Winter 2015
Volume 5, Issue 1

Manure Injection on 15-inch row spacing prior to spelt planting (credit: Mazzone)

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Have questions or comments about something you've read or seen in *The ROSE Review?*

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The ROSE Review

Reduced-tillage Organic Systems Experiment Newsletter

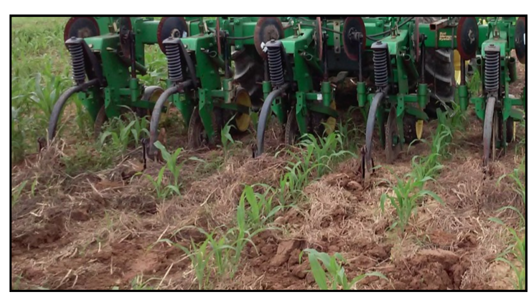
A New ROSE in Bloom

Welcome to the latest issue of the ROSE Review! The ROSE Review was started in 2010 to connect project collaborators and stakeholders so we could share the latest news on our USDA Organic Research and Education Initiative (OREI) funded project, *Improving Weed and Insect Management in Organic Reduced-tillage Systems*. Our last ROSE Review, issued in winter 2013, marked the end of field research (2010-2013) and a period of transition. It has been an eventful two years, so please allow us to catch you up on ROSE activities!

Our PhD candidates, Clair Keene (Plant Science) and Ariel Rivers (Entomology), spent much of the past two years synthesizing data collected during the ROSE project (2010-2013). This was not a small task, given that the cropping system study was evaluated at three Mid-Atlantic locations: Penn State's Russell E. Larson Agricultural Research and Education Center (RELARC) in Rock Springs PA, the USDA's Henry A. Wallace Beltsville Agricultural Research Center in Beltsville MD, and University of Delaware's Carvel Research and Education Center in Georgetown DE. Several journal articles are slated for publication in upcoming years. Our research technicians, Mark Dempsey and Christy Mullen, also worked diligently to obtain organic certification of our Penn State ROSE research site (~ 5 ac) in the winter of 2014. Alas, no ROSE bloom lasts forever. Clair, Ariel and Mark are starting new and exciting careers in sustainable agriculture this winter, and our Maryland and Delaware collaborators, Steven Mirsky and Mark VanGessel, remain close but have initiated new and exciting lines of research.

During this period of transition, we took time to identify both successes and challenges that emerged from the ROSE. Our project evaluated a cover crop-based, rotational no-till system using a corn-soybean-wheat rotation, which utilized the roller-crimper to terminate overwintering cover crops and enabled no-till planting of summer cash crops into rolled cover crop mulches. Encouragingly, rolled cover-crop mulches promoted conservation biological control of early-season invertebrate pests and our cultural and mechanical weed management strategies kept weeds below yield-limiting levels during the three-year organic transition. However, we also found that inconsistencies related to cover crop termination with the roller-crimper and planting into high levels of cover crop residue can result in volunteer cover crops and below-optimum crop yields. In addition, we found that short agronomic windows for manure management and cover crop establishment are likely obstacles to grower adoption of these strategies.

In the fall of 2014, a new ROSE bloomed that draws on our previous successes and tackles persistent challenges. We are excited to introduce "ROSE 2.0", which we have come to call our new USDA-OREI funded project (2014-2018), *A Reduced-Tillage Toolbox: Alternative Approaches for Integrating Cover Crops and Reduced-Tillage in an Organic Feed and Forage System*. In this ROSE Review, you will learn about the details of our new experiments. You will meet new students, technicians and collaborators. And finally, you will get an initial look at summary results from our first crop year. We hope you enjoy!



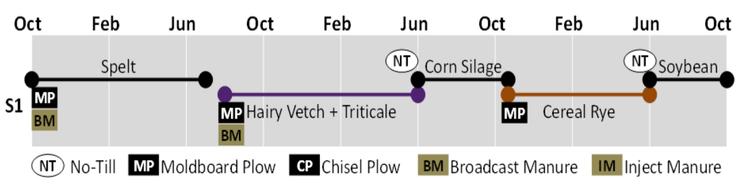
High residue cultivation in corn (credit: Mazzone)

The Reduced-Tillage Toolbox

Reducing tillage in organic annual grain systems has the potential to combine the soil-conserving and labor-saving benefits of no-till practices with soil health-building benefits of organic practices, which include diverse crop rotations and incorporation of cover crops. This is easier said than done! Reducing the frequency or intensity of tillage while also integrating cover crops into annual grain rotations produces many challenges.

