"Improving Weed and Insect Management in Organic Reduced-Tillage Cropping Systems"

Progress Report
July 2009 – May 2010

USDA OAREI Award No. 2009-51300-05656
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Project Abstract

Our overall goal for this long-term project is to develop sustainable reduced-tillage organic feed grain production systems that integrate pest and soil management practices to overcome production constraints associated with high residue, reduced-tillage environments. We will establish long-term experiments on two research stations to test four approaches: 1) expressive weed management—stimulating pre-plant weed seed germination followed by control; 2) pest avoidance – altering cash crop planting date to avoid early-season insect pests and weeds; 3) pest (weed) suppression – using living and dead cover crops to physically and chemically suppress weed emergence and growth; and 4) supplemental weed control – shallow high-residue cultivation to remove weeds that emerge through cover crop residues. Components of the proposed experiment will be investigated on six organic farms in three states to determine performance and farmer acceptability. Outreach programs and materials will be developed and delivered to a broad audience by the project team and farmer cooperators through a variety of means, including eOrganic.info/eXtension.org, and their effectiveness evaluated. This project is appropriate for funding by OREI because it addresses the development of organic agriculture production; evaluation of potential economic benefits to organic producers; determination of desirable traits for organic production; advanced on-farm research related to production; and optimal conservation and environmental outcomes relating to organically produced agricultural products.
Project Executive Summary

Stakeholder Need and Project Long-term Goals: Pest and soil management remain top priorities for organic growers nationally, and are consistently listed near the top of organic growers’ concerns. We have assembled a multi-institution, inter-disciplinary team to address these concerns over a range of environments in the mid-Atlantic and Upper South. Our overall goal for this long-term project is to develop sustainable reduced-tillage organic feed grain production systems that integrate pest and soil management practices to overcome production constraints associated with high residue, reduced-tillage environments. We will accomplish this goal through initiating long-term experiments on two research stations and complementary experiments on organic farms.

Outreach plan: The research team and collaborating farmers will develop and implement an outreach plan that includes activities (e.g., on-farm and research station field days and workshops) and products (e.g., extension bulletins, articles and other materials for print and electronic media, including eExtension.org through eOrganic.info; and scientific publications) that will directly support organic producers, extension educators and other technology transfer agents, and researchers. We will create and disseminate easy-to-use decision support materials online and in print to help growers manage crops, cover crops and pests in reduced tillage organic feed grain production systems. All outreach activities and products will be evaluated for efficacy in changing attitudes, knowledge, and behavior.

Potential economic, social, and environmental benefits: We, along with our stakeholders, are working cooperatively to build comprehensive research and outreach programs that will have numerous benefits. This project will contribute to organic systems that are environmentally, socially, and economically sound over the long-term. Results from the proposed project activities will facilitate the adoption of practices that minimize adverse impacts of agriculture on the environment by reducing production constraints posed by weeds and insect pests, negative impacts on soil, and energy use; while at the same time promoting the conservation of beneficial organisms and soil quality. This project will strengthen the regional research and outreach capacity for serving organic growers. Developing strategies for farmers to produce high value organic crops may provide farmers sufficient income to succeed on small and medium-sized farms, and support production of organic animal-based products.

Stakeholder engagement: This project is based on active collaborations between the multi-disciplinary research/extension project team and participating farmer-researchers. Cooperative activities will include on-farm research, on-site meetings and regular communication between the research/extension team and farmers, and outreach events dedicated to co-learning with farmers. The project research/extension team and participating farmer-researchers will help deliver research- and experience-based information by co-presenting at field days and workshops, and in preparation of extension materials based on farmer experiences.
Progress Report Narrative

Long-term goals: Our overall goal for this project is to develop sustainable reduced-tillage organic feed grain production systems that integrate pest and soil management practices to overcome constraints associated with high residue, reduced-tillage environments. Our outreach goals are to contribute to and disseminate science-based information that supports sustainable organic production and builds capacity to address the needs of organic producers. Our strategic goals are to increase the amount of land at research stations dedicated to organic research and demonstration, and to strengthen collaborative relationships within and among research and extension personnel, the organic farming community, producers considering transition, and organizations that represent organic and sustainable agriculture interests.

