Michigan Organic Reporting Session
Friday, March 2nd, 2012 | 11:00 am-5:00 pm

Organic Research Presentation Abstracts
Graduate Student Poster Abstracts

Organic Research Presentation Abstracts

Author: George W. Bird, Professor
Title: Understanding Cover Crops: Use Objectives and Cultivar-Race Specificity
Abstract: Cover crops can be used for many purposes. Their functions include:

1) Soil Builders
2) Soil Looseners
3) Soil Water Conservers
4) Erosion Fighters
5) Nutrient Sources
6) Hay Crops
7) Silage Crops
8) Seed Crops
9) Livestock Grazers
10) Weed Fighters
11) Food for Friends
12) Pest Starvers
13) Pest Trappers and
14) Pest Gassers

For successful use of a cover crop or mixture of cover crops for many of the above fourteen use categories, it is imperative to:

A) Determine the species and race or biotype of the target organism, if the cover crop is being used to manage a pest or pathogen
B) Select the appropriate cover crop and variety-cultivar for achieving the proper results
C) Manage the cover crop in the specific manner for obtaining the desired system responses.

This presentation will demonstrate the importance of these three principles in relation to the use of cover crops in pest management. In two studies, general organic agriculture soil quality building practices in organic vegetable and apple production systems significantly reduced relative population densities of plant-parasitic nematodes. In two trials in organic cherry production, this enhanced nematode-flagellate-ciliate-amoebae mediated nutrient mineralization. Including alfalfa in a corn rotation doubled grain yield due to the fact that this species is a non-host for the corn needle nematode. In future orchard sites, risk to tomato ring spot virus is reduced by lowering population densities of the American dagger nematode with the non-host, Essex rape. Population densities of the Penetrans root-lesion nematode were lowered through use of Pearl Millett, a poor host for this species. Use of oilseed radish as a trap crop for beet cyst nematodes is variety specific. In Michigan, the only cultivars that have functioned as trap crops are Adagio, Colonel and Defender . Successful bio-fumigation is dependent on

the types and concentrations of glucosinolates produced by specific cover crop varieties, their immediate incorporation at the proper time of plant development and physical sealing of the soil immediately after incorporation. The bottom line is that cover crops have highly significant potential for use in both organic and conventional systems, but their success depends on proper selection and management of varieties that provides the desired system responses.

Author: Roger Blobaum
Title: Ceres Trust Supported Research: Progress and Direction for the Future
Abstract: This presentation will describe and review the competitive organic research programs supported by The Ceres Trust that are available to land grant university graduate students and organic research teams in the 12-state North Central Region. It will discuss the growth of the region's organic research capacity. It will describe the special farmer involvement requirements and other characteristics of the 51 organic research projects funded since 2009 that help make sure the results are relevant to organic farmers. It will describe eight challenges that should be considered in thinking about how to strengthen the national organic research agenda and move it forward. And it will describe the trust's commitment to use its grant making ability to help meet these research challenges and make organic farming the foundation and the future of American agriculture.

Authors: Daniel C. Brainard*, Ben Henshaw and Carolyn Lowry
Title: Integrating reduced tillage and cover crops for organic vegetable production
Abstract: Tillage is an important tool on organic vegetable farms for managing pests, incorporating soil amendments, creating a fine seedbed, and promoting mineralization and soil warming for optimal crop growth. However, the extent of tillage that sometimes occurs on organic farms can accelerate loss of soil organic matter, destroy soil structure, and entail considerable fuel, labor and equipment costs. Strip tillage (ST) is a potentially valuable method of reducing tillage on organic farms. Under ST, tillage is limited to the narrow zone where crops will be planted, while the zone between crop rows remains untilled. ST systems retain the benefits of tillage for crop establishment and growth while maintaining and building soils between crop rows. When combined with cover crops, ST systems facilitate a diversity of edaphic conditions and habitats that may promote beneficials and improve crop resilience to stress. However, several challenges remain before ST systems are likely to be widely adopted by organic growers including: 1) management of weeds and cover crop re-growth in the untilled between row zone; and 2) provision of sufficient fertility to satisfy heavy-feeding crops like sweet corn. To address these constraints, projects supported through grants from MSU's Project GREEEN, the Ecological Food and Farming Systems Fellowship Program, and the Ceres Trust have examined: 1) the effects of early-flowering hairy vetch varieties and rye-vetch mixtures on N fixation and re-growth under ST sweet corn; and 2) the impact of spatial arrangements of rye and hairy

vetch plantings on cover crop productivity, weed suppression, and crop yields under ST. Results to date suggest that ST holds promise for improving the sustainability of organic vegetable production, but that continued research is needed to: 1) identify low-cost, flexible equipment to accommodate ST under multiple scales of organic production; and 2) develop complementary weed management practices to minimize yield losses from weeds under ST.