The primary objective of our new study is to assess the agronomic benefits and tradeoffs of various strategies for reducing tillage. In order to do this, we have developed four cropping systems applied to 30 by 160 foot plots in a full-entry design with four replications. Each system is a three year rotation of spelt-corn-soybean with a cover crop preceding corn and soybean. Our cropping systems differ in how tillage is used to establish cover- and cash-crops, ranging from no-till planting to full inversion tillage with a moldboard plow. These strategies also determine the cover crop species mix, growing season length and termination timing. Let's have a look at the details of our four cropping systems.

No-Till Cash Crop System (S1)



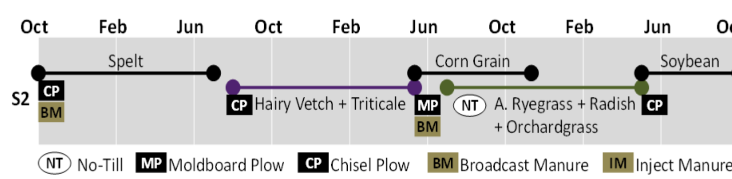
Our first cropping system utilizes the rotational no-till strategies that were developed in our previous study (2010 – 2013). There are three primary tillage events using the moldboard plow in this 3-year rotation. We establish hairy vetch + triticale (30 + 30 lb/ac) in late August before corn and cereal rye (120 lb/ac) in mid-October before soybean. Corn and soybean are no-till planted following cover crop termination with a roller crimper. In comparison to tilled systems, we typically delay corn and soybean planting by at least 10-14 days to allow for greater cover crop biomass accumulation. Our previous studies have demonstrated that about 3 tn/ac of dry matter biomass is needed to provide good weed control. We plant corn and soybean on 30-in rows. This row spacing allows for additional in-crop weed control with the use of a high-residue, inter-row cultivator. In this system, we make two cultivation passes spaced approximately 5 days apart starting at approximately four weeks after planting corn and soybean.

Based on our previous experience, we've made a few modifications to this system. We are now growing spelt as our winter grain, which has strong food- and feed-grade markets in the Northeast, and may also produce greater agronomic flexibility compared to winter wheat. We are also making two passes with the roller crimper, spaced about three days apart, which increases termination success and produces less cover crop regrowth.

What about those agronomic and environmental challenges? It is likely that our nitrogen management strategies for corn, a high N-demand crop, may prevent optimal yields. No-till planting corn into rolled cover crop mulch necessitates manure applications to be made the preceding fall, ahead of the cover crop. Although we can achieve high levels of N-fixation by using hairy vetch, we have a poor understanding of whether plant-available-nitrogen (PAN) from hairy vetch surface residue breakdown aligns with corn demand during the growing season. Finally, adequate cereal rye stands are a necessary requirement for successful no-till soybean production. In cooler climates within the Northeast, this necessitates growing corn for silage to ensure successful establishment of cereal rye in late-fall. Consequently, producers who place a high-value on corn grain production are less likely to adopt this no-till soybean strategy.

Rolling hairy vetch prior to planting corn (credit: Mazzone)

Tilled Grain System (S2)



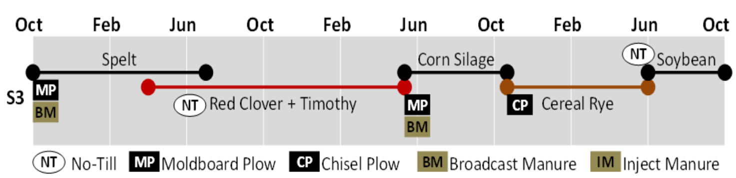
Our second cropping system addresses a few of these agronomic and environmental challenges. This system allows for tilled corn grain production while reducing the intensity of primary tillage across the three-year rotation to one moldboard plow event and three chisel plow events. We still grow a hairy vetch + triticale cover crop but incorporate both manure and the cover crop using a moldboard plow prior to corn planting. This strategy should improve nitrogen availability to the corn crop.

Interseeding cover crop into V6 corn (credit: Mazzone)

The exciting new practice that allows for corn grain production and cover cropping before soybean while also reducing tillage frequency is interseeding. This technology has been developed and tested by Penn State staff and researchers in conventional no-till systems for the past several years. Using a high-clearance no-till grain drill, we plant an annual ryegrass + orchardgrass + forage radish (10 + 10 + 3 lb/ac) cover crop mixture in corn following our last row cultivation at the V6 growth stage.

