Michigan Organic Food & Farming Reporting Session & Poster Contest

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Organic Research Presenters

I. ***Michigan State University organic farming research, outreach, teaching and service overview,*** John Biernbaum, Department of Horticulture, Michigan State University, East Lansing, MI 48824.

Information regarding organic farming and organic farming related projects and programs at MSU were collected by email contact to approximately 50 faculty and staff previously or currently involved in organic projects. Submissions, comments and suggestions were compiled and provided for further review. The work was completed in preparation for invited presentations at the MOSES Upper Midwest Organic Farming Conference as well as to inform the MSU and the Michigan organic farming communities about the continued growth and success of organic farming at MSU. Information to be presented includes general focus areas, faculty involved, funded research grants, outreach projects, websites and publications, teaching programs and organic farming related courses and community service projects.

II. ***Carbon and nutrient cycling and beneficial microorganisms in organic and conventionally managed blueberry soils in Michigan,*** Jesse *Sadowsky*, Annemiek Schilder, Department of Plant Pathology, Michigan State University, East Lansing, MI 48824.

Highbush blueberries are grown on acidic, high organic matter, moist but well-drained soils. Blueberries receive frequent pesticide (fungicides, herbicides, and insecticides) applications and nitrogen inputs of 70-80 kg N ha^{-1}. Little is known about biological processes and microbial communities in these unique agricultural soils or they are affected by organic and conventional management practices. With funding from the USDA North Central Region SARE, we conducted a survey of soil biology on organic and conventionally managed blueberry farms in Michigan. Eight pairs of conventional and certified organic blueberry fields of similar age, cultivar, and soil series were sampled on five dates between fall 2008 and spring 2010. Prior to organic transition, all organic fields were managed by conventional practices. The soil variables we measured include enzyme activity, labile and slow-cycling C, inorganic and potentially mineralizable N, cultivable fungal and bacterial populations, and mycorrhizal colonization. At 0- to 5-cm soil depth, organically managed soils had higher N-acetylglucosaminidase activity, labile C, potentially mineralizable N, and a wider ratio of N:P enzyme activity; conventionally managed soils had more slow + recalcitrant C.

Exchangeable inorganic nitrogen was higher in conventional fields in July and organic fields in October. Potential nitrogen mineralization was higher in organic fields in July. Fluorescent *Pseudomonas* spp. bacteria were more abundant in organic field soils at 0- to 5-cm depth. Organic management increased mycorrhizal colonization and this effect was most pronounced on muck soils. Principal component analysis indicated that as biological activity increased across field sites, beneficial microbe communities diverged to a greater extent by management type. These findings suggest a shift in soil biology occurs following the transition from conventional to organic management practices, contributes new knowledge to the understanding of key biological processes in Michigan's blueberry soils, and may aid in developing recommendations tailored to the needs of organic blueberry growers.

III. ***Organic tomato and pumpkin production*****,** Dale R. Mutch, Todd E. Martin, W.K. Kellogg Biological Station, Hickory Corners, MI 49060.

In 2009 organic pumpkins were grown to evaluate a reduced tillage system using the crimper/roller (C/R). The C/R system for killing rye was used to evaluate growing pumpkins organically at the MSU W.K. Kellogg Biological Station. Farmers throughout the Midwest desire new methods to keep pumpkins clean from soil. Clean pumpkins reduce the need for hand labor, which is expensive and becoming harder and harder to hire.

Fall seeded Wheeler rye produces very high plant biomass in the spring. Healthy, vigorously growing rye will C/R better than stressed rye. Healthy rye will remain on the ground as a mulch and will not come back upright as long as it is C/R at the pollination stage. The pollination growth stage of the rye at KBS usually occurs about the first week of June. This date can be late for soybean planting, but is very acceptable for pumpkin plantings.

Weed control in organic pumpkins is very difficult. We used several farmer advisory inputs to reduce weeds. We had good success growing pumpkins in 2009. Pumpkin yields from the treatments using rye and no-till were not as good as clean cultivation and the hand-hoed pumpkin treatment. We found that broadleaf weeds dominated when wheat straw was used in the zones where the pumpkins grew and grass weeds where we didn't use straw. The rye mat did reduce soil on the pumpkins. Transplants matured earlier than planting by seed and had a higher percentage of orange pumpkins. With an unseasonably cool summer in 2009, there was an advantage for growing pumpkins as transplants. Most farmers currently grow pumpkins from planting seeds.

