2017 Organic Agriculture Research Symposium
Abstracts

Session 1: Soil Health

The Potential of Soil Health Building Management Strategies to Improve Resilience and Sustainability of Organic Processing Tomato in California

University of California, Davis
- Anna Azimi, Scott Park, Margaret Lloyd, Amélie Gaudin

Building long-term soil health is intrinsic to increasing agricultural resource use efficiency and crop resilience in sustainable tomato production. Understanding the key mechanisms for soil management can promote the conservation of freshwater resources and maintain the economic viability of the tomato industry in a time of unprecedented drought in California. We seek to specify how management decisions such as long-term compost application, cover crops and diverse crop rotation have altered soil function and its impact on yield and fruit quality when water application is limited. This project compared a deficit irrigation schedule which delays onset combined with early cutoff of water application by 15 days to a regular irrigation schedule in an organic processing tomato field. We will present results on the co-benefits of capitalizing on greater soil health to improve water use efficiency, retain nutrients and decrease disease and pest pressure without limiting tomato yield, quality and nutritional value. This holistic approach will help identify and quantify effective management decisions that both reduce production costs and conserve natural resources.

Can Locally Derived Effective Microorganisms Improve Organic Broiler Litter Compost?

University of Georgia
- Kishan Mahmud, Dr. Dorcas H. Franklin, Laura C Ney, Aspen R. Hattabaugh, Dr. Miguel L Cabrera, Dr. Dennis Hancock, Dr. Mussie Y Habteselassie, Dr. Quint Newcomer

Southeastern organic poultry production systems can generate a large amount of waste such as broiler litter, which can be an excellent source of nutrients for plant nutrition in organic production systems. However, when broiler litter is freshly applied as an organic source in any agricultural practice, it poses a potential threat to the environment by increasing ammonia volatilization into the atmosphere and, if applied according to the plant N requirement, an excess of P accumulates in the soil. Composting is a viable way of recycling a waste that yields a more stabilized and sanitized final product. However, the maturity and stability of the compost should be assessed carefully before incorporating it into the soil-plant continuum. During composting, N is also often lost to the atmosphere, which is why researchers and farmers adopt different chemical and biological techniques in order to create high quality compost, for example, a low C to N ratio and a high N to P ratio. In this study, we used a locally derived microbial inoculant that we termed as "Locally Derived Effective Microorganisms (LEM) as our treatment in addition to two other treatments namely Control (water only) and False-LEM (F-LEM). The objectives of the study were: (1) to identify the role of this effective microbial inoculant in suppressing ammonia volatilization and carbon dioxide respiration from the composting broiler litter and (2) to determine compost quality and maturation time for each of the treated composts with LEM, F-LEM and Control. We composted organic broiler litter for two seasons starting from mid-fall (2014 and 2015) and throughout the winter until late May (164 days and 184 days, respectively). Compost samples were taken throughout two seasons to assess compost maturity by measuring, ammonia volatilization, carbon dioxide respiration, total nitrogen, C/N ratio, NH_4-N and NO_3-N concentration. We found a significant reduction in ammonia volatilization from the LEM treated composts for season 1 (22%, $P<0.05$) and in season 2 (18%, $P<0.10$) when compared to the Control compost (water only). Carbon dioxide respiration was lower in LEM treated composting piles for both the seasons although not statistically significant. In addition, a higher than 50% germination percentage and a low dissolved organic carbon from the composts treated with LEM. Moreover, LEM treated composts are expected to show an increase in the enzymatic (Amidase) activity in the microbial population indicating a more stable organic source.

Rethinking P and K Fertility in Coastal Plain Soils
University of South Carolina
- Robin W. (Buz) Kloot and Carl Coleman

In November 2013, we initiated a demonstration project on five farm fields (approximately hectares each) that encouraged the use of cool season cover crops in typical Southeastern coastal plain rotations: corn-wheat double cropped with soybeans, corn and full season soybean, and cotton rotations as well. The soils in these fields were predominantly palueudults and kandiudults with loamy sand and sandy loam surface textures. While our original goal was to reduce nitrogen inputs and increase organic matter, we noticed that despite the lack of lime and fertilizer phosphate (P_2O_5) and potash (K_2O) addition to the soils, average soil test pH (n=13) increased significantly over 29 months, while soil test phosphorus (P) and potassium (K) (sampled in the traditional 6" 'plow layer' have remained essentially unchanged even though we have taken a crop off the fields each year, meaning appreciably more P and K were removed by crops from the fields than are reflected in the soil test data. In addition to steady P and K soil test values, we have seen numeric increases in organic matter (%OM), Calcium (Ca), magnesium (Mg), zinc (Zn) boron and a doubling of manganese concentrations despite no fertilizer addition.

In 2014, we initiated a 40-plot on-farm experiment that varied nitrogen and potassium in four treatments and have been able to corroborate the data from our demonstration plots, namely that we were able to harvest wheat, soybeans and corn, over a two-year period, yet maintain soil test P and K values. We have also been able to see steady P (at times increased) and K concentrations over a growing season on several hundred GPS'd sites over about 10,000 acres. Our soil testing also suggests both P and K are seasonal, and while we understood this we did not understand how much these soil test values varied.

In a sense, long term no-till soils, possibly aided by cover crops, may be breaking the rules and tapping into other pools of P (e.g., readily soluble P-Ca compounds, P sorbed in clay and iron/aluminum oxide surfaces, organic P, decomposing residues) and K (e.g., nonexchangeable K, decomposing residues) in the clay minerals other that extracted through the Mehlich 1 method. Apart from these other pools of P and K, additional sampling showed that between 6 and 18", were as much phosphorus and three times more potassium than was found in the 0-6" plow pan. These findings (surprising and encouraging to our farmer friends), along with evidence of less compaction from cover cropping and an elimination of subsoiling on these farms, suggest a much larger resource of P and K than farmers had imagined.

While these data are not long term, our observations run contrary to the inculcated narrative that in order to maintain soil test values (hence yields), the farmer needs to continually replace what has been removed by the crop. Our observations call into question the scientific basis on making fertilizer recommendations based on soil samples of the 6” plow pan.

Session 2: Pest Management

Advances in Biological Control Methods for Control of Key Orchard Pests in the Southeastern U.S.
USDA ARS

- David Shapiro-Ilan[1*], Ted Cottrell[1], Dario Chavez[2], and Russ Mizell[3]
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Through our research, we have made several major advancements in developing biocontrol options for organic orchards. Our research focuses on pecan and peach cropping systems. However, the innovative methods that we have developed will be applicable to other systems as well. Key pests that were studied for development of organic biocontrol practices included pecan weevil (*Curculio caryae*) in pecan, and peachtree borer (*Synanthedon exitiosa*) in peach. Our results indicate that high levels of control can be achieved against each of these pests using biological control methods.

<u>Methods</u>. Pecan weevil: An integrated program was tested using entomopathogenic/beneficial nematodes (*Steinernema carpocapsae*), entomopathogenic fungi (*Beauveria bassiana*), and the bacterial-based product Grandevo® (*Chromobacterium subtsugae*). Treatments were applied in large plots on a commercial organic pecan farm and on organic plots at the USDA-ARS farm in Byron, GA. Also, in non-organic plots, we compared Grandevo® to standard chemical insecticides that are used for pecan weevil control.

Peachtree borer: We applied the beneficial nematode, *S. carpocapsae* in the late summer and fall as a preventative application, and also tested *S. carpocapsae* as a curative treatment by applying the nematodes in the spring to borer-infested trees. These experiments were conducted on a commercial organic peach orchard, conventional peach orchards, and the USDA-ARS research farm. Efficacy comparisons to standard chemical insecticides (chlorpyrifos) were also made on non-organic orchards.

All experiments included non-treated controls, were repeated over consecutive years, and conducted in randomized complete block designs.

Results & Conclusions. Pecan weevil: An integrated organic approach (using entomopathogenic nematodes, fungi and Grandevo®) caused significantly lower nut damage compared with the non-treated control. Also, when compared with standard chemical sprays (carbaryl alternated with a pyrethroid), Grandevo® was equally effective in reducing pecan weevil damage.

Peachtree borer: The nematode, *S. carpocapsae* reduced peachtree borer infestations and reduced peachtree borer survival in both preventative and curative applications. In preventative applications, the nematode treatments were equally effective compared with standard chemical insecticides (chlorpyrifos) and in curative applications *S. carpocapsae* was more effective than chlorpyrifos. *S. carpocapsae* was effective in both organic and non-organic orchards. Furthermore, the nematodes were effective when applied using various standard spray equipment (boom, trunk sprayer, or handgun).

In conclusion, biocontrol methods were highly effective in controlling pecan weevil and peachtree borer. We will also very briefly discuss our results using organic biocontrol options for control of other orchard pests such as plum curculio (*Conotrachelus nenuphar*) and lesser peachtree borer (*Synanthedon pictipes*).

Acknowledgement. Funding was provided in part from USDA-NIFA-ORG and USDA-NIFA-SARE. Mention of a proprietary product does not imply USDA's approval of the product to the exclusion of others.

A New Approach for Successful Organic Peach Production
Clemson University
- Jaine Allran, Guido Schnabel, Juan Carlos Melgar

The production of organic peaches is extremely difficult under the humid conditions of the Southeast due to high pest and disease pressures, and the lack of effective, organically approved pesticides. Consequently, few growers have taken the risk and transitioned into organic peach farming. Fruit bagging is proposed as a strategy to exclude pests and diseases, reduce reliance on spray applications, and produce high-quality peaches. The experiment was carried out in a certified-organic farm, where a 2-acre orchard was selected. Fruit was bagged shortly after thinning. When commercial ripening stage was reached the fruit was harvested and fruit quality [size, weight, soluble solid content (SSC), titratable acidity (TA), and SSC/TA ratio], pest/disease incidence, and postharvest disease incidence was evaluated. Fruit quality analyses showed similar fruit size in bagged fruit compared to control fruit. No differences in SSC, TA, or SSC/TA ratio between treatments was found. Bagged peaches developed red blush although less intense than control peaches. Bagging reduced postharvest brown rot incidence. Based on these results, and on consumer surveys performed before this study, this technique has a great potential to produce a high-quality organic peach that could be sold for a premium in certain markets, while reducing reliance on spray applications in the Southeast.