Project goal and objectives: The overall goal of this project is to develop organic agronomic crop production strategies that balance pest management, crop productivity, soil quality and profitability. We propose that replacing soil degrading practices with soil-building practices, coupled with cultural practices to address pest challenges will result in desirable agronomic, environmental, and economic performance in organic crop production systems. We will establish long-term experiments to test this proposition on two research stations and on organic farms. Our project goals will be addressed through the following specific research objectives:

• **Objective 1.** Determine the effects of *expressive* weed management tactics (i.e., stimulate pre-plant weed seed germination followed by control) on pest, agronomic, soil quality, and economic indicators in an organic reduced tillage feed grain production system.

• **Objective 2.** Determine the effects of pest *avoidance* tactics on pest, agronomic, and economic indicators in an organic reduced tillage feed grain production system.

• **Objective 3.** Determine the effects of weed *suppressive* tactics (i.e., use living and dead cover crops to physically and chemically suppress weed emergence and growth) on pest, agronomic, soil quality, and economic indicators in an organic reduced tillage organic feed grain production system.

• **Objective 4.** Determine the effects of *supplemental* weed management tactics on pest, agronomic, soil quality, and economic indicators in a reduced tillage organic feed grain production system.

• **Objective 5.** Determine the on-farm performance and farmer-acceptability of components of the reduced tillage organic feed grain production system through farmer-participatory research.

Outreach will be a collaborative activity of the research/extension team and farmer-cooperators. Outreach objectives include:

• **Objective 6.** Develop new, incorporate existing, and deliver information on organic reduced tillage crop production systems to growers, extension educators and other trainers, and agriculture-related organizations through field-based education events, workshops, and various media, including eOrganic.info/eXtension.org.

• **Objective 7.** Create and disseminate easy-to-use decision support materials online and in print to help growers manage crops, cover crops and pests in reduced tillage organic feed grain production systems.
Progress to date:
Project activities since notification of the award address all seven goals. These activities have focused on project planning and staffing, site preparation and preliminary trials at participating research facilities, extension programs and publications, scientific presentations, and on-farm research planning.

Project Planning Activities:
Since notification of funding in July 2009, the project team has participated in regular planning activities (Table 1). These activities include:

- Establishment of a public project website hosted by Penn State University, [http://agsci.psu.edu/organic/research-and-extension/Rotational%20No-till](http://agsci.psu.edu/organic/research-and-extension/Rotational%20No-till). Project overview, products, and record of outreach activities are located here. We established a project newsletter: the first two issues can be accessed here. The next newsletter will be produced in June 2010.
- Establishment of a collaborative workspace at eOrganic.info, [http://eorganic.info/node/4348](http://eorganic.info/node/4348). Access to this website is limited to members of eOrganic. Summaries of project planning activities are located here. We will use this site to create extension materials for publication on eXtension.org.
- Regular teleconferences. These meetings have been conducted to discuss and fine tune experimental design, project management, and to plan face-to-face project meetings (Table 1). Minutes are available at [http://eorganic.info/node/4348](http://eorganic.info/node/4348).
- Two face-to-face meetings. One project investigator meeting in State College, PA, and an investigator/farmer advisory board meeting in Beltsville, MD. Minutes available at [http://eorganic.info/node/4348](http://eorganic.info/node/4348).