With an established cover crop, we are able to extend the cash crop season and harvest corn for grain. However, this cover crop mixture will not produce enough spring biomass and cover to utilize a rolled no-till soybean system. Consequently, we plan to use the chisel plow to establish soybean, as well as spelt and hairy vetch + triticale in the fall. Finally, we will be making two to three passes using a traditional row cultivator to manage early season weeds in our corn and soybean crops.

Tilled Corn Silage – No Till Bean System (S3)

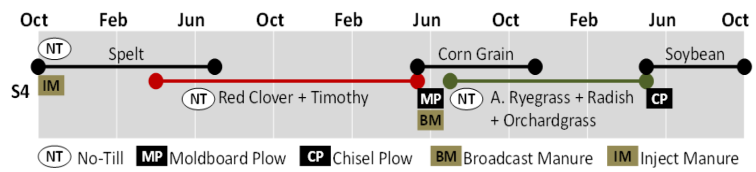


Our third system is designed to improve nitrogen management of corn grown for silage. We are able to reduce the frequency of tillage across the rotation to two moldboard plow events and one chisel plow event by utilizing the roller-crimped rye, no-till soybean strategy and by frost-seeding a legume cover crop into our winter grain.

Frost-seeding is a strategy that many farmers have tried or practice. Typically, small-seeded cover crops are broadcast into a small grain in late winter. Alternatively, we have found that using a no-till drill to establish a red clover + timothy (11 + 3 lb/ac) mixture can improve stand establishment. Frost-seeding extends the cover crop growing season length, which should result in high-levels of N-fixation from red clover. Frost-seeding also produces management flexibility following spelt harvest. The established cover crop mixture can be harvested for forage in late summer or mowed to decrease weed seed production. In the following spring, we incorporate the cover crop and manure prior to corn planting.

Under-seeded red clover + timothy cover crop as winter grain dries down (credit: Wallace)

No-Till Fall Crops System (S4)



Our fourth system combines our two relay cropping methods, frost-seeding and interseeding. In addition, we are no-till planting spelt with the help of a shallow-disc manure injector. Manure injection is another agronomic technique that Penn State researchers have helped develop for conventional conservation-tillage systems that could also be integrated into organic grain systems in the future. Manure incorporation with a shallow-disk injector helps to prevent nitrogen losses through volatilization or runoff, while minimizing soil disturbance. For our project, we will be able to establish spelt using a no-till grain drill to meet the crop's nitrogen demand through manure incorporation using injectors on 15-inch row spacing. With respect to tillage reduction, this system is our most ambitious. We will be establishing all of our fall crops using no till methods, while using only one moldboard plow and one chisel plow event throughout the length of the rotation. As you can see in figure above, the use of relay planting methods to establish our cover crops before corn and soybean significantly increases the length of time in which vegetative cover will be present in the cropping system.

There you have it, our Reduced-Tillage Toolbox! You might imagine that there are many questions regarding how these cropping system rotations will impact pest- and fertility-management objectives. We hope to answer as many questions as possible. In the next two articles, several of our new graduate students will share just a few questions they plan to address.

New ROSE Project Team Members

Armen Kemanian, Ph.D., is an Associate Professor of Production Systems and Modeling at Penn State. He joined the ROSE 2.0 in 2014, and will focus on combining station and on-farm research findings into a farmer-oriented decision support tool called Cycles-OT (Cycles Organic Tool). Cycles-OT will be a tactical decision support tool that can inform farmers of the expected nutritional needs and other management implications at critical times in the rotation.

Debasish Saha, Ph.D., is a post-doctoral student working with Armen. He grew up in east India and obtained his Master's degree in Soil Science from Punjab Agricultural University in 2010. He earned a dual Ph.D. in soil science and biogeochemistry in August of 2015, while studying soil nitrous oxide emissions in conservation lands undergoing the transition to perennial bioenergy crops. Since December, his post-doctoral work will address the nitrous oxide emissions from the ROSE 2.0's organic crop management strategies.

Jason Kaye, Ph.D., a Penn State Associate Professor in Soil Biogeochemistry, is now collaborating with the ROSE team. Jason also leads another Pennsylvania organic cropping systems experiment, "Finding the Right Mix: Multi-functional Cover Crop Cocktails for Organic Systems". His expertise will add a soil health component to our research including nutrient and greenhouse gas management.

Andrew Morris, a Master's student working with Jason, began his Penn State studies this season, and is looking forward to his future work with ROSE. Andrew received his B.S. in Plant Sciences from Cornell University in Ithaca, NY in 2014.