Shade-cloth based Permanent Pest Exclusion System for High Tunnel Vegetable Producers
Auburn University
- Dr. Ayanava Majumdar, Extension Entomologist, Alabama Cooperative Extension System, Auburn University, Auburn, AL, bugdoctor@auburn.edu, 251-331-8416, Will Mastin, Local Appetite Growers, Fairhope, AL; Russell and Jewell Bean, S&B Farms, Eufaula, AL; Andrew Williams, Deep South Food Alliance, Thomaston, AL.

Context of research: Insect pests are the number one issue on organic farms. Based on direct producer feedback and integrated pest management (IPM) research, the average crop loss due to insect pests exceeds 50 percent in the absence of control measures. A high tunnel not only extends the crop season but it also prolongs insect presence. Sucking insects (like stink bugs and leaffooted bugs) and moths (like armyworms and loopers) tend to aggregate in large numbers inside high tunnels. Pest prevention is the best strategy for organic producers rather than therapeutic tactics. Majority of published organic IPM research focus on short-term tactics using biorationals and/or row covers for temporary pest exclusion. This is the first permanent exclusion system research that is supported by laboratory and on-farm assessments across Alabama. This study was funded by grants from the USDA SARE and Extension IPM Grant Programs.

Research method: Replicated laboratory studies on high tunnel pest exclusion (HTPE) system were initiated using model arenas (picture on right) that enabled rapid evaluation of six different shade cloths for stopping leaffooted bugs and moths. HTPE models were tested with and without food crops to accurately assess differences in insect behavior. Beneficial insects were also assessed using the model arenas with aphids as hosts; this resulted in excellent understanding of unintended consequences of exclusion tactics. The HTPE system is now being evaluated at four commercial farm locations with additional sites being added every year.

Major research and demonstration findings: Laboratory studies indicated a 40 or a 50 percent shade cloth, tightly installed around the side and end walls of the high tunnel, effective in reducing or stopping the leaffooted bugs. On-farm studies (picture on right) indicated 50 percent shade cloth installed prior to crop planting to be very effective in excluding moths, leaffooted bugs, and large stink bugs. A 50 percent shade cloth excluded lacewings but not lady beetles in the laboratory and field studies. Cost of the shade cloth for a standard high tunnel was about 26 to 50 cents per square foot depending on material; this was equivalent to <$500 per tunnel. Producers reported the improved crop quality from shade cloth-based pest exclusion system to be highly satisfactory. The HTPE system also opens the door for the use of biological control agents that are forced to feed on small insects like aphids and whiteflies with minimal need for insecticide applications.

Minimum Risk Pesticides for Organic Farmers
Cornell University
- Brian Paul Baker and Jennifer Ann Grant

Organic farmers have fewer pesticide options than non-organic farmers to deal with insect pests, diseases and weeds. The EPA has made a set of 31 active ingredients (AIs) eligible for exemption from registration because they are considered to be minimum risk. Most are natural and derived from plants. These include essential oils such as from cloves and cinnamon, and vegetable oils such as castor, garlic and linseed. Products formulated with these AIsmust meet additional conditions to be exempted, and most of these products comply with the National Organic Program (NOP) standard. Minimum risk pesticides offer organic farmers several choices for overcoming pest management challenges. We reviewed the literature to evaluate their efficacy against specific targeted organisms, and found a substantial body of scientific studies. To compile accurate, verified information about minimum risk pesticides and make it more accessible, the New York State Department of Environmental Conservation requested that profiles be prepared for each of the eligible active ingredients. The eligible NOP compliant AIs will be identified and the efficacy literature will be summarized. The environmental effects of minimum risk pesticides will also be considered, particularly the impacts on beneficial organisms such as pollinators and parasitoids. We will also identify gaps and opportunities for further research and development, including uses and applications that have not been the subject of rigorous scientific research.

Session 3: Biodegradable Mulches

Life Cycle of Biodegradable Plastic Mulches for Specialty Crop Production
University of Tennessee, Knoxville

- Douglas G. Hayes [speaker], Larry C. Wadsworth, Carol Miles, and Annette L. Wszelaki

Use of thin plastic film as mulch is standard practice for specialty crop growers throughout the U.S. to increase yields, prevent weeds and conserve water and soil. Unfortunately, most plastic mulch after its use is stockpiled or burned due to limited recycling and landfill options, releasing harmful residues such as microplastics into the environment. Biodegradable plastic mulches serve as a potentially more sustainable alternative to polyethylene mulches, since they can be tilled into the soil after harvest (thereby eliminating labor costs for the retrieval and disposal of mulch), where they will undergo biodegradation. However, widespread adoption of biodegradable mulch by farmers has been hindered due to higher purchase costs, lack of knowledge, perceived or observed deterioration during use, and slow or incomplete biodegradation after soil incorporation. This presentation will compare and contrast polyethylene and biodegradable plastic mulches in terms of their life cycle and implications on specialty crop production, soil fertility, and soil microbial communities. A focus will be the composition of biodegradable mulches, and the origin of the components. Specifically, we will discuss how increased biobased content for mulches does not necessarily enhance biodegradability; moreover, a plastic's beginning and end-of-life are completely uncoupled.

Suitability of Biodegradable Plastic Mulches for Organic and Sustainable Agriculture
Washington State University

- Carol Miles[1], Lisa DeVetter[1], Shuresh Ghimire[1], and Douglas G. Hayes[2]
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Biodegradable plastic mulch is an emerging technology that has the potential to enhance the sustainability of agricultural production systems. Some of the benefits of biodegradable plastic mulches include reduced labor and associated costs for mulch removal and disposal, as well as plastic waste reduction. To be an adoptable and sustainable technology, biodegradable plastic mulches must perform equally to polyethylene (PE) mulches and degrade into constituents that do not accumulate and damage soil heath or the environment. The National Organic Program (NOP) added biodegradable biobased plastic mulch to the list of allowed synthetic substances for organic production in Oct. 2014. However, several factors limit the use of biodegradable plastic mulches in organic agriculture. First, none of the currently available biodegradable plastic mulch products meet the requirement of being completely biobased and thus have not been approved for organic production, even though they meet the NOP biodegradability requirements of 90% biodegradation within 2 years (based on standardized laboratory tests). And second, genetically modified organisms (GMOs; yeast and bacteria) are used in the fermentation process whereby feedstocks are created for most commercial biodegradable plastic mulches; GMOs are prohibited by the NOP. Growers should always verify materials with their certifier before applying, as some manufacturers have erroneously labeled mulches “organic”.

A future challenge for organic and sustainable agriculture is to characterize allowable biodegradation rates. For example, if biodegradable plastic mulches meet the NOP requirement of 90% biodegradation within 2 years, there still remains the possibility that 10% of mulch residuals will persist in soils (if they comprise of non-biodegradable ingredients). If this were the case, plastic residuals could exceed 2 times the amount applied per year after 8 years of annual mulch application. Monitoring the occurrence of biodegradation in field conditions is another challenge, as current methods used by the NOP are laboratory-based (e.g., monitoring CO_2 evolution) and may not be applicable to field conditions. Growers and certifiers need reliable field sampling methods that can be easily applied to estimate biodegradation and provide assurance that materials are biodegrading appropriately.

Tests that develop these sampling methodologies should be done in parallel with additional tests that measure the rate and extent of plastic mulch biodegradation across diverse field conditions. This presentation will highlight currently available biodegradable mulches and the NOP requirements for their use in certified organic agriculture, as well as future research that is needed before biodegradable plastic mulches can be embraced in organic systems.

Where the Rubber Meets the Road: Can Biodegradable Mulches Produce Comparable Yields to Black Plastic Mulch for Pumpkin?
University of Tennessee, Knoxville

- Annette Wszelaki[1], Jennifer Moore[1], Shuresh Ghimire[2] and Carol Miles[2]
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Plastic or polyethylene mulches have been used in vegetable production for over 50 years because of the many production advantages they provide, including speeding up time to harvest, managing weeds, reducing some diseases and insects, warming soil in the spring, increasing yield and crop quality, reducing soil erosion and compaction, conserving moisture, and allowing for more efficient use of water and fertilizer. Plastic mulch use, however, is not without its disadvantages, such as the cost, labor and environmental issues associated with plastic mulch disposal. Biodegradable mulches (BDMs) are a promising alternative to traditional plastic mulches. In order for BDMs to be a sustainable technology and widely adopted, they must cause no harm to the environment, reduce landfill waste, and reduce overall labor costs, particularly costs for removal and disposal, while providing benefits similar to polyethylene mulch. In this study, we grew pie pumpkins (*Cucurbita pepo*), cv. Cinnamon Girl, on five BDM treatments (BioAgri, Experimental PHA/PLA, Naturecycle, Organix and WeedGuardPlus) with both a black plastic mulch and bare ground control on raised beds in two distinct regions of the U.S. – the Southeast (hot, humid) in Knoxville, TN, and the Pacific Northwest (cool, humid) in Mount Vernon, WA. Data were collected on visual degradation, weed counts, insects and diseases, yield and storage and quality evaluations. Here we report on yield across treatments and locations over two years (2015 and 2016). Yield did not vary by treatment in TN in either year, likely due to excessive vining of the plants in the hot, humid environmental conditions. In 2015, yields varied by treatment in WA with BioAgri and Experimental PHA/PLA performing similarly to black plastic mulch, and all BDMs except WeedGuardPlus yielding higher (t/ha) than the bare ground treatment. In 2016, Naturecycle and Experimental PHA/PLA were the highest yielding treatments and out-yielded the bare ground and WeedGuardPlus treatments, while producing comparable yields to the black plastic mulch as well as the BioAgri and Organix treatments. As in 2015, all treatments with mulches had higher yields than the bare ground plot. These results demonstrate potential differences due to environmental conditions both by year and location, but demonstrate that using BDMs can provide similar yields to black plastic.