Table 1. Organic reduced-tillage project planning activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
<th>Project Personnel</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory award notification</td>
<td>16 July 2009</td>
<td>Barbercheck, Ryan, Hoover, Mirsky, Curran, Reberg-Horton, Hostetter, Harper, VanGessel, Mullen</td>
<td>Discussion of award, re-cap of project, discussion of project timeline and deliverables</td>
</tr>
<tr>
<td>Teamwork and Farmer Advisory Board Teleconference</td>
<td>25 Aug 2009</td>
<td>Barbercheck, Ryan, Curran, Hostetter, Mirsky, Reberg-Horton, VanGessel, Mullen</td>
<td>Discussion based on team survey on teamwork issues: ground rules, personal goals and priorities, communication preferences, expectations on level of contribution, data management issues, publication issues, conflict management</td>
</tr>
<tr>
<td>Experimental protocols Teleconference</td>
<td>27 Aug 2009</td>
<td>Barbercheck, Ryan, Curran, Nord, Mirsky, Reberg-Horton, VanGessel, Mullen</td>
<td>Discussion of crop varieties, soil fertility management, weed seedbank establishment and measurement</td>
</tr>
<tr>
<td>Experimental Design Teleconference</td>
<td>17 Sept 2009</td>
<td>Curran, Ryan, Barbercheck, Nord, Hoover, Mirsky, Cavigelli, VanGessel</td>
<td>Design of the systems experiment at PSU and USDA BARC</td>
</tr>
<tr>
<td>Weed Seedbanks Teleconference</td>
<td>8 Oct 2009</td>
<td>Ryan, Curran, Barbercheck, Mirsky, VanGessel, Nord, Mullen</td>
<td>Discussion on establishment of seedbank subplots, methodology for measuring seedbanks</td>
</tr>
<tr>
<td>Entomology Teleconference</td>
<td>14 Oct 2009</td>
<td>Barbercheck and Weber</td>
<td>Discussion of insect sampling in the systems trial, development of standard protocols</td>
</tr>
<tr>
<td>Soil Fertility Management in Organic Corn Teleconference</td>
<td>22 Oct 2009</td>
<td>Ryan, Curran, Barbercheck, Mullens, Mirsky, Nord, Hoover, VanGessel, Spargo, Cavigelli</td>
<td>Soil fertility management in the systems experiments at PSU and USDA BARC</td>
</tr>
<tr>
<td>Experimental protocols Teleconference</td>
<td>4 Dec 2009</td>
<td>Ryan, Curran, Barbercheck, Mirsky, VanGessel, Nord, Mullen, Teasdale</td>
<td>Continuation of discussion on weed seedbank establishment and measures, target crop planting dates in systems trials, cultivar selection</td>
</tr>
<tr>
<td>PI Face-to-Face Meeting at PSU</td>
<td>3 Feb 2010</td>
<td>PSU: Ryan, Barbercheck, Curran, Hoover, Mullen, Nord UDel: VanGessel. USDA: Mirsky, Weber. NCSU: Reberg-Horton</td>
<td>Continuation of discussion on weed seedbank establishment and measures, target crop planting dates in systems trials, cultivar selection, sampling protocols, on-farm research protocols</td>
</tr>
<tr>
<td>Entomology Teleconference</td>
<td>19 Feb 2010</td>
<td>Barbercheck, Weber, Mullen, Pisani-Gareau</td>
<td>Continuation of discussion of insect sampling in the systems trial, development of standard protocols</td>
</tr>
</tbody>
</table>
**Advisory Board Meeting Planning Teleconference**

- Date: 23 Feb 2010
- Participants: Mirsky, Ryan, Barbercheck, Hoover, Curran, Mullen
- Discussion: agenda items, who to invite, and lodging/meal planning

**Farmer Advisory Board Meeting**

- Date: 10 March 2010
- Participants: Mirsky, Ryan, Hooven, Mullen, Ryan, Voight. UDel: Johnson. USDA: Mirsky, Teasdale, Weber. Farmers/Advisors: Rob Foscue (NC), Ben Haines (NC), Michael Ranck (PA), Kirby Reichert (PA), Dave Wilson (PA)
- Discussion: project overview and planning; farmer orientation to project; soil fertility management, crop varieties, on-farm research plans; activity on farmer decision-making

**Farmer/Stakeholder Focus Group**

- Date: 31 March 2010
- Participants: Barbercheck, Curran, Hooven, Mullen, White, Kaye, Mortenson, Sandy, Eckert, Smith, Gareau, Kieman. Farmers/Advisors: Esbenshade (PA), Yoder (PA), Zielgler (PA), Garling (PA), Zuck (PA Certified Organic), Beal (PASA), Dupont (PSU CE)
- Activity: to gather farmer and NGO and extension stakeholder information for extension materials