The rye C/R system did provide excellent season-long weed control between the rows. We applied OMRI approved fungicide treatments every week from July 21 through September 15 in 2009. We never needed to use an insecticide. This could be from the rye system, the cool season or our location.
Organic tomatoes for fresh market were evaluated at MSU Southwest Research Extension Center (SWMREC) in Benton Harbor, Mich. Cover crops of cereal rye and hairy vetch were seeded in the fall prior to planting tomatoes in the spring. Five different sources of organically approved nitrogen and two sources of potassium were evaluated for tomato yield and quality.

Cereal rye biomass in the spring of 2010 (1,300 lb/A) was higher as compared to 2009 (1,100 lbs/A).
Tomato yields in 2009 were higher than 2010. In 2009 hairy vetch as a cover crop resulted in greater yields of number 1 large tomatoes as compared to cereal rye. In 2010 all tomato yields were lower than 2009. In 2009 we picked tomatoes six times as compared to three in 2010.

Using an organic K_2O source such as sulphate of potash (SOP) plus non-GMO soybean meal as a nitrogen source resulted in our highest yields when combining yields from 2009 and 2010 for cereal rye cover crop. Hairy vetch provided similar tomato yields as all organic nitrogen treatments in 2009.
Weather can impact organic tomato production. Over the two years, using an organic potassium fertilizer such as SOP plus non-GMO soybean meal resulted in the best quality and highest yielding organic tomatoes.

IV. ***Michigan organic soybean variety comparison trials*****,** Dan Rossman, MSU Extension, Gratiot County, MI 48847.

Michigan has significant organic food grade soybean production. Non-GMO soybean varieties are becoming more difficult to find. Michigan State University has a food grade soybean breeding program headed up by Dr. DeChun Wang. The criteria for selecting organic soybean varieties are somewhat different than for conventional food grade varieties. Large bush type varieties desired by the organic growers were being discarded while shorter compact varieties were selected for the conventional growers. Soybeans from other breeding programs throughout the midwest were not being evaluated in Michigan organic conditions. Many Michigan organic producers have been planting varieties developed 10-25 years ago and were missing out on potential yield and agronomic advances that newer varieties might offer.

Three sites on certified organic farms were located in Isabella, Lapeer, and Tuscola counties. Soybean performance comparison trials were conducted at these sites in 2010. The trials involved 41 varieties solicited from soybean breeding programs, seed companies, and end users throughout the midwest. Each entry was replicated 3-4 times at each site in small 20' by two 30 inch row research type plots. The entries were evaluated twice during the growing season by growers and buyers. Evaluation criteria were plant height, canopy closure, and pod height. Harvest data recorded was yield, plant height, average lodging, protein, oil, seed count and hilum color. Significant differences accrued with all criteria evaluated.
These results are extremely beneficial for organic soybean producers who are looking for higher yielding, more organically adapted varieties that meet the demands of end users. A five bushel difference in yield with food grade organic soybeans can easy equate to a $100 an acre gain.
The results of these trials have been shared through the Mid Michigan 2010 Crop Report, The Field Crops Team On-Farm Research & Demonstration report and at two organic producer meetings this winter.

The research was funded by the seed companies entering varieties to be evaluated. It was also supported by the MSU soybean research team. Without the availability of the MSU soybean research team to assist in 2011, the trials will be greatly modified to larger scale producer conducted on-farm evaluations. In future years beyond 2011, attempts will be made to acquire organic-designated planting and harvesting equipment through grants or other means.

V. ***Managing soil organic matter and nitrogen in organic field crops: Lessons from a 12 year trial,*** Sieglinde Snapp, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824, W.K. Kellogg Biological Station, Hickory Corners, MI 49060.