Impact of Biodegradable Plastic Mulches on Soil Quality and Ecology
University of Tennessee, Kentucky
- Jennifer M DeBruyn, Sreejata Bandopadhyay, Henry Sintim, Marie English, Sean Schaeffer, Markus Flury, D Hayes

Plastic mulch films are used in fruit and vegetable agriculture to reduce weed growth, conserve moisture, and increase soil temperatures. Conventional plastic mulch films are made of polyethylene (PE) plastic. PE is not biodegradable, and thus imposes considerable end-of-life costs, both in terms of removal and disposal expenses, and environmental impacts of PE fragments left behind in the soil. Several biodegradable plastic mulches (BDMs) from biobased or other biodegradable polymers (e.g., starches, PBAT, PLA, and other polyesters) are now available and present a viable alternative to PE that can be tilled into the soil at the end of the growing season. However, the decomposition fate of BDMs and impact on soils is not well understood; this is a primary concern with growers who are considering adoption of biodegradable plastics. The goal of this study is to 1) determine the impact of BDMs on the soil environment in long term cropping experiments in two different soils and climates and 2) understand the microbial degradation of these materials. Randomized block trials of pumpkins planted with four different BDMs, conventional PE film, cellulosic ground cover and bare ground were conducted in Knoxville, Tennessee and Mount Vernon, Washington, USA. Generally, BDMs increased soil temperature compared to bare ground; however, only two of the four BDMs had comparable soil temperatures with PE. After the first growing season with BDMs tilled into the soil, we assessed the soil quality in terms of carbon, nutrients, chemistry (pH and electrical conductivity), bulk density, respiration and infiltration. There were significant differences in soil quality between the two locations. However, except for small differences in nitrate and conductivity, there were no other significant differences in soil quality parameters among the BDM and PE treatments, indicating that BDMs have negligible effects on soil quality compared to conventional PE films, at least over the short term. To better understand the degradation of these materials by soil microbes, microcosms and enrichment cultures were set up in the laboratory. In soil microcosms, degradation of BDMs was enhanced under higher temperature, with maximum C storage occurring at an intermediate temperature (20°C). Enrichments of microbial consortia on minimal media led to the isolation of strains including a *Rhodococcus* sp. and *Bacillus* sp. which were capable of degrading multiple BDMs in culture. Taken together, the lab studies have demonstrated microbially-mediated degradation of the plastics.

Session 4: Organic Farming Systems

Fall Season High Tunnel Production Effects of Warm Season and Cool Season Crops with Row Covers

Kentucky State University
Krystal Conway, Shawn Lucas, Kirk Pomper, Anthony Silvernail

High tunnels are used to extend the growing season of various crops, particularly cool season crops. Similarly row covers are also used for season extension in temperate climates. Using Row covers within high tunnels can provide additional temperature moderation during the cool season to produce better crops and yields. In this experiment, the use of high tunnels and row covers was explored to extend the growing season of a cool season crop (lettuce) and a warm season crop (basil). In Sept. 2016, lettuce was direct-seeded into four randomized 8 x 4 ft plots inside four high tunnels for fall season planting. Also, basil was planted in nine 72-cell trays and then transplanted into four randomized 8 x 4 ft plots. Each of the four high tunnels had a total of eight randomized plots. Row covers were placed over the plots for the last two weeks of growth. Each crop has the following treatments: row cover and control (no row cover). There were two duplicates of each treatment per high tunnel. In all there are four true replicates of each treatment, one per high tunnel. To estimate crop yields, fresh weights will be sampled by harvesting entire plots. Sub-samples will be analyzed for potential moisture differences between treatments using fresh weights and oven dry weights. Chlorophyll content will be analyzed as an indicator of plant health amongst treatments. We hypothesize that at harvest, there will be a significant yield difference between treatments due to the enhanced insulation provided by the row covers within high tunnels. The yields of row cover vs. non-row cover cool season and warm season crop production will be discussed.

Optimizing No-till Cover Crop Management for Organic Vegetable Production

Clemson University
- David Robb[1], Nishanth Tharayil[1], Holly Garrett[1], Dara Park[1], Shawn Jadrnicek[1], Robin (Buz) Kloot[2], Geoffrey Zender[1]
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Organic no-till, which uses cover crop residue as in situ mulch, offers a more sustainable approach to weed management in vegetable production than the frequent use of herbicides and tillage. Despite the potential advantages, few organic vegetable growers in the southeastern U.S. have adopted no-till production because of several challenges posed by these systems, such as inadequate weed control and slower nutrient release in the absence of tillage. Field research was conducted at the Clemson University Student Organic Farm (South Carolina Piedmont region) over two growing seasons in 2014-15 to evaluate no-till vegetable production using a fall-planted cover crop of cereal rye and crimson clover. A roller-crimper device was used to terminate the cover crop in no-till plots which were compared to plots with conventional tillage. This research compared yields of squash and tomato, labor inputs, and soil N dynamics between the no-till and conventionally tilled cereal rye + crimson clover cover crop systems.

Research findings indicated significant labor savings using no-till, whereas vegetable yields and nitrogen availability were comparable between tilled and no-till systems. Additional research is being conducted at Clemson University to address the need for more refined organic no-till planting and termination recommendations for both fall and summer planted no-till cover crops. In 2016, field trials were done in three geographic regions of SC to compare weed suppression and soil nutrient availability between early-, mid-, and late-season fall planting dates, and also three spring termination dates of a roller-crimped cereal rye + crimson clover cover crop. Results from year one of this study will be used to develop recommendations to optimize cover crop planting and termination dates for the different growing regions, which will be tested in two additional years of research in organic no-till summer and fall vegetable production. Preliminary data showed that significantly more biomass was attained by delaying cover crop termination until later in the spring. Also, significantly greater weed suppression was found with early-planted cover crops compared to mid- and late-season planting treatments. Preliminary nutrient (nitrate) analyses of the first year trial indicated no significant net nitrification differences between cover crop termination treatments.

Effect of Planting Time and Use of Biologically-Based Products on Germination and Survival of the Organic Sweet Corn 'Luscious' at Lincoln University's Alan T. Busby Certified Organic Farm
Lincoln University

- Zelalem Mersha[1] and Martha O'Connor[2]
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Achieving an acceptable germination and maintaining the survival until harvest are critical steps for a successful organic sweet corn production. We evaluated effect of planting time and use of biologically-based products (containing *Streptomyces lydicus* and *Trichoderma spp.*) on germination and survival of the organic sweet corn 'Luscious' at Lincoln University, Alan T. Busby organically certified farm. Experimental design was split-plot with a randomized complete block design replicated three (2015) or five (2016) times. The type of organic product compared to non-treated control was the main plot and planting time was the sub-plot. Planting dates were May 6, May 20 (failed) and June 4 in 2015 and May 7 and May 23 in 2016. Organic products tested were Actinovate®, RootShield® and RootShield® Plus (only in 2016). Generally, germination on the trial plots was very low in both years, with only few cases of 80% germination with Trichoderma containing products.

The first planting in 2015 resulted in significantly better germination than the second. The trend, interestingly, was reversed in 2016. The first planting on May 7, 2016 showed significantly ($P < 0.05$) lower germination than the 2nd planting. Weather parameters, particularly rainfall and soil-temperature, acquired from nearby stations highly correlated with these observed differences. While growers are highly advised to pay attention to 7-10 days weather forecasts thereby target a window of warmer temperature for planting, they are at the same time encouraged to use *Trichoderma spp.* containing products to enhance germination and survival of organic sweet corn. In 2015, infection of roots by *Pythium spp.* was seen on few plants uprooted from non-treated control plots. Future studies shall include sampling of roots to test for any potential damping-off causing pathogenic infection for a conclusive remark regarding the cause of such a low germination rate. Installing and using a weather-station at the experimental site will also help to accurately investigate the role of weather parameters such as rainfall and soil-temperature.

Session 5: Posters

Local Knowledge Development in Organic Agriculture Practices in Nigeria

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A survey was carried out in South West and North Central zones of Nigeria for the documentation of application of local knowledge to the development of Ecological Organic Agriculture in Nigeria. Three states (Oyo, Osun and Ogun) from the South West and one state (Niger State) from the North Central were selected for sample. The tools employed for data collection were Focused Group Discussion (FGD) and Key Informant Interview (KII). Thirty eight plant species from twenty four (24) plant families were documented to be used for various crop and animal management in the two geo-political zones investigated. Fabaceae and Arecaceae families were the highest inventoried . Summary of information documented cum specialty are: information on soil fertility, local knowledge application on seed dressing, local knowledge applicable in field pest management, storage pest management and storage technique. With respect to animal production, local knowledge information to development of EOA was on animal fertility and parturition management. The use of different application documented was highest for the crop pests and diseases management across the zone surveyed, which pinpoint importance of these biotic factors for productivity. The methods being used in various aspects of agriculture such as soil fertility management, seed dressing, weed control, field pest management, disease management, storage pest management, storage techniques, nutrition management, parturition management and fertility management range from methods that are scientific to the ones that are folklore and superstitious

Winter Wheat and Cover Crops in Organic Rotations in the Western Corn Belt

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Our primary objective was to develop information that will help organic producers incorporate winter wheat (WW) into organic dryland crop production in the upper Midwest (Concord, NE average rainfall 750 mm). While many growers utilize cover crops (CC) and forages, the main cash crops in this region are corn and soybean. Including WW allows time for CC establishment after harvest, breaks pest cycles, and spreads labor more evenly throughout the seasons. Based on organic farmer suggestions, the research focused on determining the optimal combination of nitrogen (N) inputs for WW yield and quality; to identify suitable CC species that could follow WW and precede corn or soybean; and to evaluate several CC termination methods to facilitate subsequent row crop production. The WW fertility management phase examined WW response to previous crop (corn silage or alfalfa) and in-season N inputs (previous crop, manure rate and timing, and late-season foliar N application). The CC termination phase evaluated legume, grass, and broadleaf CC species with 4 termination strategies (winterkill, disking, roll-crimping, and broadcast flaming) before a subsequent corn or soybean crop.