**BARC site visit**

- Date: 18 April 2010
- Participants: Mirsky, Reburg-Horton
- Soil, cover crop, and fertility management

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**Project Personnel:**

**Technical:** Christy Mullen (Research Technician, PSU Entomology) is conducting the preliminary trials of the entomology methods, created and maintains the project website, maintains the Organic Systems Plan for the PSU research site, and has served as the project historian. A second technician, to be supervised by PI Curran will be hired with a start date of Sept. 1, 2010. At USDA BARC, PIs are in the process of hiring two student workers for the summer, and a full time technician, who will have a start date of Fall, 2010. At UD-REC, Barbara Scott has been assigned to the project.

**Graduate Students:** Two graduate students have been recruited and will join the project in August 2010. Project funds support one student directly. Claire Keene (PSU Crop and Soil Science), whose research will focus on agronomic aspects of the systems experiment, will be supervised by PI Curran. We leveraged the OREI grant to obtain PSU support for an additional student. Tom Huff (PSU Entomology), who will focus on entomological aspects of the research, will be supervised by PI Barbercheck. Both of these PhD students will participate in project extension activities.

**Post-doctoral Researcher:** We have identified a post-doctoral researcher, Matt Ryan. Matt will join the project upon completion of his PhD (July 1, 2010). Matt is currently a student at PSU, helped in the preparation of the proposal, and has participated in all project activities to date.

**Preparation for Systems Experiments:**

Field work to address Objectives 1 – 4 in the original proposal has been initiated. The Reduced-Tillage Organic Systems Experiment will be implemented in late summer 2010 at the Russell E. Larson Agricultural Research Center (RELARC) near Rock Springs, PA, and at the Beltsville Agricultural Research Center (BARC) in Beltsville, MD as described in the original proposal. Through our planning activities, the plot layout has been altered to facilitate management, but all treatments remain as described in the original proposal (Fig. 1, Table 2).

Four pest management approaches (experimental treatments) will be tested: 1) *expressive* weed management—stimulating pre-plant weed seed germination followed by control; 2) pest *avoidance* – altering corn and soybean planting date to avoid early-season insect pests and weeds; 3) pest (weed) *suppression* – using living and dead cover crops to physically and
chemically suppress weed emergence and growth, and; 4) supplemental weed control – shallow high-residue cultivation to remove weeds that emerge through cover crop residues (Figure 1).

The experiment will use a split-split-block experimental design to test the four pest management approaches. The main plot of the experiment will test expressive weed management practices (Obj. 1) (e.g., false seed beds, tine weeder) aimed at reducing the density of the summer annual weed seed bank in corn and soybean, and late summer and winter annual weed seedlings in wheat, hairy vetch, or cereal rye crops. The effects of the practices will be compared to a no-expressive weed management control.

The first split plot will test pest avoidance and suppressive practices (Obj. 2 & 3). Cover crop termination and corn and soybean planting date (early, mid, and late relative to tillage-based organic systems at the two sites). Because crop maturity will be affected by planting date, this treatment includes different cultivars with varying days-to-maturity requirements. At each of the three planting dates, two cultivars will be included. The first cultivar will be selected based on the appropriate maturity group for the specific date and location, and the second will be a standard (reference cultivar) that is common across all planting dates and sites. Because we know that later-maturing cultivars may not reach maturity when planted late, we consider the nested cultivar maturity treatment (season-length appropriate plus reference standard) to be an efficient alternative to test this question. Each treatment of a single cash crop will be harvested on the same day regardless of grain moisture. The specific moisture level will be recorded at harvest, and fuel costs and other expenses associated with grain drying will be included in the economic/energy use analysis. Cover crop termination date/cash crop planting date will also affect cover crop biomass, thus, Obj. 3 will be tested here.

The second split plot (split-split-plot) in the experiment will test the effects of supplemental weed management (Obj. 4), i.e., shallow high residue cultivation. At approximately 5 weeks after crop planting, a high-residue cultivator with wide sweeps at a low angle will be used to remove weeds that were not suppressed by the cover crop mulch. The effects of two passes will be compared to a no high residue cultivation control.

