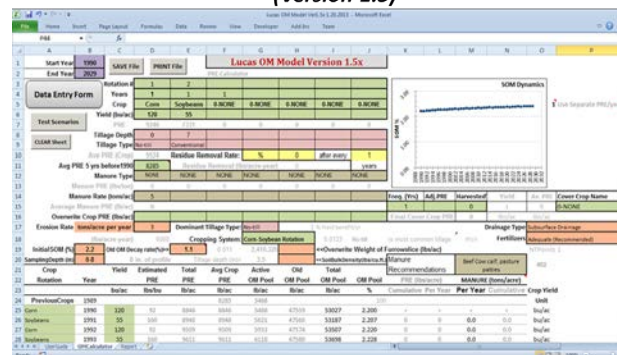
### Development of bio-polymers and bio-products

Management of phosphorus (P) and nitrogen (N) pollution from both farmland runoff and leaching has been a challenge to minimize water pollution and improve agroecosystem services. Lakes, streams and rivers in Ohio have become eutrophic with soluble reactive phosphorus (SRP) and subsequently, polluted with toxic and nuisance algal blooms (e.g., Grand Lake St Mary's). Similarly, Midwest agricultural

contribution of reactive N and P through the Mississippi river is responsible for algal blooms and anoxic conditions in the Gulf of Mexico.

We are actively researching with the funding support from Battelle and the Ohio Sea Grant on to develop efficient and dual-purpose adsorption materials for binding and retaining reactive P and N, based on quaternized biomass anion resin and cation exchange materials. Mixing of anionic biomass resin with cationic nanoporous zeolite will serve as the dual-purpose adsorption material and is expected to bind and retain both P and N (NH<sub>4</sub><sup>+</sup>) simultaneously to minimize reactive P and N formation and loss with enhanced agroecosystem services. *(continued on page 24)*

## OSU Lucas Ecosystem Services Calculator (Version 1.5)



Research on **soluble reactive phosphorus** adsorption

$+ H_2PO_4^-$   
 $++ HPO_4^{2-}$   
 $+++ PO_4^{3-}$

Soybean-based biopolymer

Research on **reactive N and P** adsorption

Agriculture wastes  
Zeolite

Quaternization process

N and P adsorption biopolymer

## 2014 Soil, Water, and Bioenergy Resources Program Achievements *(continued)*

### Express soil quality test kit

We have modified our express soil quality field test kit for routine evaluation of field soil by farmers, Educators, crop advisors and citizens. The test kit was developed at the OSU South Centers several years ago. People from around the world have purchased our express soil quality test kit for instant measurement of soil quality, organic matter content, plant available N, biological activity, and soil tilth. The kit can also be used to help predict crop yields. Farmers typically spend at least \$30/year for routine analysis of soil. Our soil quality test costs less than a \$1 per year. Collectively, this test can help farmers to save hundreds of thousands of dollars per year spent on commercial lab analysis. We are working with the OSU Licensing and Technology Department for patent application on our soil health test kit.



Photo: Soil quality professional development training in Ukraine and at NRCS soil quality workshop in Illinois.



### Applied Research: State, Regional and National Level

#### Sustainable soybean production and climate change mitigation

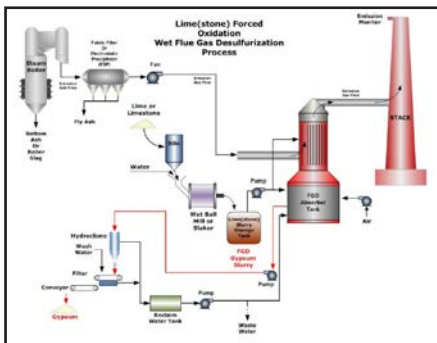
Using a research grant from United Soybean Board (USB) in collaboration with USDA-ARS Drainage Research in Ohio, Indiana, and Alabama, as well as Penn State University, and the University of Kentucky, we are conducting research to grow soybeans continuously and improve marginal lands with multifunctional cover crops and industrial waste products (flue gas desulfurized (FGD) gypsum). Our research results were presented at the Ohio Farm Science Review, the Conservation Tillage and Technology Conference, the National No-Till Conference, and the Farm Show in Pennsylvania with active participation of farmers and coal-based power industries. The production management approach based on holistic and novel integration cover crop and Gypsum in continuous NT has helped to increase soybean yield and expand production on marginal lands in the Midwest.

