DEVELOPMENTS IN ORGANIC NO-TILL AGRICULTURE

THE BEST OF BOTH WORLDS?

by Paul Hepperly, Jeff Moyer & Dave Wilson

Note the vigorous, healthy growth of organic no-till corn. The preceding cover crop provides nitrogen and a thick vegetative mat to improve soil moisture retention, weed suppression, beneficial habitat and erosion prevention.

Since Rachel Carson's book *Silent Spring* was published in 1962, there has been a growing appreciation of the negative impacts of agricultural chemicals. The side effects and the mechanisms that cause them are well documented. Moreover, recent work by Dr. Warren Porter of the University of Wisconsin and Dr. Tyrone Hayes in California points to the increased potency of agrichemical mixtures for their detrimental effects on wildlife, animal and human health.

On the other hand, talk to conventional no-till farmers about organic farming, and they conjure up a world of too much tillage, increased labor requirements and erosion run amuck. After all, we do need these chemicals to feed the world, they argue, and if we crack some eggs in doing so, well, that is just part of the price of omelet.

Who's right and who's wrong?

The answer may be they are both right and they are both wrong.

We suggest that both organic and conventional no-till farmers can benefit by changing their practices, but most importantly their mind-sets need to change as well.

WE ALL CAN DO BETTER

Novel research and development work at the Rodale Institute are proving that "it ain't necessarily so" that no-till and organic farming are mutually exclusive and contradictory.

Enter stage right, a new technology called organic no-till is indeed being shown to be alternative for farmers wishing to get off the chemical treadmill and reduce and eliminate tillage of the soil all at the same time.

As such this technology offers real potential to bridge the gap between conventional and organic farmers and create a food and farming system friendlier to the environment.

Jeff Moyer, the Rodale Institute's farm director, has been shepherding a combination of mechanical adaptation and collaborations between scientists and farmers which are making this new reality happen.

WEEDS: A MAJOR PROBLEM

Talk to Doctor Dave Mortensen and Matthew Ryan, weed ecology researchers with Pennsylvania State and the Rodale Institute, and they will tell you that in both organic and conventional agriculture weeds are considered the chief obstacle to optimized production.

The approaches for managing weeds vary. In conventional no-till, for example, herbicides and genetic modification are used as the chief tools in adapting to the weed constraint. Organic farmers, on the other hand, have traditionally relied on increased tillage to confront the omnipresent threat of unwanted vegetation.

Jeff Moyer, considered the father of new Rodale organic no-till farm methodology, has remarked that when we have no herbicides to depend on, we have opted for more tillage in organic systems. However, he also noticed that when the use of cover crops is intensified, they can effectively substitute for chemical inputs by providing effective weed control and even adding nutrients to the soil.

BIOLOGY DOES IT BETTER

Dave Wilson, research agronomist with the Rodale Institute, is a nationally recognized expert in cover crops. In his work, he was able to determine that 5,000 pounds of dry rye matter in a winter cover crop could provide excellent control of weeds in soybeans, our crop that shows least ability to grow and prosper with competing weeds. In addition, his work demonstrates that cover crop legumes can produce all the nitrogen needs of an organic cash grain system, up to and even exceeding 200 pounds per acre — just from the aboveground biomass, not including roots.

Soil Carbon Gains & Losses in Different Farming Systems

(Long-Term Field Experiments)

Field trial	Components compared	Carbon gains or losses (lbs./acre/year)
DOK experiment, CH	Organic, FYM composted	37
(Mäder, et al., 2006)	Organic, FYM fresh	-110
1977 - 2005	IP, FYM, mineral fertilizer	-75
	IP, mineral fertilizer	-184
SADP, USA, 1994-2002	Organic, no-till	1,629
(Teasdale, et al., 2007)	Conventional, no-till	0
Rodale FST, USA	Organic, FYM	1,085
(Hepperly, et al., 2006);	Organic, legume based	763
(Pimentel et al., 2006)	Conventional	193
Bavarian farm survey	18 organic farms (average)	358
(Hülsbergen and	10 conventional farms (average)	-180
Küstermann, 2008)		
Frick reduced tillage	Organic, ploughing	0
experiment, 2002-2005	Organic, reduced tillage	783
(Berner, et al., submitted)		

Soil Carbon Sequestration Estimates

(Data Projected from Rodale Long-Term Trials & Literature Values)