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**Table 2.** Crop rotations in each entry of the Reduced-Tillage Organic Systems Experiment established at the RELARC in PA and BARC in MD. All cash crops will be present in all years of the experiment.

<table>
<thead>
<tr>
<th>Year</th>
<th>Entry 1</th>
<th>Entry 2</th>
<th>Entry 3</th>
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<tbody>
<tr>
<td>2010 fall</td>
<td>Hairy vetch</td>
<td>Cereal rye</td>
<td>Wheat</td>
</tr>
<tr>
<td>2011 summer</td>
<td>Corn</td>
<td>Soybean</td>
<td>Wheat</td>
</tr>
<tr>
<td>2011 fall</td>
<td>Cereal rye</td>
<td>Wheat</td>
<td>Hairy vetch</td>
</tr>
<tr>
<td>2012 summer</td>
<td>Soybean</td>
<td>Wheat</td>
<td>Corn</td>
</tr>
<tr>
<td>2012 fall</td>
<td>Wheat</td>
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</tr>
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<td>Wheat</td>
<td>Corn</td>
<td>Soybean</td>
</tr>
<tr>
<td>2013 fall</td>
<td>Hairy vetch</td>
<td>Cereal rye</td>
<td>Wheat</td>
</tr>
<tr>
<td>2014 summer</td>
<td>Corn</td>
<td>Soybean</td>
<td>Wheat</td>
</tr>
</tbody>
</table>
At the Russell E. Larson Agricultural Research Center, Kepler N6/7 is the designated field for the systems experiment and is about 15 acres. The field was previously (2009) divided into conventionally-managed corn, soybean, and wheat fields. In early April 2010, approximately 4000 gallons/acre of liquid dairy manure was applied across the entire field site. The field was chisel plowed on April 12, 2010, and disked, field cultivated, cultimulched, and planted to 80 lb/acre Blaze oats on April 19 to provide a uniform field history in preparation for the systems experiment, and to allow for more uniform establishment of weed populations and timely seeding of cover and cash crops. At BARC, the entire experimental area was planted to a cereal rye cover crop (120 lb/a) in Fall 2009. In June 2010, 2 T/acre poultry manure will be applied, and sorghum sudan grass will be planted.

The systems experiment will begin in late August, 2010. Cover crops will be terminated in August, the individual treatment plots for the systems experiment will be mapped, initiating the systems rotation of corn, soybean, and wheat for 2010/2011. Following oat (PSU) and sorghum sudan (BARC) harvest, liquid dairy (PSU) or pelleted poultry (BARC) manure will be applied to supply estimated crop needs. In late August 2010, a hairy vetch (Purple Bounty) cover crop will be planted in treatment plots that will contain corn, and a rye cover crop (Aroostook) will be planted in treatment plots that will contain soybean. Treatments to include wheat will be seeded in early October. Weed seedbank subplots will be established with annual species in late fall, 2010. In spring of 2011, the cover crops and cash crops will be managed as outlined in the original proposal.
University of Delaware: At the UD-REC, the fields for the project have been identified. PI VanGessel has discussed the project the needs and requirements for organic certification with Pennsylvania Certified Organic and with the farm staff (Brain Hearn and Victor Green). Two fields, both approximately 9 acres and with capacity for overhead irrigation to alleviate moisture stress, will be used. The fields have been marked off, and sub-soiling was completed to alleviate soil compaction. Soil sampling for fertility status of the fields was conducted in fall of 2009. In mid-May, 2 tons/acre of poultry manure will be applied and sorghum-sudan grass (35 to 40 lbs/A) will be planted in preparation for fall planting of winter wheat and cover crops.

Preliminary Tests of Methods:
Currently, preliminary trials to refine methods are being conducted at PSU and BARC. These preliminary tests include: black cutworm and armyworm pheromone trapping, soil baiting for wireworms and other soil insects, seedcorn maggot monitoring, and a predation assay using sentinel black cutworm and greater wax moth larva.