#### Sustainable organic production systems

Organic production is receiving world-wide attention with the growing demand for healthier foods. The outlook for continuing growth of US organic production is bright. The organic market continues to grow by 10% annually. In Ohio, there are over 500 certified food operations. Ohio produces 25% of the nation's organic spelt, 8% of its corn silage, and about 3% of other organic produce. Total farm gate organic production is estimated as high as \$75 million. However, current organic systems rely heavily on excessive tillage-based approaches, which are not ecologically harmonious and are

also functionally inefficient. Ohio farmers have shown a great interest using cover crop blends to improve production and food quality, farm economics, and soil health. However, there are limited research activities focused on helping producers use appropriate cover crop blends to improve organic agroecosystem functionality and services.

We are impacting (by USDA-Organic Transition funded and CERES Trust funded projects) organic production research in Ohio using an innovative combination of no-till, multi-functional cover crop blends and vinegar (as a herbicide) to assess and maximize ecosystem services. Our 2014 research results have shown that several cover crop blends of winter pea, soybean, radish, carrot, oat, cereal rye, safflower, sun hemp, and pearl millet and Sudan-sorghum act as a weed suppressor, bio-diversifier, N provider, scavenger and recycler of nutrients, compaction alleviator, drainage improver, and soil builder. *(continued on page 25)*





Our research on the use of multi-functional cover crop blends could potentially save up to \$100,000 per year for organic farmers in Ohio.



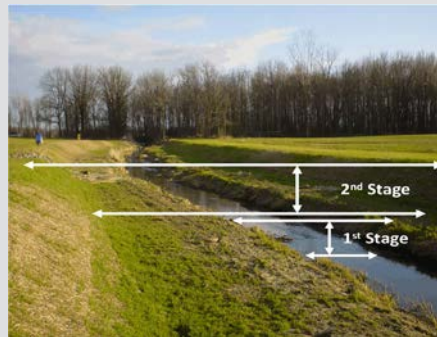
## 2014 Soil, Water, and Bioenergy Resources Program

### Achievements *(continued)*

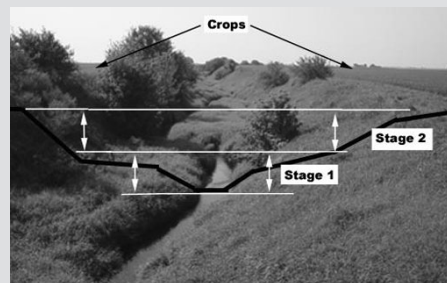
#### Drainage ditches, BMP and reactive N and P recycling

Funded by a USDA-NIWQP project for 3 years, in association with the Food, Agriculture and Biological Engineering department, our research project, "Integrated and Science-Based Management of Agricultural Drainage Channels in the Western Lake Erie Basin" is impacting farmers, educators, crop advisors, high-school students and scientists. Management of agricultural drainage channels to protect and improve water quality by mitigating sediment and reactive P and N pollution while meeting drainage needs is essential for agricultural production sustainability.

#### Renewable energy research



Drainage ditches



Currently, we are managing seven bioenergy experimental studies on corn, sweet sorghum (annual vs. perennial), sweet corn, Sudan-sorghum, Miscanthus giganteus, 6-warm-season grasses, hybrid willow, and Arundo donax. These projects were funded/collaborated by the NE Sun grant through the Department of Energy; Mendel Biotechnology, Inc. Hayward, CA; Reprive Renewables (Giant Miscanthus), Soperton, GA; Speedling, Inc. Ornamental and Energy Crop Divisions, Ruskin, FL; Konza Renewable Fuels, LLC, Meriden, KS; and New Polymer Systems, Inc., New Cannan, CT. We are still continuing research on these experiments.

Our long-term research results have shown that applying sewage sludge @ 5,000 gal and FGD gypsum @ 4 ton/acre significantly increased Miscanthus feedstock production (15 to 20 ton/acre) for cellulosic ethanol (~100 gal/ton of biomass) and a valuable use of the waste products (biopolymers or energy pellets). Furthermore, our research has shown promising to use Miscanthus giganteus biomass for controlling soil erosion in new construction areas rather than wheat biomass. Likewise, several biosolids treatment companies are working with us on using Miscanthus biomass as a core matrix for sewage sludge solidification.