In the WW phase, cattle manure was applied to provide 0, 58, and 112 kg ha^{-1} N plant available N in either fall or spring. An organic-approved foliar N was applied at 0, 11, and 22 kg ha^{-1} N in late spring. In both trials, mean grain yield was 3700 kg ha^{-1} and grain protein values were above 130 g kg^{-1}. In one trial, yield and N uptake were higher in fall manure treatments compared to spring manure, and grain protein concentration was slightly improved by spring N treatments but slightly decreased by fall manure. In the other trial none of the treatments had a clear effect on response variables.

In the CC termination phase, 10 treatments were established following WW harvest (no CC control, winter rye, winter triticale, hairy vetch, red clover/yellow sweet clover mix, buckwheat, spring oat, berseem clover, soybean, and sudangrass). Overwintering CCs were terminated at row crop planting by roll-crimping or flaming, or by disking 2 weeks prior. Winterkill CC plots were also disked. Winter rye and hairy vetch were the best-suited CCs to roller-crimper and flame termination. Kill method had greater influence than CC species on corn and soybean yield and quality, with disked treatments performing better than roll-crimped and flamed treatments, likely due to CC regrowth or incomplete kill. Average corn yield for the disked plots was 6829 kg ha^{-1}, while roll-crimped and flamed plots produced 57-78% less. Soybean yield losses were less severe, with roll-crimped and flamed plots producing 32-55% less than disked plots. Flamed plots had greater yield than roll-crimped plots in one of the trials for both corn and soybean.

Our results indicate that acceptable organic WW yield and quality may be produced without costly N inputs; thus, manure could be more effectively used on a summer crop such as corn. Broadcast flaming was as effective as roll-crimping, which will be of interest to growers employing reduced tillage CC-based rotations.

On-farm Production and Utilization of Arbuscular Mycorrhizal Fungus Inoculum
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Arbuscular mycorrhizal [AM] fungi are naturally-occurring soil fungi that form a mutualistic symbiosis with roots of the majority of crop plants. Among the benefits to the host plant are enhanced nutrient uptake, disease resistance, and drought tolerance. Better utilization of the AM symbiosis is a potentially important tool for organic farmers and conventional farmers seeking to reduce chemical inputs. The primary option in this regard for row crop farmers is to enhance the activity of the native population of their soils through management practices that reduce soil disturbance and increase availability and diversity of plant hosts. Vegetable farmers who grow seedlings for later outplanting have the option to use inoculum of AM fungi in the greenhouse growth phase, thereby producing a seedling ready to take immediate advantage of the symbiosis upon outplanting.

Though inocula are available commercially, farmers can produce inoculum themselves, on-farm, thereby having the option to utilize the AM fungi indigenous to their farm. We have developed a method for the on-farm production of AM fungus inoculum using plastic “grow bags” as the container, compost and vermiculite mixtures as the growth substrate, and bahiagrass (*Paspalum notatum* Flugge) as the nurse host plant. Forty site-years at cooperating farms has shown this method to be reliable and effective, producing an average of 300 propagules of AM fungi cm^{-3}.

The next step in utilizing inoculum of AM fungi for vegetable production is amendment of horticultural potting media with the inoculum and modification of nutrient regimes in the greenhouse. Particular care must be taken to limit phosphorus availability, because high P can inhibit colonization of roots by AM fungi. This can be a challenge for organic growers since amendments come as a “package,” making it hard to manipulate levels of an individual nutrient. Care is necessary to provide sufficient levels of other nutrients, notably nitrogen, while limiting P. Experimentation showed that hydrolyzed fish was a better high N low P option than blood meal.

The impact of the on-farm production and greenhouse utilization of AM fungus inoculum process upon the subsequent yield of fruits and vegetables was examined in field research, albeit on conventional farms. This work demonstrated statistically significant increases in yield of AM fungus inoculated vs. uninoculated plants for sweet potato (10%), potato (10-45%), peppers (4.4%), tomatoes (6%), leeks (250%), strawberry (17%), and eggplant (18%). As fertilizers become more expensive, both financially and ecologically, utilization of naturally-occurring symbioses such as arbuscular mycorrhizas are a way to enhance yield with no change in inputs.

Extending the Market Season with High Tunnel Technology for Organic Fruit Production

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The goal of this integrated organic project was to develop high tunnel production systems for blackberries and raspberries in the Mid-South that may compliment a field system by extending the harvest season, thus expanding cropping, improving fruit quality. Two field studies using high tunnel technologies and modifications to tunnels were conducted to determine how the technologies may fit into sustainable and organic fruit production systems in Arkansas. The two replicated experiments used high tunnels (HT) to 1) advance floricane blackberry harvest and blueberries, and 2) extend the harvest season of primocane fruiting blackberries and raspberries cultivars. Experiment results indicated the potential for both. High tunnels were modified to include A) tunnels within tunnels (TnT) around the fruiting plants, B) total screening of the tunnels to exclude insect pests, and C) an overhead micro-fogger system to reduce summer temperatures. Additional studies on the use of shade to delay flowering and fruiting in primocane fruit blackberries were conducted with additional support from the SARE Young Scholar Enhancement supplemental grants. Project activities focused on organic field experiments, organic insect pest management practices, developing and testing interactive enterprise budgets for blackberries, raspberries and blueberries and the grower sustainability assessment, *Sustainable Blackberries and Raspberries: A Self-Assessment Workbook for Growers*, and sharing project results through various outreach and extension methods.

Is Soil Sampling with a Soil Core an Accurate Method to Specify the Amount of Mulch Remaining in the Field?

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In the U.S. to be allowed in organic agriculture, biodegradable plastic mulch must reach at least 90% biodegradation within two years. While biodegradation is measured in standardized laboratory tests which measure CO_2 evolution, in the field mulch is extracted from soil samples and biodegradation is inferred based on presence or absence of mulch. A study which included three experiments was carried out in 2015 and 2016 at the Washington State University (WSU) Northwestern Washington Research and Extension Center in Mount Vernon, WA to develop a protocol for measuring the amount of mulch remaining in the field and determining the number and distribution of soil samples needed for an efficient and accurate measurement.

Plot size was 9.1m x 0.8 m for Experiment 1 and 2, and 1.6 m x 0.8 m for Experiment 3. Experiment 1 included five biodegradable mulches (Experimental PLA/PHA, BioAgri®, Naturecycle, Organix and WeedGuardPlus), and a polyethylene reference plot (which served as a positive control for the soil sampling method) that were used to grow pie pumpkins. At the end of the pumpkin growing season all the weathered mulches were tilled down. In Experiments 2 and 3, which included only one mulch product, Experimental PLA/PHA, the mulch was tilled down on the same day of laying to avoid any degradation. In all three experiments mulch samples were collected with a golf cup cutter (10.16 cm diameter and 15.24 cm deep). In the first experiment, five soil samples (0.6% of the soil in the bed, based on volume) were collected randomly in each plot. A maximum of 60% of the mulch fragments were captured from the reference plot, and the percent recovery ranged from 13% to 53% for other treatments. Additionally, there was high plot-to-plot variation in the amount of mulch captured (3% to 83%). In Experiment 2, 15 soil samples (1.7% of the soil in the bed) were collected from each plot.

Preliminary results show that 70% of mulch fragments was recovered, and more mulch was found towards the edges of the plots compared to the center. In the third experiment, 128 samples (79% of the soil in the bed) were collected from each plot, and preliminary results indicate that 72% of the mulch fragments were captured. Preliminary results from this study show that soil sampling with a relatively large soil core (10.16 cm x15.24 cm) captures less than 75% of the mulch post-incorporation, and a reasonable number of soil core sampling (10 cores per plot) will not provide an accurate estimate of mulch fragments, and new methods must be developed.

Increasing Plant-available Phosphorus through Effective Microorganism Treatment

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Organic fertilizer sources (manures) often contain large amounts of organic phosphorus unavailable for plant uptake until undergoing enzymatically catalyzed release reactions. Phosphatases produced by soil microbes drive the hydrolysis of phosphate groups from organic molecules, producing phosphate ions available for nutrient uptake by crops. Phosphatases are more prevalent in soil when the soil microbiome is high in biodiversity and biomass. Adding biodiversity and biomass through microbial inoculants (Local Effective Microorganisms-LEM) may increase plant-availability of nutrients supplied by organic fertilizers. The objective of the research project focuses on increasing the hydrolytic release of phosphate ions by applying a microbiallly-inoculated treatment during composting of locally-sourced, organically raised broiler litter and to the field plots post-application of the compost. If higher biodiversity and biomass indicate higher amounts of plant-available phosphate anions, the crop could potentially produce a higher yield, a more nutrient-dense crop, or both. For end of season sampling, it would be expected for the LEM-treatment to show the lowest amounts of available P as phosphorus present in these plots would become available for uptake earlier in the season than the control or false-LEM (FLEM) plots. The crops planted in the LEM plots will also be expected to have a higher nutrient density than crops planted in control or FLEM plots. Differences in P ppm between FLEM and LEM plots were small for both years of baseline sampling, but showed a significant difference in P ppm for the second post-treatment application sampling in the 2016 season.

Organic IPM Working Group Poster
Ali Loker and Karen McSwain

One of the greatest challenges of the 21st century is the need to feed a growing population while improving the productive capacity of agricultural ecosystems and the health and integrity of surrounding environments for future generations. Integrated Pest Management (IPM) and organic production methods can work together to address this vital challenge. These two groups share broadly overlapping interests in environmentally conscious food production, yet few opportunities exist for cross-pollination of ideas between them.

Organic and IPM advocates, researchers, and practitioners from all facets of the agricultural arena, with diverse backgrounds in agronomy, entomology, plant pathology, marketing and communications, and commercial production, share a desire to work together to meet the demands of 21st century food production. Shared interests include promoting and improving environmental quality, farm economic viability, social equity, and soil and human health. Organic is wholly compatible with advanced, biologically based IPM and most IPM principles and tactics will work in organic systems.