Authors: Steve Culman, Sieg Snapp, Mark Freeman, John Green, Nikhil Jaikumar, Christine Sprunger, Sienna Tinsley, and Mary Ollenburger
Title: Perennial Small Grains in Michigan: Interactions of Management and Ecosystem Services
Abstract: Perennial small grains, such as perennial wheat, perennial rye and intermediate wheatgrass, are new crops that are being developed to regrow year after year. The grain can be marketed as specialty wheat, while the continuous growth habit and deep rooting system show tremendous potential for protecting the land and fostering soil life. This has sparked interest among organic growers, who are particularly interested in using these perennial grains as dual purpose crops—grazing in the fall and harvesting grain in the summer. These perennial grains could be valuable tools for organic farmers, given its potential to support complex soil food webs and access to nutrients and water deep in the soil profile. Field experiments were conducted at the Kellogg Biological Station to determine the yield potential of these perennial grains compared to annual wheat and to assess the effects of these crops on soil nutrient cycling and soil biota under different management regimes. After the establishment year, perennial intermediate wheatgrass demonstrated much lower rates of nitrate leaching than annual wheat, and also demonstrated greater amounts of labile organic matter. Nematode communities and soil enzyme activity from microbial communities showed some differences due to both perenniality and management. Second year intermediate wheatgrass yields were roughly 28-39% those of annual wheat, but wheatgrass total aboveground biomass was nearly twice that of annual wheat. Although more plant breeding is needed to increase grain yields, these preliminary results show the potential of these new crops to significantly improve on-farm ecosystem services in a short time. Additional work is underway to determine if harvesting these crops for both forage and grain reduces yields, and to assess overall profitability of these systems in Michigan.

Authors: Jerri Gillett, Annemiek Schilder, Laura Avila Miles, John Biernbaum, and Matthew Grieshop
Title: Evaluation of Compost Teas for Disease Suppression
Abstract: Watery extracts (teas) of compost are commonly applied to plants and soil to increase plant or soil health, provide nutrients and protect plants from diseases or herbivorous insects. Compost tea is a microbially- and nutrient-rich tool for organic crop production that can be easily prepared by a grower on-farm from locally available materials. While there are many purported claims of the benefits of compost teas, few science-based recommendations are available for

organic growers who prepare their own compost teas. Therefore, the specific objectives of the project were to:

1) Develop a bioassay for evaluating disease suppression by compost teas
2) Evaluate grower-produced compost teas to examine variability between batches and/or recipes, and
3) Evaluate the effects of substrate, brewing method and time, addition of biocontrol agents and adjuvants on disease suppressiveness.

We developed a reliable bioassay to evaluate the suppression of *B*. *cinerea* by measuring the spore germination on microscope slides. Our results suggest non-aerated compost teas have more biological activity against *B*. *cinerea* than aerated compost teas. We also observed that as fermentation time progresses, inhibitory properties increased except for most vermicompost teas, which were actually most effective after 24 hrs. of fermentation. Of all the compost teas tested, those that were made from Tuthill Farm compost and Vermicompost 6 performed the best in terms of fungal suppression. Both composts contained manure. It is important to point out the risks of using compost teas fermented from manure-containing composts (e.g., potential of human pathogens), which is why we prefer to use plant-based composts. Compost teas produced by growers were effective at suppressing the germination of *B*. *cinerea*; however, the suppression level varied significantly between production batches. Augmenting the compost tea with a starter (*Bacillus subtilis*) increased the disease suppressiveness. The work was conducted at MSU in 2011 and will continue for 2 more years. The work was funded by the Ceres Trust Fund. This project will provide organic growers with insight into how to reliably increase the disease suppressiveness of compost teas.

