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Wise counsel guides Rodale Institute organic farming research

This is a hairy vetch cover crop as farmers--and researchers--want to see it. When germination is more spotty, those advising Rodale Institute scientists counseled to try some replanting where a legume cover crop is needed for rolling down in no-till organic plots. (Rodale Institute photos by Rita Seidel)

Regional farmers, scientists help staff make cropping choices in complex system.

By Christine Ziegler, with Alison Grantham and Rita Seidel
(Posted May 4, 2010)

Long-term agricultural research projects face a myriad of questions in the areas of research design, management and statistical analysis. Operation of the 29-year-old Farming Systems Trial (FST) at the Rodale Institute benefits from the multi-disciplinary wisdom of an outside advisory group. Its members guide critical FST decisions, especially in making the research valuable to farmers.

We organized this **diverse group** of 18 regional farmers, university and USDA researchers, and extension experts in 2007 with funding from a Northeast SARE research and education grant. One project goal is to improve the processes that Rodale Institute scientists use to make decisions about how to manage the complexities of the different, but integrated, farming systems in FST. Keeping a systems-based agricultural research trial both operationally realistic and scientifically sound is a complicated and dynamic process.

Rodale researchers believe winter ponding suppressed wheat survival in this FST plot. They left the stand as it was, with some recovery evident by April 28, lower photo.

The Rodale Institute research team relies on input from the committee's farmers and researchers to suggest annual improvements. Members bring knowledge of best practices from four states (PA, NY, NJ and MD) relative to cover crops, equipment, timing of planting and cultivation, variety selection and other items. These help the team make creative but realistic and science-based decisions to address each system's management.

The results are important. To help the Institute know how our findings about cover crops and no-till organic planting have helped you to plan or carry out these practices, please fill out the survey to the left of the story, or click **here**.

The best laid plans of farmers and researchers

The current design requires management of not three rotations with specific practices (as in past years), but six unique agricultural systems. Systems include:

- Tilled and no-till organic manure-based treatments
- Tilled and no-till organic legume-based treatments
- Tilled and no-till conventional ones.

The tilled organic and conventional practices, as well as conventional no-till practices, are well established. The organic no-till practices, however, are quite new and are still being refined to achieve maximum productivity and weed management, particularly in the wide variety of environmental conditions that southeastern Pennsylvania throws our way.

The trial's systems range in diversity from a mere 2-year, 2-crop rotation in the conventional tilled system to an 8-year rotation replete with perennial crops, winter annuals, summer annuals, and cover crops in the organic manure system. Systems representing the middle ground between these two extremes include a conventional no-till system with a 3-year, 3-crop rotation, a tilled organic legume system with a 4-year, 5-crop rotation, and a no-till organic legume system with a 4-year, 4-crop rotation. But the differences don't end there.

The organic systems are similar in many ways. Both include corn, soybeans, wheat and oats. Both use rye and vetch cover crops. Both use underseeded legumes in small grains to smother weeds. And both primarily depend on legumes for nitrogen. Differences lie in the more dependable multi-year legume-based hay crops used in the manure system and the fact that the manure system receives small amounts of relatively predictable nitrogen from composted manure in years 2 and 7 of the rotation.

Organic no-till corn can be a beautiful thing. A thick, even stand of hairy vetch in full bloom can be rolled into a mat that supplies nitrogen and suppresses weeds throughout the season. So, instead of just needing about 150 lbs. of available nitrogen per acre from the hairy vetch, which even a thin imperfect stand can provide when plowed down, the vetch now needs to perform consistently and evenly. Sometimes a confluence of weather and other factors over the few fall and spring months that vetch has to reach our lofty goals for its biomass and nitrogen production limit the usefulness of these perfect plans.

Too much oats in an mixture with hairy vetch seemed to lessen vetch survival last winter. Emergency reseeding of vetch on March 25 resulted in these seedlings (lower photo) on April 28. Goal is enough biomass for weed management and fertility as a rolled down mulch for corn.

System management conundrum

To be credible to both farmers and scientists, FST needs to balance scientifically-consistent maintenance of each field treatment with what "real farmers would do" to improve their soil and increase productivity on a case-by-case basis. For example, this past winter's weather resulted in poor survival of some of FST's hairy vetch and winter wheat.

Any practice involves weighing what it will do to the current crop year, the historic data set and the future behavior of a plot's soil life, soil structure and ecological situation. Each of the six system treatments is represented (replicated) in four 60'x300' plots which are laid out in a blocked, randomized, split-plot design across a 12-acre field. This land is quite variable in terms of soil type, soil quality, drainage, weed pressure, and herbivorous critter activity over winter (as most Pennsylvania farm fields are).

These landscape challenges meant that within each treatment subplot there are areas where vetch is incredibly lush and thick and other patches as bald and barren as the moon. To complicate matters further, vetch fared differently in each replicate of the treatment. Some plots are polka-dotted by patches of living vetch and others have a beautiful, even stand. Both the vetch and wheat plantings were only affected in specific portions of some of the treatment plots, and usually not in all four plots.

So what is a researcher to do?