Sarah Isbell joined our team and is also working with Jason Kaye in a PhD program in Ecology. Her hometown is Annapolis, MD and she earned a B.S. in Biology from Dickinson College, Carlisle, PA. Before she came to Penn State, she lived in Hudson Valley, NY, where she worked with diversified organic vegetable producers. She enjoys playing the piano, eating ice cream and saving seed.

Karly Regan joins the Barbercheck lab after finishing an M.S. at South Dakota State University, where she studied the effects of neonicotinoid insecticides on spider mites and their predators in soybean. She received a B.S. in Biology and Women's Studies from the University of Massachusetts in 2008. Karly loves animals of all kinds but decided insects and spiders were her favorites after a trip to the rainforests of Costa Rica during college. Since most farms where she grew up in Massachusetts are very small in scale, moving to South Dakota was an eye-opening experience and she's been hooked on agriculture ever since. She's excited to leave pesticide research behind and learn about organic production by studying the arthropod communities in the ROSE project. Her specific interests lie in how sustainable management practices such as reduced tillage and use of cover crops influence predator populations and biological control of pests.

Tosh Mazzone joined our team in May of 2015, as a technician on the project. Tosh previously worked with the Penn State Weed Ecology Lab in cooperation with PA-DCNR in invasive species management and research, while earning his bachelor's degree in Plant Science. His previous research included novel weed management strategies for riparian conservation buffers, and biological control of invasive weeds.

Rebecca Champagne is a Master's student working on the ROSE project with Bill Curran beginning this season, specifically on agronomic performance and weed suppression dynamics. She received a B.S. from University of Maine in 2015 in Sustainable Agriculture. She enjoys playing ice hockey, horseback riding, visits to the Maine oceanfront, and discovering new and fun places to eat.

Some of the faces of ROSE 2.0. Back Row, Left to Right: John Wallace, Tosh Mazzone, Christy Mullen, Andrew Morris. Front Row: Dayton Spackman, Rebecca Champagne, Karly Regan, Sarah Isbell (Credit: Keene)

Insect Investigations in the ROSE 2.0!

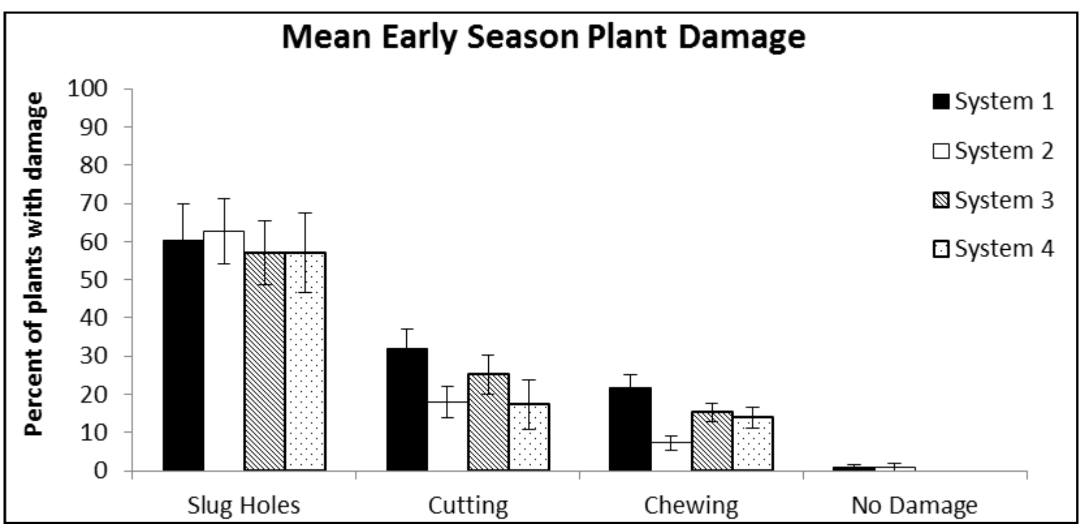
By Christy Mullen, Karly Regan, and Mary Barbercheck

Different tillage and cover cropping practices can have significant impacts on pest insects and their natural enemies, and the resulting plant damage from insects. Therefore, we are monitoring insects and collecting plant and soil samples to help us understand the potential effects of the experimental systems on pest and beneficial arthropods. We initiated arthropod sampling in the new ROSE project in the summer of 2015. We focused our sampling effort on early season pests and their potential predators in corn, but we also sampled some key corn pests in August and September. The sampling season started in April with the implementation of pheromone traps for black cutworm and true armyworm moths to monitor their flights through mid-July. The caterpillars of these moths can be problematic in high residue systems. Black cutworm adult numbers via pheromone traps never reached a significant threshold flight of 9 male moths over 2 nights. True armyworm numbers remained relatively low until a mid-June, with a peak flight occurring in late June with an average of 59.5 moths per trap.