Authors: Matthew J. Grieshop, Emily Pochubay, Joe Riddle and Jeanne Himmelein

Title: Engineering Living Pest Management for Organic Greenhouses and Diversified Farms

Abstract: The continuing goal of our projects is to develop improved insect pest biological control based on open rearing for use in greenhouses and diversified organic farms. Ongoing research has focused on the development of improved predatory mite release systems, on-farm production of entomopathogenic nematodes (EPN), and companion planting. Specific projects include determining the impact of intraguild predation on predatory mites by additional thrips natural enemies, optimal EPN release strategies, and the relative attractiveness of companion plants to aphids, thrips, and natural enemies. We have found that predatory mites are negatively impacted when placed in contact with the soil due to predation by soil based natural enemies and that release duration is highest when mites are placed in protective “sachets.” Four Kalamazoo area greenhouses are now producing their own EPN and we are initiating research on best release strategies. Fiddleneck, Alyssum, and Eggplant have all been identified as potential trap/indicator crops for thrips and aphids and may serve as

insectary plants for parasitoids. The development of integrated insect biological control systems is expected to facilitate new and existing organic production and improve the profitability and sustainability of large organic greenhouses, smaller 3-4 season hoophouses, and outdoor organic vegetable production. Our research and extension activities are funded by USDA-NIFA, MSU Project GREEEN, and the CERES Trust.

Author: Dan Rossman
Title: Organic Markets, Prices and Trends
Abstract: Organic demand is increasing despite the overall weak economy. According to the Organic Trade Association the domestic sales of organic products rose from $ 21.1 billion in 2008 to $26.7 billion in 2010. The strong organic demand continues to grow into 2012. Organic grain and bean buyers are looking for more product and are offering higher prices for both feed grade and food grade this year. There are opportunities for individuals who may want to transition to organic milk production in Michigan as well. Mainstream processors and retailers continue to be major players in the overall organic market. Health and environment are two compelling reasons why consumers buy organic.

Authors: Erin C. Taylor*, Karen A. Renner, and Christy L. Sprague
Title: Influence of cover crops on organic dry bean production systems
Abstract: Michigan is the number one producer of organic dry beans in the nation. With the limited inputs allowed in organic systems, it is essential to maximize the potential benefit of cover crops for increasing weed control, nutrient availability, and ultimately crop yields. The aim of this research, funded by the USDA Organic Research and Extension Initiative, is to determine the effect of cover crops on weed suppression, nitrogen availability, and dry bean populations and yields in an organic system. To meet this goal, an experiment was conducted at the Michigan State University Student Organic Farm (East Lansing, MI) and at the Kellogg Biological Station (Hickory Corners, MI) during the 2010-2011 growing season. The cover crops studied included: medium red clover, oilseed radish, and cereal rye; a no cover treatment was also included. Within each cover crop treatment there were four bean varieties: ‘Zorro’ and ‘Black velvet’ black beans and ‘Vista’ and ‘R-99’ (non-nodulating mutant) navy beans. Weed management was uniform across the experiment following dry bean planting. Cover crop biomass was recorded at peak production and included both above and belowground growth. Weed biomass and populations by species were recorded at two times, 1) V2 bean stage- after early season weed management was complete (i.e. tined weeding and rotary hoeing) 2) R5 bean stage- following final cultivation. Throughout the course of the experiment several methods were used to monitor nitrogen availability, including: the use of a chlorophyll meter at numerous stages of bean development (V2, R1, and R5), soil sampling (fall, planting, V2, R1, R5, and harvest), and ion exchange resin strips were also set out and changed every 2 weeks throughout the growing season. Dry bean populations were recorded at the V2 stage and at harvest prior to taking yields.