Despite common interests and tactics, few leaders and practitioners actively participate in both the IPM and organic communities, foregoing the synergies that could come from exchanging thoughts and ideas, and joint pursuit of common priorities. Our Working Group's goals include illuminating ways that organic and IPM can work together to spur further inquiry, discussion and action leading to increased adoption and growth in the benefits more sustainable production systems deliver.
The Organic and IPM Working Group has developed the following publications detailing the challenges these two communities face and opportunities for collaboration:

- White Paper entitled "Organic Agriculture and Integrated Pest Management: Synergistic Partnership Needed to Improve the Sustainability of Agriculture and

Food Systems" (2015). Distributed to a variety of national and international outlets.
    - The white paper resulted in an invitation to write a special issue of *Biological Control*. The group will pursue this project in 2017, with estimated publication in early 2018.
- Fact Sheet entitled "Organic Agriculture & Integrated Pest Management (IPM): Working Together for Sustainability" (2015). Distributed to eOrganic Newsletter in 2016.
- July 2016 Issue of IPM Insights via Northeastern IPM Center.

In addition to these publications, the group has also participated in and provided feedback about several important programs involving the organic and IPM communities. Group members have participated in regional and national priority setting meetings for the IR-4 program and have sent a letter with recommendations for improvements to the program. The working group has had initial discussions about potential involvement with federal agencies to address barriers facing organic and IPM growers.

The Organic and IPM Working Group poster will provide an overview of the group's history, mission and projects (past, current and future). Group members in attendance will coordinate the presentation. We invite you to visit our website for more information. Please contact Ali Loker, working group coordinator or Karen McSwain, working group member, with any questions.

Using Local Effective Microorganisms to Improve Nutrient Use Efficiency of Organic Amendments

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The USDA NRCS Soil Health Initiative is calling for a fundamental shift in the way we care for our nations soils. Soils must be viewed not as an inert growing medium but as an ecosystem teeming with billions of bacteria, fungi and other microbes. Locally Effective Microorganisms (LEM) is a concentrated solution of locally-derived microorganisms produced using partially decomposed leaf litter mixed with carbohydrate rich substrates. It is used around the world as a way to reduce foul odors and flies in animal production and composting areas. LEM is a simple tool that has the potential to influence the sustainability of organic farming systems in a number of ways by promoting the use of available, on-site nutrients such as animal wastes and compost, increasing the plant availability of nutrients within the soil and improving soil health/resilience through increased biodiversity. Despite its growing prevalence among small-scale farmers in tropical parts of the world and the potential for its incorporation into organic farming systems in the southeastern U.S., there is little published research that explores the beneficial or detrimental agronomic effects of changing the microbial communities of the soils to which they are applied.
The aim of this research was to evaluate LEM's effect on soil microbial communities, on the cycling and availability of important plant nutrients and its effect on crop yield and quality. Three treatments: LEM, false-LEM and a control(water) were added to swine effluent used to fertilize annual rye grass (*Lolium multiflorum* L.). Potentially mineralized nitrogen was determined using soil incubations and KCl extraction. Nematode community structure was analyzed through extraction, counting and identification to

trophic group (bacterial feeders, fungal-feeders, plant feeders, predators, omnivores and tylenchidae). Yield measurements were taken twice per season and multiple samplings were taken and analyzed for forage quality. Using multivariate analysis of variance (MANOVA) repeated measures, N mineralization was found to be higher among the LEM-treated soils. Though significant changes in both nematode abundance and community structure were observed over the course of the growing seasons, only some significant changes in these variables were found between treatments. Using MANOVA, higher populations of plant parasitic nematodes were observed in LEM-treated plots both years. This increased abundance in plant parasite populations did not, however, result in any significant differences in forage yield or quality. Based on these results, there has been no evidence that the application of LEM to organic fertilizers has any negative effects on forage production and in some instances plant available N was increased through the application of LEM. Increasing plant-available N would increase nitrogen use efficiency leading to greater fertility. Further investigation is warranted to determine the methods and timing to be used to optimize LEM's potential benefits.

2016 National Organic Research Agenda
Joanna Ory, OFRF

This 2016 National Organic Research Agenda (NORA) report provides comprehensive recommendations for future investment in organic agricultural research. These recommendations are based on the Organic Farming Research Foundation's 2015 survey of organic farmers, nationwide listening sessions with organic farmers, and a review of key documents and recommendations from other organizations. The 2015 Organic Farmer Survey was conducted online and completed by over 1,000 organic farmers. Their responses directly inform our top recommendations for organic research, including intensified research funding and attention to the areas of: soil health and fertility management, weed management, nutritional benefits of organic food, insect management, and disease management.

Cover Crop Influence on Stored Soil Water Availability to Subsequent Crops
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Reducing weed pressure on crops without affecting soil health through intense and frequent tillage and cultivation practices is a major challenge in sustainable crop production. With the increasing interest toward organic grain production in the southeastern US, fall cover crops could be explored as a sustainable practice that improve cropping system intensity and diversity as well as improving soil health and reducing weed pressure. Despite the potential benefits, few grain producers in the southeast have included cover crops as part of their cropping systems because of several challenges. One of the major concerns of producers is the possibility that cover crops may reduce the amount of water stored in the soil profile for the next grain crop, potentially reducing yields. This is a primary concern for corn producers as reduced soil water availability is a major constraint for corn production in the southeast.
In SC, 35 counties were declared as primary disaster areas due to drought by USDA in 2015. Thus, climate patterns also emphasizes the need for evaluating water use of fall cover crops in order to minimize water stress for the following cash crop. Therefore, it is imperative to test the effect of cover crops on stored soil water before they are introduced to the cropping system for sustainably managing weeds and improving soil health. The objective of this study is to evaluate the common cover crop species in

South Carolina for water use and biomass production. We will evaluate seven cover crop treatments including grasses, legumes, and brassicas as single species or in mixtures in an on-farm trial conducted in collaboration with a farmer. Water use of cover crops will be compared with that of two control treatments; fallow with herbicide control (weed free) and fallow without herbicide control (with weeds). Treatments will be applied in plots of 6 m by 6 m. The experimental design will be a randomized complete block with five replications. Soil water content will be measured at 10, 20, 30, 40, 60, and 100 cm depths at biweekly intervals starting from cover crop establishment (~3 weeks after planting) until one month after planting of next cash crop (soybean). Biomass will be measured at monthly intervals throughout the cover crop season.

Cover crop water use efficiency will be estimated as the amount of dry biomass produced per unit of water used during the growing period. Identification of high water use efficient cover crops (single species/mixes) would help identify cover crops that produce large amount of biomass, use less amount of water or a combination of both. This study is currently underway. The study will provide information to develop grower recommendations on specific cover crops to optimize biomass and soil moisture for subsequent crops.

Strategic-Rotational Grazing in Beef-Pastures for Improving Sustainability, as Measured by Soil Health, and Forage Productivity

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As the pasture-based beef-industry is an important contributor to the Gross Domestic Product of south-eastern USA, continuous improvement of the grazing management system, for a healthy, productive, and more-sustainable beef-pasture, is very important. This study aims to compare the "strategic-rotational grazing" with "conventional grazing" in terms of soil health, and forage productivity. In 2015, a baseline soil health study was conducted in 10 pastures of Georgia Southern Piedmont. Five soil health indicators were studied in 18% of randomly selected locations (of a 50-m grid ("matrix") of the pastures, as well as specific areas with high cattle activity ("AOIs"). In-field chambers, with sealable headspace, were used to measure CO_2 evolved using alkali traps. Soil samples were collected and analyzed to assess other soil health indicators.

A novel grazing management system (strategic-rotational grazing) was devised, which consisted of better grazing techniques such as: exclusion of vulnerable areas, over seeding the exclusions, short-term flash grazing of the exclusions, and cattle luring techniques (portable shades, hay, and waterer). In June 2016, strategic-rotational grazing was followed in five pastures and conventional grazing was followed in five. During the baseline study, in 2015, we found that the "AOIs" were significantly higher in nutrients (Loss in Ignition Carbon and Potentially mineralizable Nitrogen), and enzymes (Urease) but the soil-respiration was significantly lower as compared to the "matrix". Average soil respiration was significantly higher in the 'matrix" (1256.98 mg CO_2/day/m^2) as compared to the "AOIs" (1047.58 mg CO_2/day/m^2) suggesting slower microbial activity. In Summer 2016, after the implementation of strategic-rotational grazing, we found that the average soil respiration in the "AOIs" (1077.18 mg CO_2/day/m^2). While still lower as compared to the “matrix” (1370.46 mg CO_2/day/m^2) the difference was not statistically significant.

In 2015 (baseline), no ammonia volatilization was observed in any place in the pastures, whereas, in 2016, higher ammonia volatilization was observed in the “matrix”. The higher ammonia volatilization in “matrix” suggests the usefulness of portable shades and waterers in facilitating distribution of cattle associated nutrients (urine and feces) across the pastures. In one of the study sites, significantly less amount of hay (average of 17 bales) was required in the pastures in which “strategic-rotational grazing” management was followed, as compared to (average of 45 bales) conventionally grazed pastures. Also, the NDVI images created from satellites data (Sentinel-2) also demonstrated higher overall biomass of forages in the strategic-rotational pastures as a result of excluding the AOIs, and rotating the cows. While it is still early stage of our research, strategic-rotational grazing practice appears to be rapidly improving the soil health and forage productivity in these Georgia Southern Piedmont pastures.

Performance Evaluation of Five Sweet Potato Cultivars in North Central Missouri
Waana Kaluwasha, Xi Xiong, Robert Kremer, Jeanne Mihail, Zelalem Mersha and Mengshi Lin

Sweet potato, *Ipomoea batatas (L.) Lam*. is the world’s seventh most important food crop, and an important specialty crop in the United States which ranks 10^{th} in production. In the North Central region of Missouri, sweet potato is considered an alternate crop for farm markets and is occasionally under commercial production. Because of its high nutritional value, flavorful sweetness and ability to withstand environmental extremes, there has been an increase in both production and consumption of the crop over the years. Furthermore, demand for organically produced food has increased 24% yearly in the US since the 1990s. Organic producers are however challenged by issues such as soil health, weed, insect and disease management as well as nutritional quality of the crop. There is very limited information regarding the performance of sweet potato varieties in North Central Missouri, which would be very useful in addressing some of the challenges faced by organic farmers.