Insect sampling began again in mid-May to coincide with cover crop termination and subsequent planting of the cash crops. Specifically, we conducted pitfall sampling prior to cover crop termination to assess the abundance of soil-surface active pests and natural enemies, coupled with sentinel trap assays to assess the predation potential of those natural enemies. In sentinel traps, we tape caterpillar prey onto an index card, place it in the field, and then pick up cards the following morning to see if and how many of the caterpillars have been attacked by predators. Some common predators at the site include ground and tiger beetles, rove beetles, spiders, and daddy longlegs. Predation rates did not differ in the living cover crops before termination, but were higher in corn in treatments in which hairy vetch and triticale preceded the corn in early season samples.

Following corn planting in late-May, we used emergence traps to assess the relative populations of seed corn maggot flies emerging from the soil in the four systems. The risk for these seed-attacking pests is high where fresh plant residues are tilled in and actively decomposing. Another round of pitfall and sentinel trapping occurred about one week after the corn formed its first true leaf. We are still processing these samples and hope to be able to report our results in the next newsletter.

Once the corn crop emerged, we performed an early season stand count and plant damage assessment to quantify damage by early season pests such as slugs and caterpillars. Slugs were responsible for most of the early season plant damage, with an average of 57-62% of the corn plants exhibiting some degree of slug damage. Treatments that included hairy vetch and triticale preceding corn had slightly higher slug damage numbers compared to the treatments that had red clover and timothy. Cutting and chewing damage was higher in the no-till corn that was planted into the rolled hairy vetch/triticale mat (32.5% of plants damaged) compared to the other three systems which used tillage (21.7% of plants damaged).



Systems variations on average early season invertebrate crop damage. System 1: No-till cash crop; System 2: Tilled grain; System 3: Tilled corn silage and no-till soybean; System 4: No-till fall crops

We sampled the soil in corn across systems in early May to detect the presence of soil-borne insect pathogens, such as the fungus *Metarhizium anisopliae*. Insect pathogens are often overlooked but are important natural enemies of pest insects in and on the soil. We also measure key soil quality characteristics such as labile soil organic matter, pH and electrical conductivity to understand how the systems change the soil environment, and if any of these changes are related to pest or beneficial insects, or to pathogens that infect them.

We conducted mid- to late-season scouting for selected late-season pests, the fall armyworm and European corn borer, as well as another two rounds of soil sampling and sentinel prey assays. European corn borer caterpillars were more prevalent in plots preceded by red clover and timothy than by hairy vetch and triticale during 2015. This didn't directly relate to differences in plant damage. Unlike in the early season assays, predation rates were similar among all four systems during two late-season sampling dates.


Left to right: An emergence trap for seed corn maggot flies placed over a corn row; a sentinel prey trap with caterpillars attached to an index card (Credit: Mullen)

A waxworm larva infected with the fungus, Metarhizium anisopliae (Credit: Mullen)

Finally, we also helped facilitate assessments of weed seed predation in the field. We coordinated our predation sentinel trap assays in early September and October to coincide with weed biomass sampling and seed predation assays performed by post-doctoral scholar, Dr. Barbara Baraibar Padro, who works on the neighboring organic project focusing on the use of cover crop mixtures. It will be interesting to compare the two different kinds of predation data!

We're looking forward to data collection in the next two summers to help us better understand the effect that our reduced tillage systems on pest populations and crop damage, and predator populations and predation rates. Now that the field season has wound down, we will be spending the coming months processing all of our preserved arthropod samples. Never a dull moment!

Nutrient & Greenhouse Gas Management

By Sarah Isbell and Andrew Morris

The ROSE 2.0 has added a significant new component to address questions about nutrient cycling. Dr. Jason Kaye has joined the project team to explore nutrient dynamics within the ROSE systems, with a focus on soil nitrogen. Nitrogen management is a critical agronomic challenge with both environmental and economic implications. When nitrogen is added to agricultural systems, there can be unintended environmental consequences such as water and air pollution. These nutrient losses through leaching and off-gassing may also contribute to economic losses for farmers.