Peak biomass production was seen in the clover cover crop and no cover crop treatments (i.e. biomass from weeds) at the Kellogg Biological Station (both at 3,200 lbs/ha), followed by oilseed radish (2,000 lbs/A) and rye (1,500 lbs/A). However, at the Student Organic Farm, rye was unable to be controlled in a timely manner due to rain and reached a biomass of over 6,200 lbs/A. As a result of this difference, the locations were analyzed separately. There was only a significant difference among covers for weed suppression at the V2 bean stage at the Kellogg Biological Station location. Rye (2 lbs weeds/A) and radish (3 lbs weeds/A) provided greater weed biomass suppression than clover (21 lbs weeds/A); no cover (14 lbs weeds/A) fell in between. At both the V2 and R1 stages, bean chlorophyll florescence was highest in the beans following a clover cover crop, though the difference was not always significant. Information regarding plant available nitrogen as assessed from soil sample and ion exchange resin strips is currently being analyzed and will be discussed at the reporting session. Beans following an oilseed radish cover crop had significantly higher populations than the no cover treatment at both the V2 stage (both locations) and at harvest (KBS only), with 14-35% more plants. At the Student Organic Farm, bean yields following oilseed radish were higher (2,400 lbs/A), clover (2,100 lbs/A), and no cover (2,000 lbs/A) were higher than beans following rye (1,300 lbs/A). These reduced yields could be the result of the rye reducing soil moisture early in the season and immobilizing nutrients. No differences in yield based on cover crop treatment were observed at the Kellogg Biological Station. Two more field seasons of this research are planned to clarify the impacts of cover crops on organic dry beans.

Graduate Student Poster Abstracts

Authors: Brad Baughman, Ron Perry, Matt Grieshop
Title: Implementation of Strip Cultivation in Michigan Apple Orchards: An Organic Alternative to Herbicide Strips
Abstract: Ground management is a challenge to organic tree fruit growers. A variety of methods are used by growers in the Midwest; one is strip cultivation in the dripline. Some growers in Michigan have met with success using this method, finding it effective for weed management. But repeated cultivation has the potential to harm soil structure and cause organic matter loss. We are investigating the use of shallow, ground-driven (rather than PTO-driven) cultivation at frequencies low enough to maintain weed cover through most of the growing season. The idea being, to keep a cover crop of weeds, repeatedly incorporated into the soil. We compared this method with conventional herbicide-strip maintenance at three Michigan apple orchards. We present the first two years of results. Cultivation was as effective at weed management as herbicide application. Higher ammonium and nitrate levels were observed in cultivated sites, indicating some nutrient release after cultivation. No significant change was observed in organic matter content between the two treatments. But changes in OM happen slowly, so future work is required. Slight decreases in late-season plum curculio damage as well, pointing to the possibility that cultivation could be

used as an insect management strategy. We also found that strip cultivation was less expensive to maintain than herbicide strips. Especially when coupled with a rear-mounted task such as mowing or spraying, strip cultivation has the potential to be an effective, economical ground management method for growers in the Midwest.

Authors: Krista Buehrer, Matthew Grieshop and Gene Garthe
Title: Hogs in the Orchards
Abstract: Reintegrating livestock into tree fruit systems poses many challenges to growers, but offers worthwhile benefits. In this Ceres Trust-funded project, we evaluated the effectiveness of hogs in removing fruit from the orchard floor and the impact on insect damage to fruit the following season. Young hogs were purchased in the spring and raised on pasture until used for post-harvest grazing in cherry, pear, and apple orchards. The cost of feed for the hogs in the first year exceeded conventional cost. In the second year, young hogs were rotated through different pasture types offering more forage, which brought feed cost back down to the conventional level. The hogs consistently removed 100% of fruit from the orchard floors post-harvest, significantly reduced plum curculio damage in cherry and apple plots after the first year, and significantly reduced codling moth/Oriental fruit moth damage in pear plots after the first year. The impact the hogs had from the second year of grazing will be determined in the 2012 season. These results indicate hogs provide orchard floor sanitation and some pest control. The hogs also diversify farm output when sold as a high quality pork product.

Authors: Zachary D. Hayden, Mathieu Ngouajio, and Daniel C. Brainard
Title: Rye-vetch proportion and plastic mulch affect cover crop biomass production, soil nitrate, and bell pepper yield
Abstract: The unique and complementary traits of cereal rye (*Secale cereale L.*) and the legume hairy vetch (*Vicia villosa Roth*) make winter annual cover crop mixtures of the two species promising for organic vegetable cropping systems. Informed management of the relative species to proportions in the mixture could provide an important means of optimizing performance to serve various farmer goals. A variation of the replacement series experimental design was used to investigate 1) how relative species proportions (seeding rates) influence biomass production and total residue quality, and 2) the interactive effects of mixture residues and black plastic mulch (PM) on bell pepper (Capsicum annuum) performance and soil nitrate dynamics. Cover crop main plot treatments consisted of a gradient of 7 rye-vetch mixture proportions from 100% rye (94 kg/ha) to 100% vetch (42kg/ha), in addition to a no cover crop control. Subplots consisted of bell pepper grown either with or without PM. Soil nitrate levels were monitored through biweekly soil sampling during the growing season. Rye and vetch density and biomass in mixtures were generally proportional to the seeding rates used. Cover crop mixtures with higher proportions of vetch generally resulted in higher soil nitrate concentrations during the growing season, but both the magnitude and duration of the increases in soil nitrate following cover crop