In early summer 2010, a corn variety test is being established on certified organic land at the PSU. The variety test is also being conducted at three other sites: in Center Co. and Lancaster Co., PA, and at the University of Delaware Research and Education Center (UD-REC) on land that is not certified organic. The performance of eleven organic corn varieties, ranging from 80 to 95 days in maturity, will inform our choice for the systems experiment and on-farm tests in PA, MD, and DE. The Lancaster Co. site was planted on April 20, 2010, and the other sites will be planted in May/June, 2010. Sixteen rows of each variety, comprised of four rows replicated four times in a randomized complete block design, will be planted. Performance criteria will include emergence, early vigor, growth rate, time to black layer formation, dry down rate, and yield. The varieties being tested include: 1). Masters Choice OG-463 – 83 day. 2). BlueRiver 30A12 – 90 day. 3). BlueRiver 19K19 – 84 day. 4). BlueRiver 25A16 – 87 day. 5). BlueRiver 36K71 – 95 day. 6). Viking O.7292 – 95 day. 7). Viking O.39-94N – 94 day. 8). Viking O.89-80N – 80 day. 9). UT333X – 89 day. 10). American Organic B916 – 85 to 87 day. 11). American Organic C912 – 91 to 93 day.

At UD-REC, cereal rye, hairy vetch and crimson clover cover crops were planted in fall 2009 to observe 2010 flowering dates to facilitate project planning. Similarly, tests to provide information on biomass production and management timing were conducted with four varieties of cereal rye planted in late October through early December, 2009. After full flowering, a representative sample (0.5 sq m) will be cut and dried for biomass determination. Following rye termination by rolling, a planting date by corn hybrid and planting date by soybean maturity group demonstration is planned for 2010 to help “fine-tune” crop selection and planting dates for the UD site.

At USDA BARC, a triticale/vetch cover crop mixture experiment is being conducted to evaluate the performance of mixtures with injected manure. The mixtures are planted in a reciprocal series design with vetch:triticale ratios of 100:0, 75:25, 50:50, 25:75, and 0:100; the pure stand is 30 lb/a of vetch and 120 lb/a triticale. Six accession of hairy vetch will be evaluated for characteristics and utility for the systems experiment. Data collected will include cover crop biomass (2-4 times during the season), cover crop C:N, corn yield, and weed densities.

Extension Activities that Support the Project Goals

- Stakeholder survey. In January 2010, a needs assessment survey was conducted in collaboration with PSU Cooperative Extension staff. The purpose of the survey was to
gather data to inform extension programming in organic grain and forage production. The survey was distributed electronically and in paper to organic and non-organic grain farmers. Electronic surveys were sent to organic grain farmers certified by Pennsylvania Certified Organic (PCO). Announcements with a web link to the survey were distributed via PCO’s electronic newsletter and the Pennsylvania Association for Sustainable Agriculture listserves. Paper surveys were distributed by county extension educators to farmers who have shown an interest in organic grain production practices. In total, 105 farmers from Pennsylvania, Maryland, and New York completed the survey. 57% of respondents had acreage that was certified organic or in transition. 47% said that information and programs on organic grain and forage production would be very useful and 18% said it would be moderately useful. The topics of information that were most needed by the respondents included weed management, soil fertility management, soil quality management, crop variety trials, and insect pest management. The formats of information delivery that were considered the most useful included fact sheets, a comprehensive production guide, on-farm field days, and farmer-to-farmer networking or mentoring. Results of the survey are available at http://eorganic.info/node/4348.

Based on the stakeholder survey results, we held a stakeholder focus group to gather information on the desired format and content for a comprehensive organic grain production guide. Summary information gathered is available at http://eorganic.info/node/4348. The project team is working in collaboration with the PSU Crop Management Extension Group, PCO, and organic farmers to produce the guide. In this way we are engaging stakeholders and a group of extension educators who, for the most part, have not have not previously served the organic or transitioning grower community.