#### Academic research (graduate studies)

Yogendra Raut (Yogi), Jim Hoorman and Michael Brooker, students in the Environmental Science Graduate studies program of the Ohio State University School of Natural Resources are conducting their Ph.D. research experiments at Piketon research sites and/or with us involving our projects. Yogi is emphasizing his Ph.D. work on management of CRP land, Jim is conducting his Ph.D. research on reactive P and N fates in post-manure applied soil, and Mike is involved in Ph.D. research with us on soil biogeochemistry of under two-stage ditches. *(continued on page 26)*



Visiting experiments with high-yield rice varieties in Heilongjiang province, north-east China.

*(continued from page 25)*

### **Applied Research: International level**

Over the years, the OSU South Centers has developed a national and international reputation in soil, water and bioenergy research. As a result, internationally funded graduate students, scientists, scholars and professionals as visiting students, scholars/post-docs from Bangladesh, Brazil, Egypt, Ghana, India, Pakistan, Tunisia, Turkey, Uzbekistan, and Ukraine, have joined our program for research and educational activities. In 2013-14, we have hosted 3 scientists from Turkey and Ghana as Fulbright scholar, a Tubitek scholar (Turkey Government), and a Norman Borlaug scholar. All of them have successfully completed their work and returned home. Drs. Ekrem Aksakal, Kenan Barik and Emmanuel Amoakwah had their high-quality research works published, and presented and displayed at the International Research Exposition of Ohio State University, World Food Prize Award, American Society of Agronomy/Soil Science Society of America/Crop Science Society of America, USDA Foreign Agricultural Service Newsletter, and Monsanto Newsroom

(<http://news.monsanto.com/news/sustainability/world-food-prize-panel-highlights-impacts-climate-change-food-production>, [www.asa.org](http://www.asa.org), [www.fas.usda.gov](http://www.fas.usda.gov)).

Rafiq Islam, Alan Sundermeier and Jim Hoorman visited the Peoples Republic of China at the invitation of the Jiamusi

Branch of the Chinese National Academy of Sciences from July 24, 2014 to August 5, 2014 to initiate collaborative research and educational programs with China. Based on our acquired experience on Chinese agricultural management practices and in-depth discussion, we set-up a long-term field research experiment entitled "Tillage and Cropping Systems Impact on Ecosystem Services" for academic and applied research activities at the research farm of the Jiamusi Branch of the Chinese National Academy of Sciences. We are expected to visit China every year to further strengthen our collaborative research and educational programs.

### **Extension Impact**

#### **State, regional and National level**

We have organized several field days, train-the trainer workshops, and annual meetings/conferences at different locations in Ohio (6) and Michigan (1) on "Eco-farming, biodiversity and soil health: A systems approach to enhance organic and natural agro-ecosystem services" OFEEA (~ 100 participants), OSU organic field day at Harzel farm (~40 participants), farmer's forum with NC-SARE (~ 76 participants), Piketon SWR field day (~ 65 participants), and Ohio no-till farmers association (~ 100 participants). At Kellogg Biological Research Station, University of Michigan, we organized a train-the trainer workshop (15 participants) *(continued on page 26)*



*(continued from page 26)*

on “Bioenergy feedstock production, ecosystem services, and bioenergy and bio-based products.”

We have also actively involved and supported the Conservation Tillage and Technology Conference and Ohio No-Till Farmers Association annual meetings. We have delivered 25 presentations, published 6 peer-reviewed papers and several newspaper articles.

### **International level**

We participated in two international meetings and workshops. One of the workshops was held July 28-29, 2014 at Jiamusi with the Chinese National Academy of Sciences on sustainable agriculture and ecosystem services. We have outreached to more than 60 professors, farmers, educators and scientists in China. As part of our participation, we delivered two presentations, one on “Developing educational and research collaboration” between the Ohio State University and the Chinese National Academy of Sciences and another one on “Sustainable Agriculture and Ecosystem Services.” This year, our farm manager, Wayne Lewis and I will visit China. Wayne is expected to provide hands-on demonstration and training to Chinese technicians for maintenance of farm equipment and sustainable farming practices.

Results from our experiments were presented at the 2014 Balkan Congress. I delivered 2 professional presentations at the meeting. Our Fulbright fellows, Drs. Celal Yucel and Derya Yucel delivered 2 professional presentations and four poster presentations on Extension and demonstration research.



Presentations at the meeting



Sustainable Agriculture and Ecosystem Services.



**THE OHIO STATE UNIVERSITY**

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