The objective of this study was therefore to evaluate sweet potato cultivars commonly grown in mid-Missouri for their performance in terms of tolerance to disease and insect, marketable yield, and nutritional quality. Five cultivars namely Beauregard, Covington, Centennial, Murasaki-29 and Jewel which range in maturity from 90 to 120 days were selected based on tolerance to disease, yield and social acceptance. The field experiment was conducted at the Bradford Research Centre in Columbia, Missouri in a split-plot randomized complete block design with four replications. The whole plot variable was the cultivar which was randomly assigned (10 x 40 ft^2), the sub plot was with or without inoculum randomly assigned (10 x 15ft^2). Slips were first hardened in the greenhouse for about three weeks before transplanting to the field, and planted at a spacing of 12 inches. Inoculation of subplots using four fungal isolates isolated from diseased sweet potato tubers collected from a local farmer, and grown in a cornmeal-perlite mixture was done the same day as transplanting. After transplanting, plants were fertilized once at 5 weeks after planting to provide 40 lbs N, 170 lbs P and 195 lbs K based on soil test. Dripping irrigation was installed in addition to precipitations. Weeding was done using a hand hoe once every two weeks initially then as need arose for the rest of the period. Data collected included evaluation of plant vigor based on a 1-5 scale, insect damage based on percent area fed on by insects per plant at week 8 and week

11. Other evaluations include the aboveground biomass at harvest, disease incidence of tubers, marketable yield of each cultivar and the tuber quality. This experiment is still ongoing, and results will be discussed in the presentation. It is however expected that there will be differences among the varieties.

Session 6: Social Science

Parallels in the Raw Milk and Organic Agriculture Movements

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In recent decades a diverse community of dairy farmers, consumers and nutrition advocates has campaigned to secure and expand the right for individuals to produce, sell and consume fresh unpasteurized milk, commonly referred to as "raw milk". Their efforts to increase public access to raw milk share important parallels with the emergence of the organic food movement over the past century. Both the raw milk and organic food movements originated with farmers and consumers who sought to replace industrialized food production and processing practices with more traditional ones. Both movements equate the preservation of natural integrity in farming and food handling with more wholesome, nutritious food and environmental conservation. Advocates for both movements have had to work diligently to overcome perceptions that the food production and processing practices they endorse are relevant in the modern era, notably with regard to organic agriculture's productivity and the safety of raw milk. Finally, the raw milk movement has the potential to economically benefit family farmers much as organic agriculture has proven capable of doing.

The Nature of Spatial Externalities in the Decision to Adopt Organic Production Systems

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It is widely recognized that spatial externalities impact the decision to adopt agricultural technology and production systems. In particular, the probability that a given farmer transitions from conventional to organic production in the United States has been shown to be significantly increased by the presence of neighboring organic farms (Lewis, Barham, & Robinson, 2011). While studies in both the rural sociology and economics literature have explored the determinants of organic adoption, the nature of the positive spatial externality created by nearby organic farms remains elusive. Specifically, are farms with established organic neighbors more likely to adopt because their presence helps lessen the cost of acquiring technical and marketing information? Or does the presence of early adopting organic farms reduce the "social costs" of adopting an uncommon and possibly controversial production system? This study is the first to identify the nature of the positive spatial externality created by organic producers in the decision of subsequent farmers to adopt organic systems.
We analyze organic certification and surrender behavior using a spatially-explicit panel dataset of certification records for organic farms in Oregon. The data, provided by the largest certifying bodies in the state (including Oregon Tilth, California Certified Organic Farmers, Oregon Department of Agriculture, and Washington State Department of Agriculture), include certification and surrender dates, geographic locations of each farm,

as well as crop and livestock products produced by each operation. These data are joined with tax lot databases and crop layers that provide information on the number and proximity of agricultural neighbors as well as the types of crop and livestock systems that predominate in each area. Contextual information, including distance to population centers, dominant cropping and livestock systems in the region, and conventional farm profitability measures, are also included in the model.

Preliminary results suggest that existing organic farms and processors do increase the probability that an additional nearby farm achieves organic certification, and that this effect persists regardless of enterprise type. This extends the conclusions of Lewis, Barham, & Robinson and shows that farms need not produce the same crops or livestock products to positively influence additional transition. In light of this research, the interesting question is: would organic promotion and outreach efforts be more effectively targeted on areas without existing organic farms or those areas with existing "clusters" of organic growers. I am keenly interested in discussing this issue with conference participants.

Lewis, D., Barham, B., & Robinson, B. (2011). Are there spatial spillovers in the adoption of clean technology? The case of organic dairy farming. *Land Economics*, *87*(May), 250–267. Retrieved from http://le.uwpress.org/content/87/2/250.short

The Changing Geography of U.S. Organic Production

- Maria Bowman[1], Claudia Hitaj, Catherine Greene

Organic products account for approximately 5% of total retail food sales in the United States, and consumer demand for organic food continues to grow (Organic Trade Association, 2016a). According to a 2014 poll by the Gallup organization, 45% of Americans actively try to include organic foods in their diets—and a 2014 Consumer Reports survey found that 84% of consumers buy organic food "sometimes", while 45% buy organic food at least once a month (Riffkin, 2014; Watson, 2014). In response to this increased demand, certified organic acreage and livestock numbers have continued to grow, particularly for fruits, vegetables, dairy, and poultry. Though less than 1% of cropland is certified as organic, more than 6% of the land in vegetable production is certified as organic, and organic fruit and vegetables now account for 13% of the retail market for those products (Greene, 2013; Organic Trade Association, 2016b).

Using the Organic Integrity Database maintained by the USDA Agricultural Marketing Service National Organic Program, we compile data on the certification status, location, operation type, and products produced by certified organic operations in the United States to investigate how the sector has been changing over time. In what regions is the number of organic operations expanding, and how is the geography of crop vs. livestock operations changing over time? Where possible, we supplement this analysis of geographic trends in the industry with data on organic production from the Economic Research Service's Agricultural Resource Management Survey and the National Agricultural Statistical Service's Organic Survey.

Figure 1 shows the regional concentration of currently-certified operations that produce crops and/or livestock. The highest level of adoption of organic certification was in the northeastern states, particularly in Vermont and Maine, where 7.7% and 5.8% of farm

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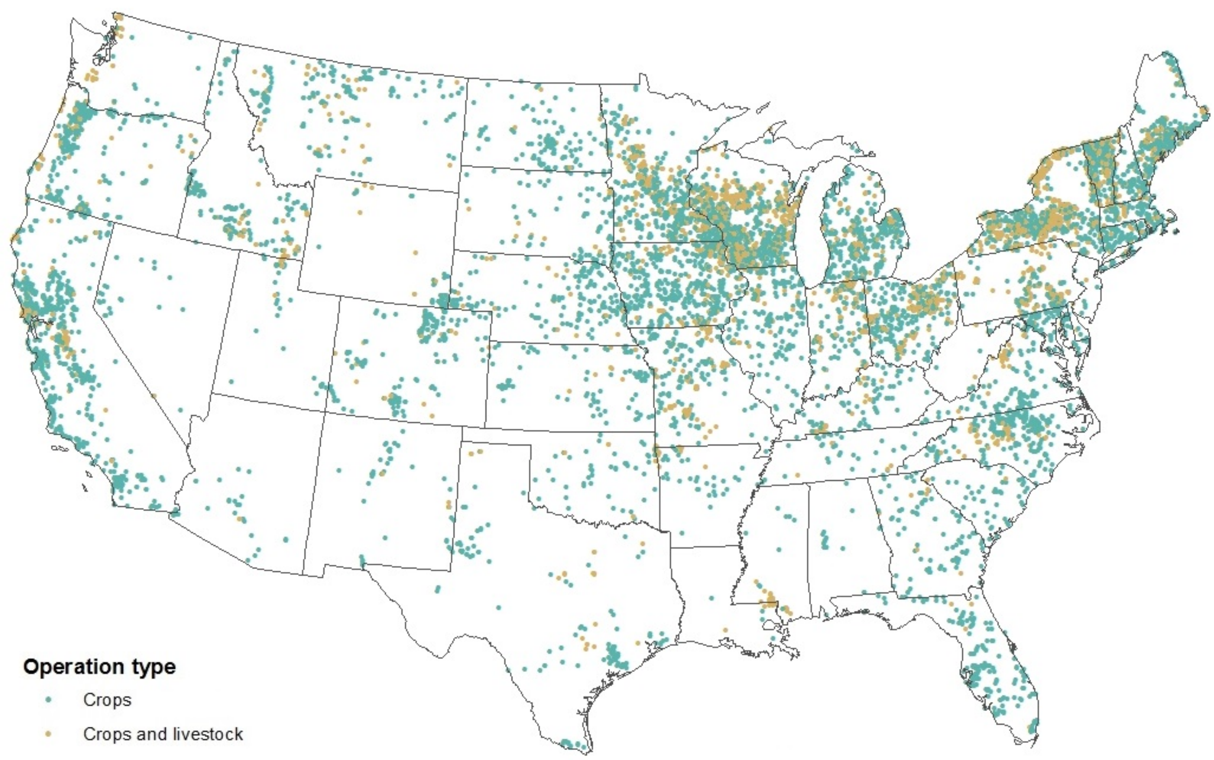
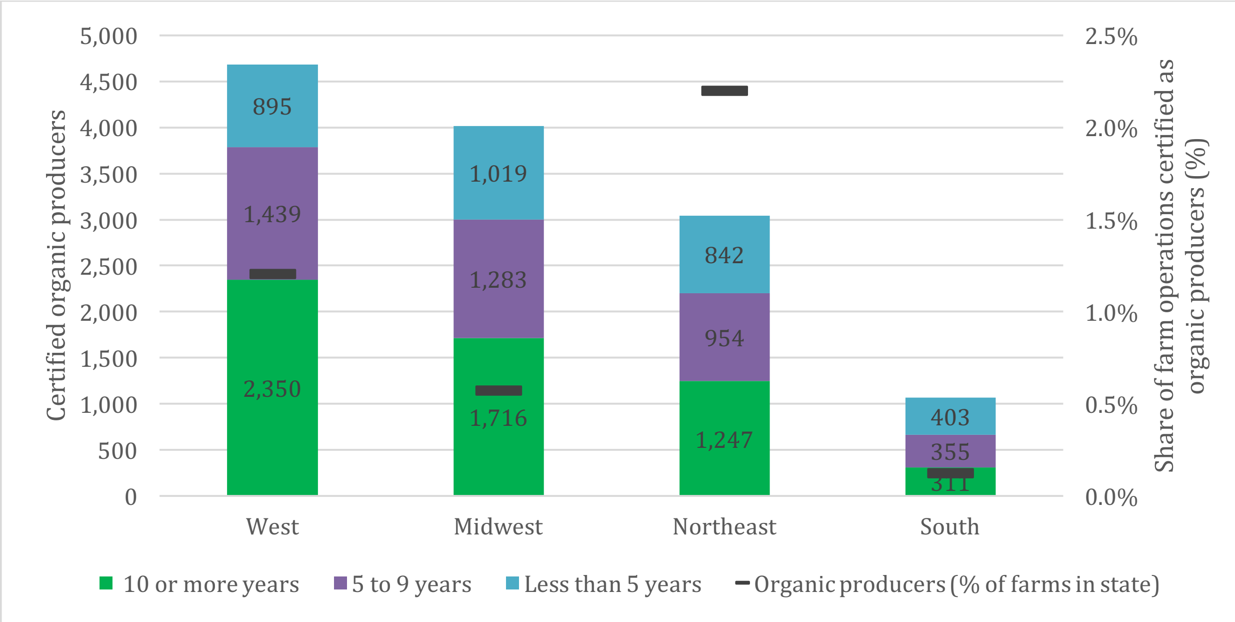
operations were certified organic, as well as in California, where about 3.4% were certified organic. California has the largest number of organic farms, with 2,637 certified organic farms in 2015 (NASS 2016). New York, Indiana, North Carolina, Missouri, and Texas are all high-growth states, where the Integrity database suggests that more than half of operations (excluding those only certified as handlers) were newly certified since 2013. Figure 2 shows that proportionally more operations were added during the last 5 years in the South relative to other regions. Reasons for this growth in operations in the South may include new interest from Southern produce distributors, and increases in a number of states may be related to public and private initiatives to increase domestic organic grain production.