Extension presentations:

- Barbercheck, M. 2010. The Importance of Soil Quality to Sustainable Agriculture. NRCS-NJ Soil Health Conference, Mt. Laurel, NJ. March 9, 2010. 250 attendees. 91 responses to evaluation. Overall rating of conference: 39.4% Excellent, 49.3% Good; Overall rating of presentation: 17.5% Excellent, 52.6% Good; Relevance to soil health: 25.8% Excellent, 49.5% Good.
- Curran, W.S. 2009. Agronomic Weed Management Field Day, Rock Springs Agronomy Farm, July 9, 2009. 15 attendees completed evaluations. 100% considered attending the event a good use of their time. Knowledge gain: 1) Using mechanical weed control in high residue no-till, before workshop minimal = 60%, moderate = 33%, considerable = 0.06% ; after workshop minimal = 0.03% , moderate = 66%, considerable = 13%; 2) Managing cover crops to enhance weed control, before workshop minimal = 40% , moderate = 46%, considerable = 13% ; after workshop minimal = 0.06% , moderate = 66%, considerable = 26%.
• Curran, W., Ryan, M., Nord, E., Gareau, T. P., Smith, R. G., Mortensen, D., and DeBarros, N. M., Barbercheck, M. Field Day: Weeds Suppression and Biodiversity through Cover Crops and Field Edge Plants. 17 June 2009. Russell E. Larson Agriculture Experiment Station, Rock Springs, PA. 39 attendees, 21 evaluations returned. 100% considered attending the event a good use of their time. 91% likely to make changes to their farming operations in the next two years as a result of the program.

• Curran, W.S. 2010. Using biology to help manage weeds in organic systems. 5th Annual Organic Grain and Forage Workshop, Queen Anne’s County, Centreville, MD. March 9.

• Mirsky, SB. 2010. Reducing tillage within an organic grain rotation. Maryland Organic Grain Conference. 3/09/2010. 88 attended. Overall rating of workshop: 73% Excellent, 27% Good. This session: 63% Excellent, 31% Good, 6% Fair. 93% have better overall understanding of organic production.

**Extension publications:**


**Research presentations that support the project goals:**


**Plans for the 2010/2011 Reporting Period**

*Project planning and communication:* The project team will continue with planning and update teleconferences, approximately monthly and as needed. We will convene a face-to-face PI meeting in Winter 2011 to review activities from the 2010 field season and to discuss upcoming field experiments and extension activities. We will convene a project advisory board meeting in late winter 2011 to review and receive input on project research and extension progress and direction, on-farm research progress, successes, and challenges.
**On-Station Systems Research:** We will proceed with the systems experiment to address the project research goals at the RELARC and BARC as described in the original proposal. Research focused on components of the systems experiment will be conducted at the UD-REC as described in the original proposal.

**On-Farm Research:** On the Reichert farm (PA), a trial will be initiated that will include medium and shorter season corn hybrids. The five-replicate trial will be located on approximately 2 acres that was in mixed cool season grasses and red clover. The entire field has been manured and plowed in preparation for corn planting in mid-May. Plots will measure 15 feet wide and approximately 500 feet long. As soon as corn is mature, the shorter season hybrid will be combined, followed soon after with a rye cover crop no-till drilled into plots. Likewise, the medium maturity corn should be harvest by mid-October, followed by no-till drilling of rye. All covers should be planted by mid to late October. During 2011, soybeans of 2 maturities will be planted or drilled into the rye cover crops; if the cover is sufficiently heavy to provide season-long weed control without the need for cultivation, the soybeans will be no-till drilled. If the cover is not heavy enough, at the time when the soybeans should be planted, soybeans will be planted into 30-inch rows to facilitate row-cultivation with a high residue cultivator.

On the Ranck farm (PA), cover crops will be planted in 2010, and cash crops in 2011. A four-replicate trial will consist of two treatments: corn intended for silage harvest in mid-September and corn intended for grain harvest in early to mid-October. Each plot will be 30 feet wide and 400 feet long. The grain plots will be over-seeded with cereal rye in late August or when corn grain has achieved the early milk stage. In the silage corn plots, corn will be cut soon after broadcasting of rye, and then no-till drilled with cereal rye. Stands and biomass of rye in the two systems will be compared in mid-May 2011, with the goal of no-till planting soybeans soon after rolling/crimping the rye. A high-residue cultivator will be available to assist in weed control where the rolled rye is insufficient to provide the desired weed control. Yield data will be collected from the soybean plots in 2011.