incorporation were greater under PM than without. In general, total bell pepper yields were higher following cover crop mixtures with greater proportions of vetch. However, total yields were uniformly higher for peppers grown on PM. Our results suggest that PM may be an important tool for maximizing N fertility benefits from incorporated cover crop residues, but evaluations of overall mixture performance must ultimately be based on a systems-level consideration of the numerous services that cover crops can provide, as well as their relative costs.

Authors: James Heilig and James D. Kelly
Title: Navy and Black Beans Evaluated under Organic Production and for Biological Nitrogen Fixation Ability
Abstract: Organic dry bean acreage in Michigan accounted for 38% of the U.S. total organic dry bean acreage in 2008. Historically, navy beans were the leading market class in the state. More recently black beans have overtaken navy beans. To better evaluate elite navy and black breeding lines for performance under organic management two field studies were conducted in the “Thumb”-the major bean producing area of the state. Thirty-two elite breeding lines and four checks were evaluated. The non-nodulating check had the lowest yield, identifying nitrogen as a limiting factor. Black bean genotypes generally performed better than navy bean genotypes. The same genotypes studied in the field were evaluated under greenhouse conditions for their biological nitrogen fixation (BNF) ability as well as in growth pouches to evaluate early development of nodulation. The results largely mirrored those of the field study-black beans showed greater BNF potential than navy beans and developed significantly more nodules during early seedling development than did navy beans. Current black bean genotypes appear to be better suited to organic production than navy bean genotypes. These results also highlight the need for improving yield and BNF ability in navy bean genotypes.

Authors: Daniel Kane and Sieg Snapp
Title: Managing Nitrogen in Organic Systems with Zonal Tillage: Proposed Research
Abstract: Managing the supply of soluble nitrogen to crops is a primary challenge for organic growers. Organic growers typically use tillage to incorporate and mineralize nitrogen from crop residues, cover crops, or animal manure, but often it is difficult to synchronize the supply of nitrogen from these biological sources with plant demands.

Zonal management systems may help organic growers manage nitrogen by giving them a degree of control over when and where residues are mineralized by creating “soil functional zones” within crop rows. A planting zone is created using minimized tillage that mineralizes some soil nitrogen and prepares a narrow seedbed, while an adjacent soil building or composting zone is either planted with a cover crop or left undisturbed to build soil organic matter and nitrogen. Residues left in the composting zone can be slowly mineralized over the season providing a steady supply of nitrogen to crops. Growers also have the

option of later utilizing tillage to stimulate mineralization or relocate soil from the composting zone to plants, providing nitrogen at crucial growth stages.

Our research focuses on the efficacy of zonal management systems, particularly ridge tillage, by evaluating the spatial variability of carbon and nitrogen on both on a small scale (across ridges) and large scale (across fields) throughout the season.

Authors: Emily Pochubay, Joseph Riddle, Jeanne Himmelein, Mark Elzinga, Matt Grieshop
Title: Companion Plants in Greenhouses: Potential for Pest Monitoring, Trapping, and Natural Enemy Open Rearing
Abstract: The release of natural enemies is an important approach towards organic insect pest management in greenhouses but can be expensive. Companion plants can provide food and habitat to maintain natural enemies and also serve as pest monitoring and or trapping tools. Our objective was to determine which species of commonly available plants may serve as trap plants for pests or as habitat for natural enemies in organic greenhouses. We assessed thirteen plant species for their potential as companion plants in greenhouses. Potted plants of each species were placed in plant plots on benches adjacent to lettuce crop in a certified organic commercial greenhouse. Plants were monitored for pests (e.g., thrips, aphids, fungus gnats) and natural enemies (e.g., parasitoids, minute pirate bugs, lady beetles). Our results show that eggplant and fiddleneck could serve as potential trap or indicator plants for aphids and thrips, respectively. Eggplants infested with aphids may support open rearing of parasitoid wasps. Natural enemies were also observed on alyssum, dill, and fiddleneck, indicating that these plants may be beneficial for natural enemies in greenhouses.