Figure 1. Location of certified organic farms in January 2016



Source: Organic Integrity Database, January 2016 (https://apps.ams.usda.gov/integrity/). Note: This map includes certified organic farms that produce crops and/or livestock (operations that are only certified as handlers of organic products are excluded).

Figure 2. Certified organic producers by region and period of certification, as well as share of farm operations within a region that are certified organic.



Source: NASS 2015 Certified Organic Survey and NASS 2012 Census of Agriculture. Note: This chart includes only certified organic producers of crops and/or livestock and excludes operations that are certified in handling only.

References

Greene, Catherine. 2013. Growth Patterns in the U.S. Organic Industry. *Amber Waves Magazine.* October 24, 2013. http://www.ers.usda.gov/amber-waves/2013/october/growth-patterns-in-the-us-organic-industry/ .

NASS (2016). 2015 Certified Organic Survey. National Agricultural Statistics Service, US Department of Agriculture.

Organic Trade Association. 2016a. 2016 State of Organic Industry Fact Sheet. https://www.ota.com/resources/market-analysis .

Organic Trade Association. 2016b. State of Organic Produce Industry Infographic 2016. https://www.ota.com/resources/market-analysis .

Riffkin, Rebecca. 2014. Forty-Five Percent of Americans Seek Out Organic Foods. The Gallup Organization. http://www.gallup.com/poll/174524/forty-five-percent-americans-seek-organic-foods.aspx .

Watson, Elaine. 2014. Consumer Reports: 84% of US consumers buy food with organic seal, but some are confused about its meaning. Food Navigator USA. http://www.foodnavigator-usa.com/Markets/Consumer-Reports-84-of-US-consumers-buy-food-with-organic-seal-but-some-are-confused-about-its-meaning

Adoption of Industrial Hemp by Organic Farmers in Indiana: An Agronomic and Social Perspective

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Industrial hemp (*Cannabis sativa* L.) is used to produce a wide range of products including foods, beverages, nutritional supplements, fabrics, and textiles. Although interest is high and there are encouraging signs that industrial hemp may soon be legal to grow again in the United States, Hemp has not been grown in this country for nearly 80 years. Research is needed to address production issues in Indiana. Hemp has been bred for Europe and Canada, however with different climatic and soil conditions, research is needed to determine the effect of planting date and cultivar selection on hemp growth in organic systems in Indiana. Thus, the agronomic project objectives are to 1) characterize the growth and phenology of industrial hemp cultivars and identify cultivars suitable for growing conditions in the Midwest. It has been suggested that hemp might be particularly well-suited for organic production because it is believed to compete well with weeds, experience relatively low disease and insect damage, and its extensive root system can improve tilth and add organic matter to the soil (Ehrensing, 1998; Kraenzel et al., 1998). Over the long-term, this project has the potential to improve organic farming systems and make existing farms more profitable by providing research-based information on agricultural practices necessary to re-establish industrial hemp. This will contribute to the rebuilding of crop diversity on organic farms. This research should be conducted before the crop becomes widely available so that farmers can make informed decisions and avoid costly mistakes.

Ten cultivars, seven seed varieties and three fiver varieties, were imported from seed companies in Canada and Europe and seeded at three separate planting dates (June 2, June 20, June 30). Number of plants within a two row by 1.8 meter quadrat were recorded five days after planting (DAP) and then on a weekly basis until harvest. Additionally, type of flowering plants were recorded each week and distinguish between male and female plants, as well as the height of ten plants per quadrat were measured on a weekly basis. This approach, although time-consuming, allows for characterization of changes in height over time as well as to estimate time to emergence (a measure of seedling vigor), and time required for seed production. Using the staging code set forth by Mediavilla (Mediavilla et al., 1998), plants were harvested by hand at seed maturity (Aug. 17, Aug. 30, Sept. 19), stripped to separate stalks from leaves and fluorescence, weighed, and dried. Seed samples will be cleaned and seed oil and protein content will be determined on a dry matter basis.

Preliminary results show distinct height differences among cultivars, especially between seed and fiber varieties. Emergence increased across planting date, however, this was due to equipment used and depth placement. Fresh weight yield was significantly lower at the third planting date, while there was not a significant difference between the first and second planting dates across cultivars.

Session 7: Organic Crop Breeding

The Effect of Sowing Density on Biomass Production of Autumn Sown Fava Bean and Lupin: Opportunities for Improvement via Selection

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The USDA-ARS Western Regional Plant Introduction Station's (WRPIS) mission is to evaluate, enhance, and distribute plant genetic resources via research. Since the cool-season food legume germplasm is maintained at the WRPIS we have a wealth of opportunity and responsibility to employ this genetic diversity in order to assist organic producers in adapting to environmental uncertainty. One application of legumes in crop rotations is as a green manure or cover crop with the aim of maximizing soil health, a main tenant of organic farming. While the breadth of cover cropping research is extensive there remains a need to identify the suite of winter covers, which may contribute to soil health. To address this need we have initiated two field trials to examine the effects of three sowing densities (30, 60, and 90 plants/m^2) for nine varieties (or breeding lines) of faba bean (*Vicia faba* L.), white (*Lupinus albus* L.) and blue lupin (*Lupinus angustifolius* L.) on biomass production. Both trials were autumn sown on 25 August 2015 at the USDA-ARS Central Ferry Research Farm in southeastern Washington following a split plot randomized complete block design with three replications. Sowing density was the main plot and variety was set as the sub plot.

Plot size was 9 x 1.3m and row spacing was 0.32 m for four row plots. For the 90 plants/m^2 plots seven row plots (0.18 m spacing) were utilized. Random 1m quadrats were sampled for biomass yield of weeds and faba bean at flowering (20 April) and again at the initiation of pod set (20 May). The outer rows served as the border and were not harvested. Biomass was dried, ground, and analyzed for nitrogen:carbon. The lupin trial was not harvested for biomass due to low stand counts and high weed pressure. The white and blue lupin varieties tested were discovered to be determinant types more suited for grain production rather than as a green manure/cover crop and emergence was severely impacted by late flights of seed corn maggots. Screening of white and blue lupin germplasm has identified genotypes with promising winter-hardiness and biomass production, with possible tolerance to this damaging pest. For winter faba bean, 60 plants/m^2 showed the highest biomass production across varieties, but was not substantially different from 90 plants/m^2. Weed pressure was lessened with the 90. plants/m^2 compared to the 30 plants/m^2 , but not substantially different from 60 plants/m^2 Therefore, the agronomic justification for the highest sowing rate may not compensate for the cost of seed. Germplasm amenable to use as a cover crop/green manure have been identified, but still require testing across multiple environments.

Conventional Breeding (non-GMO) of Tomato for Insect Resistance

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Wild relatives of crop plants often possess valuable traits, especially traits that may contribute to greater sustainability of agricultural systems. Tomato has had its sustainability improved by transfer of traits from wild relatives to the crop using conventional plant breeding methods. Resistance to common diseases such as fusarium and verticillium has been utilized for more than 60 years. More recently resistances to viruses such as tomato spotted wilt and tomato yellow leaf curl (TYLCV) viruses have been transferred from wild to cultivated tomato and are widely utilized. Resistance to devastating TYLCV has been notably beneficial in temperate areas where this virus and its associated tropical and subtropical vector are now present due to widespread tomato production in protected environments. Nearly twenty viral, bacterial and fungal resistances have been conventionally bred into tomato, an impressive number. Most of these traits are controlled by single genes, which are easier for plant breeders to transfer from wild relatives to cultivated crops, compared to multigene traits.