Practice	Soil Carbon Sequestration (lbs./acre)
Compost	890 to 1,780
Cover Crop	715 to 1,070
No-till	90 to 450
Rotation	0 to 180
Manure	0 to 180
Cover + Rotation	800 to 1,250
Comp. + Cover + Rotation +No-till Proj.	1,800 to 3,600

Carbon Sequestration & Emissions under Three Systems

(pounds/acre/year)

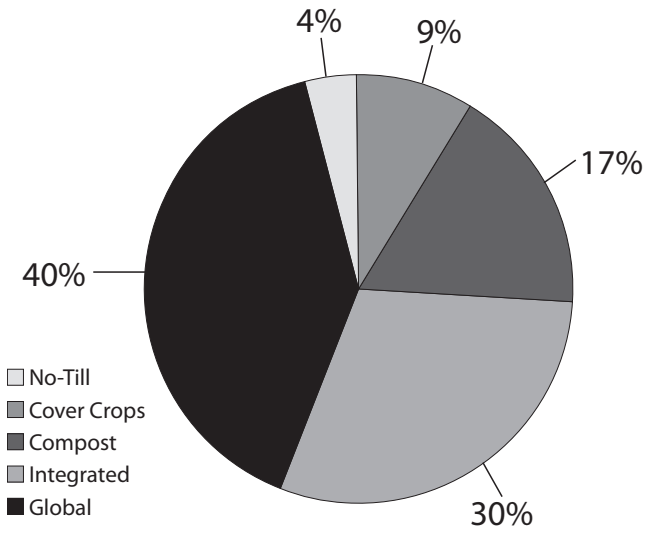
Parameters	Conventional No Till [1]	Cover Crops Till [2]	Blogical No Till [3]
Gross Carbon Sequestration	+294	+891	+1,185
Carbon Emissions	-132	-70	-53
New Carbon Sequestration	+162	+823	+1,132
Gross C-Seq. Ratio	1	~3	~4
Net C-Seq. Ratio	1	~5	~7

[1] Meta-analysis of conventional no-till West and Marland, 2002.

[2] Hepperly, 2003, Pimentel, et al. 2005, Teasdale, et al. 2007 and Veenstra, et al. 2006.

[3] Value projected using on additive model for carbon sequestration and input adjustments based on system requirements

Relationship of Agricultural Practices to Potential World Carbon Sequestration



Carbon sequestration from improved stocks of soil organic matter offers a great opportunity to complement the energy efficiency initiative. Although conventional no-till can mitigate about 10 percent of the world's present carbon emissions, cover crops, compost and other methods integrated together provide much greater potential than using any technique alone as a silver bullet.

Jeff Moyer, farm manager at the Rodale Institute Farm, rolls down a late-summer-planted, winter-annual legume cover crop of hairy vetch using a specially designed roller-crimper.

ROTATIONS

The "Rodale Rotation" includes wheat, corn, soybean and cover crops. A cash grain crop is produced each year, and soil is covered each winter. David Douds, Rita Seidel and Dave Wilson from the U.S. Department of Agriculture Research Service and Rodale have shown that coverage of soil is particularly important as a key to soil improvement and erosion control.

We start our rotation planting winter wheat in the fall. In the summer we harvest the wheat in mid-July. In early September we plant hairy vetch, a winter annual legume with excellent ability to produce substantial amounts of nitrogen. We follow the vetch with a corn crop, thus satisfying its high demand for nitrogen. In the fall after the corn harvest, we plant winter rye. In the early summer after rye, soybeans are established. After the soybean crop is harvested, we follow with winter wheat in the fall, thus completing our rotation cycle.

MANAGING COVER CROPS

Hairy vetch will flower in early June. We have designed a roller crimper that can indent the stems every 7 inches, using a drum roller with a chevron pattern designed to apply strategic pressure. When hairy vetch is in full flower, this crimping action causes the cover crop to die and leaves a persistent residue cover that blocks weeds. Hairy vetch is planted at 15 to 30 pounds per acre and can produce more than 200 pounds per acre of nitrogen, enough to optimize corn production.

When we plant soybeans, we use winter rye as the cover crop. Again, the crop must be in full flowering stage before the crimping and rolling.

ONE-PASS PRODUCTION

In our new system a front-end roller is used with a back-end tandem no-till planter. This allows a one-pass mulching and planting operation, greatly reducing the diesel fuel otherwise needed for field tillage and weeding practices. Because nitrogen is provided from our cover crop, the cost and energy of fertilization can also be reduced substantially

Besides working to reduce the diesel for plowing and cultivating, the new organic no-till also reduces the energy inputs usually required for nitrogen fertilization, the largest contributor to greenhouse gases.