Authors: Joseph Riddle, Emily Pochubay, Jeanne Himmelein, Mark Elzinga, Matthew Grieshop
Title: Protecting the Good Guys from the Good Guys: Optimizing Multiple Predator Biological Control Sytems
Abstract: Amblyseius cucumeris and Atheta coriaria are important thrips biological control agents used in organic greenhouses. A. cucumeris is a foliar predator of immature thrips. A. coriaria is a predatory beetle that attacks thrips pupae, fungus gnat larvae, and other soil dwelling insects. A. cucumeris is often applied on the soil in small breeder piles at the base of plants. These piles are a mixture of bran flakes, prey mites, and predatory mites. Predatory mites feed on prey mites as an alternative food source before dispersing from breeder pile; however, mite populations often collapse when A. coriaria invade. A. cucumeris can also be applied in hanging sachets. The objectives of the study were 1) to determine if hanging sachets prevent the invasion of A. coriaria, and 2) to compare mite migration out of breeder piles versus hanging sachets. Four treatments, breeder piles, hanging sachets, bran piles without mites, and sawdust, were randomly placed into barley beds, and beetles were released. Samples of each treatment were collected weekly to determine the number of

mites and beetles. Beetles immediately invaded the breeder and bran piles but were delayed by two weeks by sachets and were rarely observed in sawdust. To determine the rate of mite migration in the absence of A. coriaria, breeder piles and sachets were placed onto soil within a petri dish positioned on a sticky card in the center of barley plantings. The sticky cards were changed on a weekly basis. The average number of mites migrating from the sachets was greater than from the breeder piles. This suggests that sachets could be used as a slow release method of A. cucumeris at the same time delaying the invasion of A. coriaria. Delaying the release of A. cucumeris and protecting them from predation will improve long-term thrips biological control in greenhouses.

Title: Evaluation of rotation crops for their ability to suppress plant-parasitic nematodes in strawberries.

Authors: A. M. C. Schilder[1], F. W. Warner[2], J. M. Gillett[1], and R. W. Sysak[1]. [1]Department of Plant Pathology, and [2]Diagnostic Services, Michigan State University, East Lansing, MI 48824.

Abstract: To investigate the efficacy of crop rotation for nematode control, six rotation sequences (sweet corn/pumpkin; rapeseed/pearl millet; broccoli/pumpkin; broccoli/broccoli; oats/june clover/oilseed radish, continuous alfalfa, and fallow with tilling) were established in 2009 in a site infested with needle (Longidorus spp.), lesion (Pratylenchus spp.) and ring (Criconemella spp.) nematodes. Rye was planted in the fall in all annual plots. Needle and ring nematode populations were lowest in the broccoli/broccoli and corn/pumpkin rotations whereas the rapeseed/pearl millet rotation had the fewest lesion nematodes. Incorporation and tarping of broccoli residue after harvest suppressed nematode populations even more. In a replicated greenhouse experiment, potted marigold, squash, oat, rye, barley, pearl millet, sweet corn, hairy vetch, rapeseed, broccoli, soybean, june clover, sorghum-sudan grass, oilseed radish, buckwheat, switch grass, forage pea, pumpkin, and alfalfa were evaluated for their ability to suppress lesion (P. penetrans) and northern root-knot (Meloidogyne hapla) nematodes. The highest numbers of P. penetrans (30-50 per gram of root tissue) were recovered from the legumes whereas millet, squash, switch grass, marigold, barley, and pumpkin all yielded fewer than 2 lesion nematodes per gram of root. All grasses were non-hosts for M. hapla but pea was an excellent host and vetch, pumpkin, clover and soybean also were hosts.

Title: Benefiting from Wild Pollinators: natural areas on and around the farm boost vegetable pollination by native bees.

Authors: Alex Smith, Michigan State University Department of Entomology; Martin Bentley and Heather Reynolds, Indiana University Department of Biology.

Abstract: Native, unmanaged bee communities can provide pollination services to crops, and these bees rely on semi-natural areas in the agricultural landscape such as old fields and fencerows for nesting sites and forage. The spatial scale at which crop visiting bees utilize resources in the landscape can vary regionally, and has not been previously characterized for the Midwest United States.