Building soil organic matter provides a strong foundation for root health, water and nutrient storage, and resilient crop production. The 'Living Field Laboratory' trial at Kellogg Biological Station – MSU in southwest Michigan has been organic certified for field crop production since 1989. It provides an ideal opportunity to investigate the contribution of cover crops and compost to soil quality and organic fertility management. Over the last decade, soil organic matter has been built up in the organic-managed treatments. The presence of a winter cover crop plus moderate levels of dairy compost has supported corn, soybean and wheat grain yields at levels that are 8 to 20% lower than conventional production that relies on a full complement of chemical inputs. The water quality has been substantially improved in the organic treatments, as indicated by

the low levels of nitrate-nitrogen loss measured in gravimetric lysimeters (50% lower levels than in the conventional treatments). A novel finding was that total and active organic matter pools were built up by organic practices, and this was associated with reduced nitrogen fixation in soybean (by the natural abundance method). This has implications for nutrient management and amendment use. The take home message is that lower rates of compost are recommended for organic production systems, after soil organic matter accumulates. Otherwise, increasing nitrogen inputs from compost beyond a certain threshold will be balanced by reductions in nitrogen fixation from legumes such as soybean and red clover. These research findings provide evidence that compost additions build soil organic matter pools, particularly in organic-managed field crops, and this provides a nitrogen status trigger that lowers nitrogen fixation.

VI. ***Vermicomposting of campus food residuals and waste at the Student Organic Farm,*** John Biernbaum, Department of Horticulture, Michigan State University, East Lansing, MI 48824

Michigan State University Office of Campus Sustainability and the Division of Residential and Hospitality Services initiated two projects in 2010 to investigate on campus recovery and recycling of kitchen preparation fruit and vegetable residuals and post-consumer plate scraping food and paper waste in residence halls. One project involves incorporating post consumer plate scraping waste into the anaerobic digester as the dairy composting facility. The second project is to process kitchen preparation fruit and vegetable residues using vermicomposting at the Student Organic Farm (SOF). Objectives of the vermicomposting project include:

- Demonstrate the importance of addressing long term nutrient removal from farms through the sale of produce by returning organic matter and nutrients to the farm through engagement of the local community. The transport of material to the SOF was done in coordination with delivery of produce from the SOF to the residence halls.
- Develop economically viable vermicomposting strategies for farms and community farming projects.
- Test the use of unheated hoophouses / high tunnel technology for maintaining vermicomposting in the winter.

A 30’ x 72’ foot high tunnel was constructed at the SOF to provide a research location. Red wiggler / manure worms were collected through the summer from horse manure piles at local farm and raised in containers. During the fall 2010 semester approximately 250 lbs of kitchen preparation residue was collected per week for 16 weeks for a total of 4000 lbs. The materials were precomposted after mixing with straw,

leaves or wood shavings. The precomposted material was then added to the worm beds. The worm beds remained active and maintained a temperature of ~50^{o}F in a single layer polyethylene unheated high tunnel with a second interior structure covering the bed.

Additional worms were maintained in 18-20 gallon plastic totes in heated greenhouses for the purpose of developing alternative winter maintenance strategies. A team of undergraduate students designed and implemented a feeding trial as part of a class project. Treatments included two food sources, horse manure and pulped post consumer plate scrapings, and two feeding rates (moist weights equivalent to 0.5 or 1 times the estimated worm population weight per day) added to the worm bins each week. Cultures provided horse manure increased from ~400 to ~600 grams while cultures provided food waste increased from ~400 to ~2000 grams over the 8-week period.

The project is continuing and as the worm population grows, the amount of kitchen residuals collected each week is increasing. Important issues such as managing fruit fly populations during warm weather still need to be addressed. As the availability of mature vermicompost increases the intent is to work with campus researchers to test the use of the vermicompost as a crop protectant and management strategy for insect infestations and disease infections.

Graduate Student Organic Research Posters

I. ***Bringing home the bacon: Flash-grazing hogs for post-harvest organic orchard floor management***, Krista Buehrer and Matthew Grieshop, Department of Entomology, Michigan State University, East Lansing, MI 48824.