CONCLUSION

Steve Groff is a diversified farmer in Lancaster County, Pennsylvania. His license plates says it all: "Mister No Till." Working a highly sloped farm, Groff was unable to make his crop production sustainable until he went no-till. He now proclaims, "No piece of steel can benefit soil like a well-planted and tended cover crop."

Rodale's Jeff Moyer puts it this way, "Our success with our summer crops depends more on what we do with our winter crop than anything directly related to planting the summer crop itself."

We see an end to choices between bad or worse as we develop a new agriculture that weans itself from both mechanical disruption of the soil and the unbridled use of synthetic fertilizers and pesticides.

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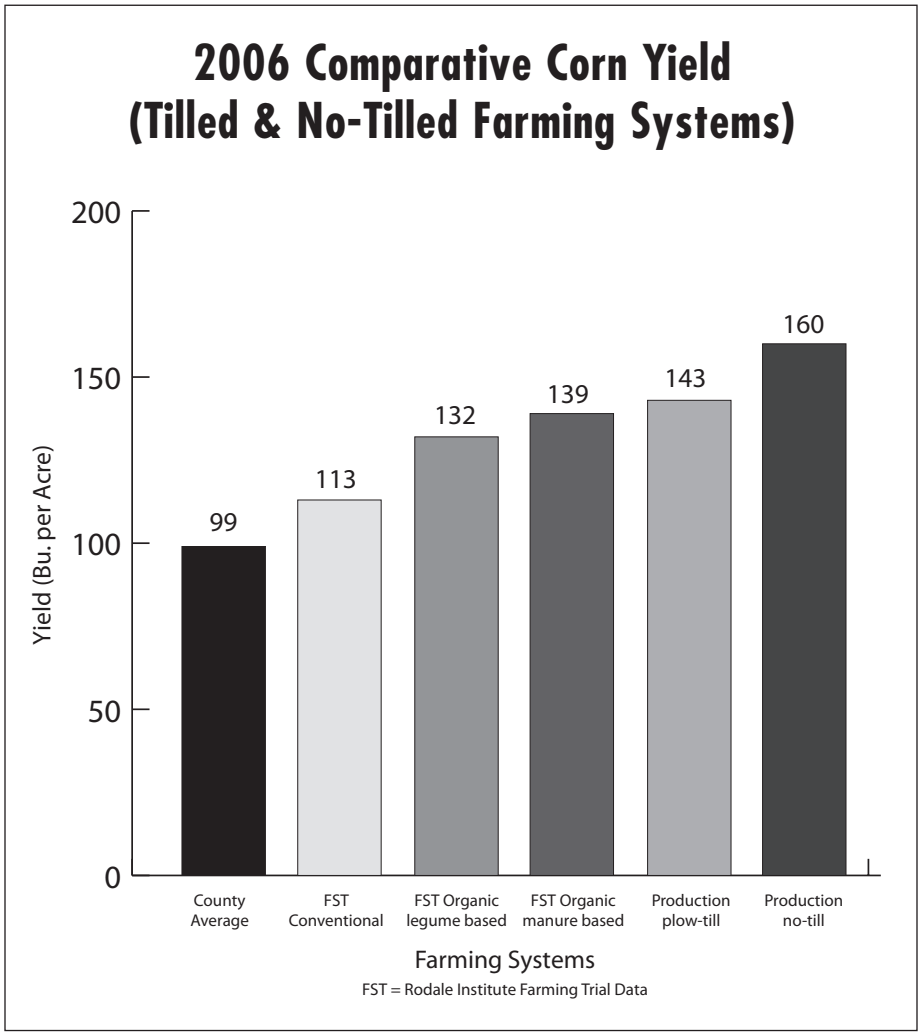
Dr. Paul Hepperly will be a featured speaker at the Farm Health Conference, October 11-12, in Maui, Hawaii. For information or to register, visit *www.mauigrown.org* or *www.mauialohaaina.org* or call 808-242-7870.

Jeff Moyer will be speaking at the 2008 Acres U.S.A. Conference in December. Check *www.acresusa.com* for more information.



All the nitrogen needed by a corn crop can be supplied through winter legume production as a cover crop. Nitrogen fertilizer is the biggest single energy guzzler in the North American food and agricultural system.