At least three species of wild tomatoes have been identified as resistant to insects and spidermites. Collectively these pests are known as arthropods. One wild species, known as Solanum habrochaites (S.h.) is nearly immune to arthropod attack. Unfortunately, it is unlikely that insect resistance is controlled a by single gene making resistance more difficult to transfer by conventional breeding. Research by the author and others has revealed that S.h. is resistant to arthropods because it has specialized trichomes (plant hairs) that produce compounds that act to deter or repel arthropods from its leaf surfaces. Neither character, the trichome or its associated anti-arthropod compound are present in cultivated tomato. Because trichomes and their associated compounds have been implicated in resistance, we are attempting to transfer or introgress these characters from wild to cultivated tomato using a modified backcross breeding approach. Success should lead to reduced pesticide applications on tomatoes and increased genetic diversity of tomato, characteristics particularly valuable for organic producers, especially those who are producing tomatoes in protected environments, an environment often be accompanied by greater arthropod pressure on the crop.

S.h., the arthropod-resistant species, easily crosses with tomato to produce an interspecific F1 hybrid. However, these hybrids rarely set fruit after self-pollination, a characteristic inherited in subsequent generations, which considerably delays breeding progress. A concerted effort has been undertaken to introgress the specialized trichome and its anti-arthropod compound from S.h. to cultivated tomato. Simultaneously efforts have been made to select hybrids that set fruit after self-pollination. We have now have the third back cross generation (BC3, the generation that has been back crossed three times to tomato). A few individuals having high densities of the specialized trichome, high concentrations of anti-arthropod compound and that set fruit upon self-pollination have been identified and will be used to generate future generations. Research methods, recent results and future breeding plans will be presented for discussion. In addition these breeding efforts will be discussed in light of the 2015 USDA publication “Roadmap for Plant Breeding” and potential benefits for organic agriculture.

Improving Plant Genetics for Soil Health and Organic Production
- Mark Schonbeck, OFRF

Plant breeding and genetics can play an important role in building soil health. Most modern crop cultivars have been bred and selected to perform well in conventional farming systems over wide geographic ranges, and today’s seed catalogues offer few regionally adapted cultivars suited to organic and low-input production systems. In recent years, several farmer-participatory plant breeding networks across the US have begun to address this critical unmet need.

Plant breeding and cultivar development conducted for and within the context of organic farming systems can lead to improved organic crop yields, and thereby facilitate adoption of organic practices that protect and build soil health. In addition, breeding crops for the following traits may contribute directly to soil and water quality:

- Enhanced ability to utilize nitrogen (N) and other nutrients from organic sources.
- Enhanced symbiotic N fixation.
- Enhanced association with mycorrhizal fungi and other beneficial micro-organisms that assist nutrient uptake, promote tight nutrient cycling, and deter plant pathogens.
- Enhanced root biomass, depth, lateral spread, volume, exudation, and rhizodeposition, which build soil organic matter (SOM) throughout the soil profile.
- Increased above ground growth and cover (live plant and residue), which protect the soil surface and add organic matter.
- Increased weed tolerance and weed competitiveness through rapid emergence and establishment, tall or dense canopy, or other traits.
- Ability to establish, thrive, and yield in cover crop based conservation tillage

systems.
· For cover crops: high biomass, weed suppression, effective N fixation or nutrient scavenging, winter hardiness, and ease of termination by mowing or roll-crimping.

In addition to enhancing SOM and soil life directly, regionally adapted cultivars with these traits would reduce the need for tillage and cultivation for weed control, facilitate the use of cover crops, and reduce reliance on applied nutrients to maintain satisfactory yield and quality.

Session 8: Organic Economic Trends

Understanding Organic Feed Grains Prices

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In 2014, the United States was the world's largest market for organic foods, valued at $30.5 billion, and it had 5.4 million acres of organic agricultural land, which accounted for 0.6 percent total of its agricultural land (Greene, 2013). The expansion of the U.S. organic food market has been driven mainly by fruit and vegetable production, which tend to be high value crops. There is also a growing demand for organic meat and milk products; however, these two sectors are currently facing shortages of domestically-produced organic grains and soybeans to feed the growing number of organic certified livestock. It is important to note that field crops remain a very small portion of the U.S. organic agriculture, and the domestic supply response and been slow and lagging. As a result, there has been recent and significant increases in the imports of organic feed grains. These grain shortages are likely linked to organic production requirements, a lack of information detailing the relative costs and returns of organic grain production, and a limited understanding of organic prices and premiums. Furthermore, the U.S. organic grain market is characterized by being thin and equipped with less risk management tools. Under these market conditions, it is plausible that there may be differences in price volatility for organic grains and their conventional counterparts, and that long-term relationships between both prices may not hold. A graphical analysis of historical price data reveals that, organic price premiums greatly diminished during the recent economic recession and the months following it. In the cases of corn, wheat, and barley, organic prices converged with conventional ones, and the premiums disappeared for several months. This may be an indication that organic prices are more volatile under adverse economic conditions.

The overall objective of this study is to conduct price analysis for organic and conventional corn, soybeans, wheat, oats, and barley. Specific goals of this study include: (1) assessing price volatility levels of organic and conventional grains; and (2) testing for long-term relationships between conventional and organic grain prices. Differences in variance and the coefficient of variation were used to measure price volatility, and reflect relative price risk for organic versus conventional commodity producers. The Welch F-test was used to test equality of price means (Welch, 1951), and the Brown-Forsythe Test was applied as the primary test of equality in variance (Brown and Forsythe, 1974). Cointegration tests were conducted to identify the presence of long-term relationship between prices, and Granger causality was estimated when appropriate. The volatility analysis was done for the 2007-2015 period as well as for three different sub-periods (pre-recession, recession, and post-recession). Organic and conventional price data for corn, soybeans, wheat, oats, and barley was obtained from the following sources: Mercaris, a market data service; USDA National Organic Grain and Feedstuffs Biweekly Reports; and USDA-NASS Quick Stats.

Study findings reveal that for the entire period of analysis, market prices of organic corn, soybeans, and oats were less volatile. Organic wheat and barley market prices experienced higher volatility than their conventional counterparts. During recession months, all organic prices became more volatile relative to their conventional counterparts. Soybean organic prices appear to be more resilient to adverse overall economic conditions. No long-term relationships were found between organic and conventional prices for any of the five grains. However, conventional corn and soybeans prices were found to "Granger-cause" their organic counterparts. That is, after controlling for past organic prices, past conventional prices are useful to predict futures organic prices of these two commodities.

Using Census Data to Analyze the Relative Resiliency of Organic and Conventional Wheat

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Two long-standing questions are (1) whether yields of organic and conventional farming systems differ and (2) how resilient are organic farming systems, in terms of ability to withstand poor weather conditions. A recent meta-analysis finds that with good management practices and growing conditions, on a global scale, organic and conventional yields are similar for certain crops, but that overall organic farms have yields about 80 percent of those on conventional farms.[2] One drawback to many studies is the reliance of data produced on research farms or through farming system trials rather than working farms. Yet analysis of data from working farms, collected by USDA's Agriculture Resource and Management Survey, suggests that yield differences on working farms appear to be larger than the farming systems trials predict.[3]

This research makes use of USDA's Organic Production Survey (2008, 2011, 2014 and 2015) along with USDA's annual survey of farms, to analyze organic wheat and conventional wheat production. Farm economic data for durum wheat, spring and winter wheat are analyzed. We use an economic model to examine the relationship between yields and the explanatory variables of farm size, acres, rainfall and temperature for organic and conventional production systems. By focusing on one crop, we can assess yield differentials around the nation without having to account for crop differentials. The inclusion of weather variables allows us to test for differences, if any, between the response of wheat yields to variation in weather under the organic and conventional farming systems.

[1] Seufert, V., N. Ramankutty, and J.A. Foley. 2012. "Comparing the yields of organic and conventional agriculture." *Nature.* 485, 229-232.

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[1] McBride, W. D., & Greene, C. 2009. The profitability of organic soybean production. *Renewable agriculture and food systems*, *24*(04), 276-284.

Motivations and Challenges of Farmer Transition to Organic Farming: United States and Oregon Studies

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Chris Schreiner and Sara Brown (Oregon Tilth, Inc.)

Despite significant domestic market demand for organic products, there is a lag in domestic organic production. More farmers transitioning to organic production would help meet this consumer demand, reduce agricultural impacts on the environment and likely provide increased profitability for transitioned farmers. These two studies investigate farmer motivations and challenges to transition to organic production.

The first study, utilizes survey research to investigate farmer motivations and perceived challenges to transition to organic farming in the United States. In a collaboration between the Oregon State University Center for Small Farms and Oregon Tilth, Inc. a survey questionnaire was administered to over 1800 farmers who had an Organic Initiative contract with the USDA NRCS during the period from 2010 to 2015. The questionnaire probed for ideological and economic motivations as well as perceived challenges to organic transition. The analysis found both similarities and significant differences between categories of farmers who were transitioning, were fully organic, had split organic/conventional operations, or were not pursuing organic farming. In addition, various cropping systems and beginning farmers were examined. Lastly, farmers were asked to identify resources and support that will assist during the transition, and to offer advice on how to motivate more farmers to transition to organic farming.

The second study (Loyd and Stephenson), utilizes survey and case study methods to investigate farmer perceptions on the transition to organic farming in Oregon. First, 30 farmers were surveyed who were transitioning or had recently received certification by Oregon Tilth, Inc. during 2014-15. The analysis placed farmers into three categories based on their overall farming experience and their experience with organic farming: Experienced Organic Farmer, Beginning Organic Farmer, Experienced Farmer/Beginning Organic. Next, case studies of six farms with different cropping systems and various levels of organic farming experience were used to enhance the survey data. The findings provide insights into farmers' reasons for transitioning to organic including economic/market motivations and ideological/philosophical motivations. Challenges to organic transition fall into three broad categories including economic, production and marketing obstacles.