Organic growers need effective means to combat weeds and deal with leftover fruit potentially harboring insect pests. In this CERES Trust funded study, we evaluated the effectiveness of hogs in removing fruit from the orchard floor and the impact on ground cover. Experimental plots bordered by electric fencing were established in cherry, pear, and apple orchards. Yorkshire hogs were rotated through each grazed plot post-harvest for a period of two days. We measured hog impact on weeds by measuring ground cover percentages of grass, forbs, and bare ground before and after hogs were grazed. We measured fruit removal by collecting fruit from experimental plots and determining biomass before and after grazing. We assessed potential hog impact on insect pests by quantifying the types and numbers of insects to emerge from the collected fruit. Hogs had a significant impact on ground cover, where grass and forbs were significantly decreased and bare ground was significantly increased. The hogs removed 100% of

fruit in all three types of orchards. Collected apples and pears contained codling moth and oriental fruit moth larvae, both major pests. Cherries contained non-pest beetles. These results indicate hogs can effectively clean orchard floors for weed management and some pest control. The hogs may then be sold as a high quality pork product.

II. Organic fruit production in high tunnels, Benjamin Gluck, Erin Hanson, Department of Horticulture, Department of Entomology, Michigan State University, East Lansing, MI 48824

Three season tunnels are low technology hoophouses that create a beneficial microclimate for crops. They are not designed to support snow, so the plastic is removed before winter. These tunnels are less expensive than 4-season tunnels (less than \$1.00 per ft^2 vs. \$2.00 to \$4.00 per ft^2), and are large enough to accommodate small trees and farm equipment. In Michigan, high tunnels increase yields and quality of brambles (raspberry and blackberry) and sweet cherries. Outdoor production of these crops typically requires extensive pesticide applications, making organic production especially difficult. Since high tunnels can substantially reduce pest pressures and pesticide needs, they have potential for organic production of high value fruit crops in Michigan. A one acre complex of Haygrove high tunnels was constructed in 2009 at the MSU Horticulture Teaching and Research Center in East Lansing. In 2010, three bays were planted in red raspberries with the cultivars Himbo Top, Joan J and Polka, while the remaining six bays received soil building treatments consisting of compost and cover crops. In 2011, three tunnels will be planted with high density sweet cherries, and three others will be used to trial organic apple nursery production and raspberry cherry inter-plantings. A primary goal of the project is to establish soil fertility and quality management guidelines that are suitable for organic production. Certain challenges are inherent to perennial crops and high tunnel environments, such as the absence of precipitation, inability to rotate crops, restriction of tillage around perennials and problems associated with injecting organically approved nutrients through trickle irrigation lines. In April 2010, trials were started on newly-planted red raspberries to compare dairy compost (Morgan's Compost) to a pelleted organic fertilizer (McGearies 8-1-1). Efforts during the first season were to determine the effects of these treatments on soil N and soluble salt levels.

III. Strip tillage and cover cropping for cabbage production: Impacts on crop growth, yield, and soil properties, Erin Haramoto, Dan Brainard, Department of Horticulture, Michigan State University, East Lansing, MI 48824

In strip tillage, a narrow strip (6-12+" depending on equipment and crop) is tilled into otherwise undisturbed soil and a crop is planted into this strip. This offers advantages over conventional tillage because soil between rows is left undisturbed and over no till because, among other reasons, it offers a better seedbed for the crop. If cover crops are used, their residues may help ameliorate some of the negative effects of disturbance in the tilled strips by adding organic matter; between the strips, the residue remains as a surface mulch which might help hold more soil moisture, prevent germination and emergence of weed seeds, and further protect against erosion. This experiment was conducted to assess the impacts of strip tillage and cover cropping on soil properties like moisture and temperature both in and between the crop row, as well as measuring cabbage growth and yield. (We also studied weed emergence, growth, and interference with the cabbage crop; these results are not shown on this poster.) Four treatments were included: strip till with a spring-planted oat cover crop, strip till with no cover crop, and chisel plow with and without cover crop. Between the crop rows, soil temperature was lower in strip tilled plots with cover crop residue; a similar in-row effect was observed but to a lesser extent. Soil moisture was also higher when cover crop residues were present, regardless of whether they were incorporated or left on the surface. These between-row differences are important because they may play a role in regulating weed emergence. Cabbage growth and yield were similar among all treatments.