On the cooperating organic grain farms in North Carolina, 14 different legumes and 3 rye/legume mixtures were planted on an organic grain farm in the fall of 2009. They were rolled on May 5th, 2010, sampled for biomass and N content, and planted to corn. Workshops are being held on June 8 and July 15, 2010, to discuss the system with farmers and collect more ideas for the on-farm trials. Trials will be planted on 3 farms in the fall of 2010 for roll planting in the spring of 2011. Legume cover crop mixtures will be utilized for corn and rye for soybeans. Two additional field days will be held in 2011 to examine weed control, nitrogen release and pest interactions from the systems.

In MD, shorter season corn maturity groups that will accommodate cover crop planting in the fall will be evaluated on the Cooper and Taylor farms. In the fall of 2010, hairy vetch (30 lb/ac) will be planted on a 2 ac strip on the edge of larger corn fields at both farms. In the summer of 2011, two corn maturity groups (105 and 90 day) will be no-till planted (32,000 seeds/ac) into a rolled hairy vetch cover crop at 75% flowering. High residue cultivation, as a supplementary weed control tactic, will be conducted twice, on a two-week interval, when corn has reached the V4 stage. Plots will be arranged in a randomized complete block experimental design, and will run the length of the field (approx. 500 ft) and span two planter passes (30-40 ft wide). Cover crop and weed biomass (2 randomly placed 1 m2 quadrats; visual rating), and corn yield (40 linear row ft) will be measured.
Planned Extension Activities:

The project team will organize a sustainable/organic agriculture webinar/seminar series. PI Curran will offer a webinar through eOrganic on opportunities and challenges to managing cover crops using the roller/crimper technology. We are planning to incorporate grower experiences, either through a farmer co-presenter, or by presenting farmer experiences from interviews. The project team will contribute materials to the organic field crop production guide being produced at PSU. We are collaborating with Pennsylvania Certified Organic to incorporate their production guidance documents (http://www.paorganic.org/organic_resources.htm) into the organic field crop production guide. As interim products, we will publish information from individual chapters in the PSU Agroecology in Practice fact sheet series. These publications will increase the capacity of agricultural educators in the mid-Atlantic region to deliver organic agriculture programming to their farmer clientele. We will produce a fact sheet on cover crop roller technology and submit it to eOrganic for publication at eXtension. We will produce three project newsletters that will include reports on project progress and plans. The newsletter will be distributed by mail and will also be available at the public project website. PI Curran will consult with Doug Miller, PSU Center for Environmental Informatics in the Earth and Environmental Systems Institute, to develop a cover crop decision tool to address the goals of Objective 7.

We will organize one PSU research station-based field day in 2010 on topics that support the project. UD-REC will offer a training/demonstration of weed biology-based approaches for weed management in early September 2010, in conjunction with Rutgers University. Many of the reduced-tillage approaches will be demonstrated (cover crops, exploiting weed biology, cultivation equipment, etc.) during an interactive one-day program. The targeted audience is county-based extension educators, state and federal agency personnel, crop advisors, and farmers. All outreach activities will be evaluated for knowledge gain and intended behavior change.

PI Mirsky will make presentations at the Rodale Institute Annual Field Day; July 16, 2010. The title of his presentation will be “Supplemental weed control practices for no-till organic soybeans.” He will also speak on reducing tillage in organic systems, cover crops, and cover crop mixtures at the Beltsville Agricultural Research Center Field day (100th Anniversary) on June 5, 2010. A field day, Organic No-till Corn Production, will be held on June 8, 2010, at Pocosin Farms in Pantego, NC. The field day will feature organic no-till corn planted into roll-killed legume and rye cover crops. Discussion will focus on weed suppression by cover crops and organic soil fertility management. We anticipate a twilight meeting at each participating farm in the late summer 2010 to showcase the on-farm activities and to inform farmers about the extensive experiments being conducted at the Penn State University and University of Delaware Experiment Station Research Farms, and at the USDA-ARS Beltsville research facility.

Project Timeline

Overall, project activities are progressing according to the timeline provided in the original proposal.