Working on 10 organic farms growing cucumber (*Cucumis sativus*) in Indiana, we investigated whether, and at what scale, the abundance and species richness of native bees visiting cucumber were positively associated with the proportion of semi-natural land cover surrounding the agricultural field. Our analysis also considered non-landscape factors that could affect native bees.

The abundance of native bees visiting cucumber was higher on farms with a higher proportion of semi-natural land in the surrounding landscape. This relationship was strongest when we considered semi-natural areas within 500 m (approximately 1/3 mile) of the center of the cucumber field. The species richness of native cucumber visitors was associated with multiple factors, including the proportion of semi-natural land cover surrounding the farms. Our results indicate that semi-natural areas can increase crop visitation by native bees in our study region, and that the habitat areas most utilized by crop visiting native bees lie within 500 m of the crop field.

Authors: Christine Dazil Sprunger, Sieglinde S. Snapp, and Steve W. Culman
Title: Conventional and Organic Management Effects on Annual and Perennial Root Biomass
Abstract: Agriculture has a tremendous 'ecological footprint,' as it is a leading contributor to carbon dioxide emissions, and other potent greenhouse gases. At the same time, innovative agricultural practices have the potential to mitigate climate change, by sequestering carbon. A transformative approach to a more sustainable agriculture has been proposed through developing perennial grain cropping systems, which produce edible grain without the need to till and replant every year. Yet, very little is known about growth of shoots and roots in novel perennial grain crops, such as intermediate wheatgrass (IWG), which is a perennial forage that has been selected for higher grain yield. This study is the first to quantify root biomass along a species and management gradient, comparing annual winter wheat (WW) to perennial IWG under conventional and organic management practices. In June of 2011, soil cores were taken to a depth of 100cm, roots recovered at different depth intervals and separated into coarse and fine roots. Minirhizotron images were also taken to assess root turnover. The IWG root biomass was five times greater than the WW root biomass. A trend was observed towards management influencing coarse root biomass, and in the topsoil roots were significantly different under organic and conventional management. Overall, perennial cropping systems had substantially higher root biomass than annual crops, which has important implications for building soils, and enhancing carbon sequestration within agriculture.

Author: Erin Taylor
Title: Organic Farmers' Weed Control Strategies in Dry Beans
Abstract: Michigan is the number one producer of black beans, including organic black beans, in the United States. Pest and nutrient management, as well as dry bean class and cultivar choice, are key to successful organic dry bean

production. Research was conducted in 2011 at nine on-farm certified organic locations to compare weed control and dry bean yield based on farmer management practices. 'Zorro' black bean and 'Vista' navy bean were planted in early to late June and harvested in late September and October of 2011. Seeding rates were 120,000 seeds/A, a 20% higher seeding rate than recommended in conventional dry bean production systems to account for crop removal with mechanical weed control measures. At the V2 and R5 bean stages, weed biomass and populations by species were recorded in each plot using three quadrats (15 cm by 76 cm) placed directly over the crop row. Dry bean populations were recorded at the V2 stage and at harvest. Dry bean yields were calculated by harvesting 18 m of row and converting to 18% moisture. There was a wide range of weed management practices at the nine farm locations. Where dry beans were planted in early June, weeds were controlled with one rotary hoeing, two cultivations, and hand labor just prior to harvest. At the four locations where dry beans were planted at the end of June, weed management practices ranged from one tine weeding followed by one cultivation, to rotary hoeing three times followed by three cultivations and hand weeding prior to harvest. Weeds were effectively managed in organic black and navy bean production at six of the nine locations by rotary hoeing or tine weeding once, followed by either one or two cultivations. Black bean populations at the V2 growth stage were 18% lower than the seeded populations, when averaged across all farm locations. Navy bean populations were, on average, 20% lower than black bean populations. Black bean yields were 2,400 lbs/A, averaged across nine locations; navy bean yields averaged 2,100 lbs/A. At three locations black beans yielded 2,800 to 3,100 lbs/A, three locations had yields from 2,100 to 2,500 lbs/A, and three locations had yields from 1,400 to 1,700 lbs/A. The three low-yielding farms rotary hoed and cultivated more frequently than the other six farms because of greater weed populations as measured by weed biomass at the V2 growth stage of dry beans.