IV. Improving the use of biological control agents for thrips management in greenhouses,

Emily Pochubay, Department of Entomology, Michigan State University, East Lansing, MI 48824.

Amblyseuis cucumeris is a predatory mite commonly used in greenhouses to manage thrips in the plant canopy. This mite is typically released by sprinkling a bran mixture that contains A. cucumeris and fungus mites, an alternate food source for A. cucumeris, onto greenhouse plants and soil. More recently this technique has been modified into the breeder pile method where small regularly spaced piles of the mite-bran mixture are placed onto soil surfaces. These piles serve as local population centers of the mite and reduce the number of applications needed. However, placing these breeder piles on the soil surface increases the likelihood for predation on A. cucumeris by soil-dwelling biological control agents thus potentially reducing the thrips management intended by A. cucumeris breeder pile use. This poster outlines an experiment that assessed the impact that two soil-dwelling thrips and fungus gnat biological control agents, Hypoaspis miles and Atheta coriaria, have on A. cucumeris populations in breeder piles. Results show that H. miles and A. coriaria have a negative impact on A. cucumeris populations

in the breeder piles and suggest less effective thrips management when breeder piles are used where H. miles and A. coriaria are present. A better understanding of the interactions among these predators provides growers with the knowledge necessary to maximize pest suppression and minimize costs.

V. Organic farming and its effect on carbon content, Christine Sprunger[1] and Darlene Zabowski[2], Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824 [1] , School of Forest Resources, College of the Environment at the University of Washington[2].

Agriculture is a major source of greenhouse gas emissions contributing to global climate change. In the past, research has shown that conventional farming practices typically lower soil carbon content. However, the effect of many organic farming practices on soil carbon storage is uncertain. Furthermore, research surrounding soil carbon content within organic farming systems is scarce. This study assessed the effects of composted poultry manure, liming and crop rotation practices on soil organic carbon levels within vegetable crop production. Soil samples were collected from three organic farms to a depth of 50 cm. While Carbon concentrations varied between control and farmed soils among three different soil series, results showed almost no difference in carbon content between control and farmed soils. Total carbon content for the control soil was 51 Mg C ha-1 compared to the 52 Mg C ha-1 in farmed soils. Total carbon content across management practices were also statistically non-significant. Total nitrogen content for both the control and farmed soils was 11 Mg C ha-1. These results indicate that organic farming practices are effective in maintaining soil carbon and nitrogen content. A broader study with more varied management practices, different soil types, and varying duration of organic farming should be completed to assess changes in carbon storage overtime.

VI. Organic weed management strategies in dry edible bean, Erin C. Taylor, Christy L. Sprague, Karen A. Renner, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824

Two two-year field studies were conducted in ‘Jaguar’ black beans to 1) evaluate the use of a propane flamer (F) and rotary hoe (RH) alone and in combination for early-season weed management, and 2) determine optimal timing of rotary hoeing using growing degree days (GDD). The first study focused on five early-season weed management treatments: 1) F once, before bean emergence, 2) F twice, before emergence and when beans were in the cotyledon stage, 3) F once before emergence + RH twice at the cotyledon stage and again when the beans had one trifoliate, 4) RH

three times, before emergence, at the cotyledon stage and at one trifoliate, and 5) no early-season weed management. In both years, the F + RH twice and the RH three times treatments resulted in the fewest weeds and the highest yields. The F twice treatment reduced the bean stand by 46% and the yield by 54% compared to the other treatments. In the second study, there were three RH timing treatments, every: 1) 7 days, 2) 125-150 GDD, and 3) 225-250 GDD. Also included were a no early-season weed control treatment and a weed-free treatment. Rotary hoeing, regardless of timing, reduced weed density compared to the no early-season weed control treatment. In the first year, yield of the rotary hoed dry beans, regardless of timing, was lower than the weed-free treatment. However, in the second year the 225-250 GDD dry bean yield was similar to that of the weed-free control. These results indicate that flaming is effective for weed control in dry beans when done prior to emergence and in combination with rotary hoeing, however it may not be as economical as using the RH alone. Rotary hoeing every 225-250 GDD early in the season results in weed control similar to other more frequent timings while reducing the number of field operations.