Throughout this past growing season, we collected soil samples every other week (fortnightly) from each ROSE system to measure the plant available inorganic nitrogen in the soil. These data will help us understand when the nitrogen added through manure and cover crops is actually available to our cash crops for uptake. This information will be paired with data quantifying the nitrogen and carbon in plant tissue collected from both cover crops and cash crops.

One of several fortnightly soil sampling events in red clover + timothy cover crop (Credit: Morris)

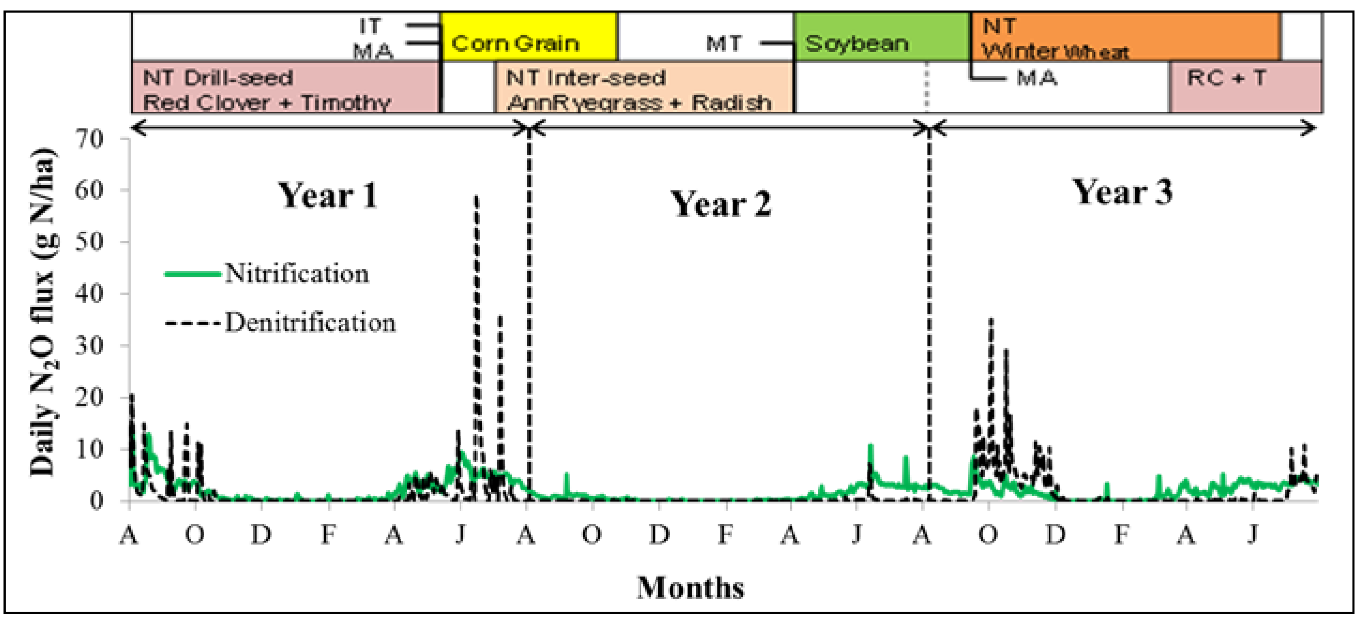
Our team is also curious about the possibility of reduced nitrate leaching in the interseeded systems. To study nitrate leaching, we are using mesh bags filled with charged resin beads to "catch" any nitrate that would filter down through the soil. This can give us an estimate of how much nitrate could potentially be leached from these systems. We buried resin bags in corn plots both with and without interseeded cover crops and about half of the bags were removed for analysis in the fall while the remaining bags will be left in throughout the winter. We also installed resin bags in frost-seeded and non-frostseeded spelt plots to estimate differences in potential nitrate leaching in these systems over the winter season.

After soybean harvest and manure incorporation, measuring nitrous oxide (N_2O) emissions prior to spelt planting (Credit: Isbell)

In October, we began to measure gaseous nitrogen losses in the ROSE plots. By capturing and analyzing samples of gas emitted from the soil, we can estimate nitrogen losses to the atmosphere and determine if any of the practices in ROSE are reducing emissions nitrous oxide, a potent greenhouse gas. We predict that practices such as manure injection and reduced tillage will provide a beneficial reduction in greenhouse gas emissions from these systems.