Authors: Sienna Tinsley, Sieglinde S. Snapp, Steve Culman, Santiago Utsumi, Nikhil Jaikumar, and John Green

Title: Potential for Perennial Grasses as an Organic Dual Forage-Grain Crop in Michigan

Abstract: The adoption of perennial grain crops presents farmers with many environmental, economic, and agronomic opportunities, as well as risks. If these crops can be used as dual-purpose forage-grain crops, many of these risks will be alleviated. In order to evaluate the potential for perennial wheat (*Triticum aestivum* x *Thinopyrum elongatum*; pwheat) and intermediate wheatgrass (*Thinopyrum intermedium*; IWG), two novel perennial grain species, to thrive as dual-purpose crops, a field experiment is in progress at Kellogg Biological Station (KBS) in which robustness of plant growth and perennial regrowth, as well as quality and quantity of harvested grain and forage is under investigation for two planting dates and two cutting regimes. This experiment was begun in fall of 2010 and will continue until fall of 2012. Preliminary data indicate that perennial wheat produces higher grain yields (279.34-378.77g of threshed grain/m^2 for

pwheat vs. 75.84-201.12g of threshed grain/m^2 for IWG) than intermediate wheatgrass, but is less able to initiate late-season regrowth, and thus maintain perenniality, after forage has been harvested (50% plant death for cut pwheat vs. 0% plant death for cut IWG). Data are not yet available regarding forage quality or the effect of planting date.

Authors: Nathaniel J. Walton and Matthew Grieshop
Title: Using entomopathogenic nematodes to manage codling moth in Michigan organic apple orchards
Abstract: Entomopathogenic nematodes are tiny parasites of insects that can be applied in a water mixture and can kill their hosts within only a few hours after infection. The codling moth (*Cydia Pomonella* [L.]) is a serious pest of apples worldwide and is of critical concern in organic apple production. Codling moth larvae pupate and overwinter in silk cocoons in soil surface litter and under the bark on tree trunks or branches. Entomopathogenic nematodes have potential for management targeting codling moth larvae since they actively search out hosts in protected locations. We have been evaluating the entomopathogenic nematodes species, *Steinernema feltiae* (Filipjev), at three Michigan organic apple orchards to test its effectiveness for codling moth management. Our research to date indicates that nematode applications are more effective in orchards planted with smooth-barked tree varieties, presumably because the codling moth larvae in these orchards are forced to overwinter on the ground where they may be more susceptible to infection by entomopathogenic nematodes. This poster presents research testing the hypothesis that codling moth larvae in cocoons on the ground are more susceptible to nematode sprays than those in other locations in the orchard. We found that nematodes applied with a backpack sprayer were able to successfully infect codling moth larvae in a variety of locations in the orchard. However, larvae that were in cocoons under wooden shelters on the soil surface did not exhibit increased infection in nematode treated plots compared to those in untreated plots. This result implies that entomopathogenic nematodes may need to be applied at a higher rate in organic orchards in order to reach larvae in protected locations on the orchard floor.

Authors: Anne E. Weir, Scott M. Swinton and Richard C. Hayes
Title: Breakeven Profitability Targets for Genetic Improvement of Perennial Wheat and Intermediate Wheatgrass
Abstract: Perennial wheat and intermediate wheatgrass are two environmentally beneficial crops that are under development. In order for a grower to switch from an established crop to one of these crops, the profits of perennial wheat and intermediate wheatgrass must be equal to or greater than the profit of the established crop. Breakeven profitability is thus a necessary condition for the commercial viability of perennial wheat and intermediate wheatgrass. This study evaluates the profits of perennial wheat and intermediate wheatgrass compared to the profits of annual wheat. Three experimental trials were conducted in Cowra and Woodstock in New South Wales, Australia from 2008 to 2010. The gross

margins of 43 varieties of perennial wheat and 2 varieties of intermediate wheatgrass were found and compared to the gross margin of 1 variety of annual wheat. At a gross margin of around Australian $400 per hectare per year, the annual wheat variety had the highest level of profitability out of every wheat variety in the three trials. Since none of the perennial wheat or intermediate wheatgrass varieties had profits equal to or greater than the profit of annual wheat, none of these varieties would be adopted as is. Changes in price, grain yield, costs or subsidy payments would be required for the perennial wheat and intermediate wheatgrass varieties to generate profit as high as that of annual wheat. So, this study discusses how the necessary changes would encourage the adoption of the Australian varieties of perennial wheat and intermediate wheatgrass.