Rita Seidel has been the Rodale Institute's FST project leader since 2000. In March of this year she queried the committee via email on their thoughts as to the best approaches to handle the drowned, thin wheat and patchy vetch stands. She offered several different options for each treatment and asked for recommendations based on what would:

1. Realistically represent a farmer's agronomically and economically motivated decision?
2. Make sense from a research/statistical point of view (having enough field replications for analysis)?
3. Be the legacy impacts (on weeds and soil quality in a long term trial) of a land-management decision that allows gaps in crops, especially in plots where increased weed pressure can't be controlled by herbicides?

2010 FST advisory committee roster

• Bill Curran, Pennsylvania State University (PSU) professor of weed science
• Matt Ryan, PSU doctoral candidate in weed ecology
• Bill Mason, farmer from MD eastern shore
• Eddie Taylor, farmer from MD eastern shore
• Peter Martens, organic farmer from Penn Yan NY
• Megan Fenton, co-farmer with Peter Martens and a cooperative extension ag educator
• Ray Weil, UMD professor of soil science
• Dave Mortensen, PSU professor of weed ecology/biology
• Steven Mirsky, USDA ARS Beltsville researcher, Sustainable Agriculture Systems Lab
• Tom Richard, PSU director, Penn State Institutes of Energy and the Environment, and associate professor of agricultural and biological engineering
• Durland Shumway, PSU Professor of statistics
• Dave Douds, USDA ARS Wyndmoor mycorrhiza researcher
• John Teasdale, USDA ARS Beltsville researcher, Sustainable Agriculture Systems Lab
• Bob Muth, organic farmer from NJ
• Steve Groff, no-till farmer and cover crop seed producer from PA
• Joel Myers, PA No-till Alliance

Rodale Institute team members:
• Rita Seidel, FST project leader
• Alison Grantham, research manager
• Jeff Moyer, farm manager
• Greg Bowman, communications manager

Results were sharply mixed. The farmers generally advocated terminating the bad plots and replanting with a different crop, while researchers were more inclined to re-seed all replications (to keep the field treatments the same for statistical purposes) or let things go as long as we can collect data from at least three replications. All agreed, however, that the organic no-till vetch plots would likely not produce enough vetch biomass to adequately suppress weeds if rolled, so there will likely be no "no-till organic" corn this year.

When facing variable die-out field sections, a farmer—whose interest is in more in a crop than in data—might spot-treat the poor sections of the field, re-seeding in the moderately-affected spots and possibly starting from scratch in some of the worst ones.

Hybrid fixes

Based on this timely and practical input, Institute researchers developed some hybrid approaches to the problems at hand. In the no-till vetch plots, vetch was no-till drilled into the existing vetch crop with no major damage to growing plants (which was a concern), and all appears to be growing well in late April. No one can say if the re-seeded vetch will grow enough

biomass or bloom early enough (unlikely) to be rolled for no-till planting, but this choice provided the best opportunity to make no-till rolling possible, and the final decision whether to roll or till will be made soon.

In the conventional wheat plots, tiller counts were taken to determine if the stands were adequate. Since two of the four plots had low tiller counts, N fertilizer was added earlier than usual to spur growth, though, to date, the early fertilization doesn't seem to be making much difference in the areas where wheat growth was poor. In the organic manure-system wheat plots, an alfalfa-orchard grass hay mix was frost-seeded into the wheat (as scheduled in this rotation) which will hopefully provide sufficient soil cover for weed control in the areas where wheat did not over-winter as well.

Finally, nothing was done to the organic legume system wheat, other than to plant oats in one previously water-logged section of one plot, to establish a grass cover that suppresses weeds and matures later than the wheat. The remainder of the plot is still large enough for data collection.

Tweak v. change

These actions were considered in light of a lingering question asked at a February committee meeting: What is the difference between a "tweak" and a full-scale "change" to a system in an agricultural research trial? The line between the two may be blurry, but it can be better clarified when management guidelines for each system are well-defined and the research hypotheses are clearly stated. As the research team understands this dichotomy, the management decisions discussed here are primarily "tweaks" at this point but could potentially become "changes" if similar kinds of winter crop survival issues pop up in coming years.

Another annual system "tweak" that the committee discussed is what seed cultivars to use in each system. Ideally, Rodale Institute researchers want continuity in the cultivars for at least three or four years in each system, until breeding improvements produce a better-yielding variety. This continuity is difficult to achieve in practice, however, because seed companies regularly eliminate and replace cultivars.

The day-long meeting also covered issues such as economic analyses and energy analyses of the FST systems, as well as ways to bring lessons learned from FST to farmers and extension agents through outreach programs for the 2010 season.

Input from the advisors in all these areas is essential to ensure that the FST fulfills its scientific and educational goals with proper rigor and scope. We'll update you at the end of the season as to how the vetch and wheat crops fared, as well as other FST and on-farm work being completed as part of the SARE grant.

Alison Grantham is research manager, Christine Ziegler Ulsh is researcher and science editor, and Rita Seidel is FST project leader, all at the Rodale Institute

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