The ROSE project offers many exciting avenues with which to explore nitrogen dynamics in organic agricultural systems. Results from these experiments will hopefully give us a better understanding of the impact of a diversity of agricultural practices on nitrogen retention and provisioning to better address nutrient management. These tools can then be presented through field days, workshops, and publications to improve environmental and economic outcomes on organic farms.

Extracting inorganic nitrogen from soil (Credit: Morris)



Simulation of N_2O emission from nitrification and denitrification in an organic system in Pennsylvania with the model Cycles. The rotation is shown in the figure upper panel. IT = inversion tillage; MA = manure application; MT = minimum tillage; RC + T = red clover + timothy.

2015 Cash Crop Performance

By Tosh Mazzone and John Wallace

The first year of the ROSE 2.0 was an exciting one. We had our first opportunity to evaluate the performance of several new reduced tillage strategies and their potential integration into our rotation. We used the InterSeeder™ to establish a cover crop into standing corn, under-seeded an early spring cover crop into winter grain using a grain drill, and injected manure on 15-inch spacing prior to planting spelt. These strategies were implemented to address some of the key concerns that arose from the ROSE, and even in our first year, we are beginning to see indicators of their effects on agronomic performance. Here, we report our first year results on a very important agronomic factor, crop yields.

A secondary 8" roller-crimper mounted behind double-disc openers on our planter (Credit: Barbercheck)

Corn Silage

In two of our systems, we planted a 90-day corn variety on June 5 and harvested silage on September 17. Our tillage strategy preceding corn had a significant effect on yields. Our silage planted into a tilled red clover cover crop mixture yielded the highest, with an average of 17 tons per acre. Corn planted into a rolled hairy vetch cover crop mixture produced comparatively lower yields, 11 tons per acre. We had some challenges with termination of the hairy vetch cover crop prior to planting. The ripple coulter on our planter had some difficulty slicing through the vetch residue, although plant populations were not impacted. Weed biomass in the no-till system was moderate, at 610 pounds dry material per acre, but was similar to that of the tilled-system, which averaged 680 pounds dry material per acre. However, trends suggest that both high-residue, inter-row cultivation in the no-till system and traditional row cultivation in the tilled system effectively controlled inter-row weeds. In-row weeds were much more common across both systems, averaging 85% of total weed biomass.

No-till corn silage (left) looking nitrogen-stressed next to tilled-system silage (Credit: Wallace)

Corn Grain

In two of our systems, we planted corn on May 29, and harvested for grain on November 5. This 90-day variety looked beautiful in the field, and we saw some good resulting yields to match. Our yields ranged from 128 to 155 bushels per acre across systems. When we planted corn following a tilled red clover cover crop mixture, we shelled an average of 146 bushels per acre. Corn grain following a tilled hairy vetch cover crop mixture yielded just a hair more at 148 bushels per acre on average. In both systems, we no-till drilled an annual ryegrass + orchardgrass + tillage radish cover crop into the standing corn grain with the InterSeeder™ on July 8, at approximately the V6 growth stage. The cover crop established well, covering much of the inter-row soil surface. Following grain harvest, we noticed patches of corn stover residue that could potentially smother the cover crop, impacting its ability to survive over winter. However, a mild late-fall and early-winter produced an extended growing season for our interseeded cover crops. We are currently processing cover crop biomass collected in late fall to evaluate the performance of our mixture. Weed biomass in corn grain was similar to that of corn silage, and ranged from 685 – 770 pounds dry material per acre. Similarly, weeds found in our corn grain were predominantly in-row, averaging 89% of total weed biomass.

Interseeded cover crop mixture growing up under corn canopy (Credit: Wallace)

Soybean

We planted soybean in our no-till systems on June 4, and on June 7 in our tilled systems. We are now planting an earlier maturing soybean variety (2.0) to hopefully allow for an earlier spelt planting date. Soybean was harvested on October 12. Yields ranged from 33 to 55 bushels per acre across our plots. No-till soybean following a rolled cereal rye cover crop averaged 43 bushels per acre. Soybean following our annual ryegrass + orchardgrass + tillage radish cover crop that was incorporated with tillage yielded slightly higher with an average of 46 bushels per acre. Due to a combination of dry soil and well-established annual ryegrass, we had to use a moldboard plow to incorporate the cover crop prior to soybean planting, rather than a chisel plow as originally intended. The high-residue cultivator did a great job at slicing the roots of weeds between no-till soybean rows, and we saw fairly clean inter-rows for the majority of the season. Just before soybean harvest, weed biomass in the inter-row averaged 118 pounds dry material per acre. The in-row weeds in our soybean were similar, averaging 128 pounds dry material per acre. In tilled systems, weed biomass in the inter-row averaged 104 pounds dry material per acre, while in-row weeds averaged 128 pounds dry material per acre.