VII. Potential for perennial grasses as an organic dual forage-grain crop in Michigan,

Sienna Tinsley, Sieglinde S. Snapp, Steve Culman, Nikhil Jaikumar, John Green, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824.

Annual winter wheat (Triticum aestivum L.) is a successful dual-purpose forage-grain crop in the southern Great Plains region of North America (Redmon et al., 1995). Intermediate wheatgrass (Thinopyrum intermedium; IWG) is a highly successful perennial forage grass. Wheat breeding programs at Washington State University (WSU) and The Land Institute (TLI) are working to establish lines of perennial wheat by crossbreeding these two species. Additional work at TLI focuses on breeding a variety of IWG with improved levels of grain production, such that it could be a feasible dual-purpose forage-grain crop. We are exploring the possibility of using these perennial grasses as dual forage-grain crops in organic systems in Michigan. This experiment has a full-factorial, split-plot design, with fall and spring planting as the main split treatment. The fall plots were planted Oct 13th, 2010 and the spring plots will be planted later this spring. Half of the plots in each of these planting groups were sown with perennial wheat and half with IWG. A forage crop will be harvested from half of these plots before stem elongation occurs. The rest will remain uncut until the fall grain harvest.

We will use estimates of leaf expansion rate during early growth, leaf area index (LAI), tiller density, and tiller recruitment rate to evaluate the vigor, weed competitiveness, and

overall health of the plants under various treatments. After harvest, we will compare the quality and quantity of grain and forage produced under each treatment. Our ultimate goal is determine whether these species are practical for use in organic systems in Michigan and, if so, which planting time and cutting regime is the most advantageous.

VIII. Codling moth management using organically approved formulations of entomopathogenic nematodes in apple orchards, Nathaniel J. Walton, Matthew Grieshop, Department of Entomology, Michigan State University, East Lansing, MI 48824

Entomopathogenic nematodes are microscopic insect parasites that can be applied with water using conventional sprayers and can kill their insect hosts within only a few hours after infection. The codling moth (Cydia Pomonella [L.]) is a serious insect pest of apples worldwide and is of critical concern in organic apple production. Codling moth larvae pupate and overwinter in silk cocoons in soil litter and on tree trunks or branches. Entomopathogenic nematodes have potential for management targeting codling moth larvae since they actively search out hosts in protected locations. National Organic Program approved formulations of entomopathogenic nematodes are now commercially available for management of a variety of pests, but their effectiveness in the context of organic apple orchard management practices is relatively untested. We have been evaluating the entomopathogenic nematode species, Steinernema feltiae (Filipjev) at two Michigan organic apple orchards to test its effectiveness for codling moth management under different application timings. We have also used laboratory bioassays to determine the impact of commonly used organic fungicides on this nematode's ability to kill insect hosts. We present the results of these studies and discuss how application timing, fungicide use, and non-target impacts influence the effectiveness of entomopathogenic nematodes for pest management in organic apple orchards.

IX. Vermicomposting of MSU Residual Food Waste, Dr. John Biernbaum, Brendan Sinclair, Kirk Green, James Manning, Kim Forte. Michigan State University Student Organic Farm, State University, East Lansing, MI 48824.

Michigan State University disposes of many tons of residual food waste as a result of providing food for thousands of students daily. Disposal of this organic material is expensive and needs to be done in a way that is environmentally responsible. The majority of the food waste could potentially be used as a source of nutrients for farming and building soil organic matter. Composting this much material can be mechanically or labor intensive, however, vermicomposting, using red worms to process the material,

may be an efficient method of converting food waste into a valuable soil amendment and crop protectant. With funding from the Office of Campus Sustainability and the Division of Residential and Hospitality Services a team of students working with Dr. John Biernbaum at the MSU Student Organic Farm have been developing a system to vermicompost campus food waste year round using passive solar greenhouse technology. Ongoing experiments are being conducted to determine how worms respond to different food waste material including kitchen fruit and vegetable preparation residue and pulped post consumer plate scrapings from the Brody Dining Hall. The results look promising. Approximately 4000 lbs of kitchen residue were processed during the fall semester and the amount of material being processed has doubled this spring as the worm population is growing.