High-residue cultivation in soybeans (Credit: Mazzone)

Spelt

Taking a tip from organic farmers seeking a niche winter grain with several agronomic benefits, we decided to plant spelt, rather than winter wheat. We made this choice because we believe its ability to germinate under later-season cold temperatures and taller growth habit, which is advantageous for underseeding makes it an excellent rotational winter grain for our system. We planted our 'Sungold' spelt variety on October 28, 2014 and saw good fall growth and overwintering success. A red clover cover crop mixture was no-till drilled into the spelt on March 23. This additional disturbance did not appear to impact the crop growth or yield. We harvested the hulled grain on July 29.Yields ranged from 2,200 to 3,500 pounds per acre (55 to 88, 40 pound bushels per acre). No-till drilled spelt with an under-seeded red clover cover crop mixture yielded 2,470 pounds per acre (62 bushels per acre). Spelt planted after tillage and without an under-seeded cover crop was comparable, with an average of 2,990 pounds per acre (75 bushels per acre). When a cover crop was under-seeded into spelt following tillage, yields were a bit reduced, averaging 2,630 pounds per acre (66 bushels per acre). We also saw the lowest weed density in under-seeded spelt following tillage at 110 pounds dry material per acre, which could be attributed to the competitive effects of the under-seeded cover crop. Chisel plowing prior to spelt establishment without a red clover cover crop mixture resulted in a higher weed density at 400 pounds dry material per acre.

Under-seeded clover at grain harvest (Credit: Wallace)

On-Farm Field Days

By John Wallace

The ROSE 2.0 project organized two field days in October 2015 to highlight on-farm research and facilitate discussion among growers about strategies for integrating cover crops into organic grain rotations while reducing the frequency of tillage.

The first field day was held at Wade Esbenshade's Summit Valley Farm in New Holland, PA. Esbenshade produces corn, soybean, hay and small grains that are sold directly to small organic dairies in the region. He is also an active member of the Southeastern Pennsylvania Organic Field Crop Producers Network. A second field day was held at Harvey Hoover's dairy farm in Millmont, PA. Hoover produces corn, soybean and alfalfa as a new member of the Central Susquehanna Valley Organic Crop Growers Network.

Discussing the Interseeder at the Hoover's farm field day (Credit: Barbercheck)

On-Farm Field Days Cont'd

John Wallace and Ron Hoover fostering some discussion at Hoover's farm (Credit: Barbercheck)

The field days offered participants a look at the two-year field trials that Esbenshade and Hoover each initiated in June 2015 in collaboration with the ROSE project team to evaluate strategies for integrating a cover crop between the corn and soybean phases of their rotations. Late fall is typically milder in southeastern Pennsylvania, which allows Esbenshade to either drill or broadcast cereal rye after corn grain harvest. In central Pennsylvania, however, late fall temperatures don't allow Hoover to establish a cover crop after grain harvest. The field trial compares each grower's typical practice to different methods of relay cropping. Relay cropping is a planting strategy in which a second crop is planted into the first crop before harvest. The first relay cropping strategy utilizes the InterSeeder®, a high-clearance no-till grain drill, to plant a cover crop mixture between corn rows when the corn is approximately knee high, following the last row cultivation made for weed control. As an alternative, Esbenshade and Hoover are also evaluating the success of broadcasting the same cover crop mixture just after their last row cultivation pass. A mixture of annual ryegrass, orchardgrass and tillage radish are being used. These species have consistently performed well in previous interseeding studies and are a good fit for the transition from corn to soybean.

Integrating cover crops with the use of these relay cropping strategies has the potential to prevent nutrient losses, prevent soil erosion, and suppress winter annual weeds. At both farms, cover crops successfully established using the interseeded and broadcast strategies. Hoover and Esbenshade agreed that timely summer rains likely contributed to the impressive cover crop stands. In general, field day participants were enthusiastic about the potential of interseeding and broadcasting strategies. The majority of participants suggested that they would be interested in revisiting the studies to learn more and several expressed interest in conducting their own little interseeding trial. One participant commented that the one thing he would do as a result of the field day was "think some more". As members of the ROSE project team, we were grateful for the opportunity to "think together" with Wade, Harvey and the many organic producers in attendance.

The field day group observing some of the cover crop treatments at the Hoover farm (Credit: Wallace)

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