Organic Ridge Till Vegetables

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The Organic Cropping Systems Project at Cornell is testing several different organic management systems. These include a ridge till system in both the organic vegetable experiment at Freeville and the grain crops experiment at Musgrave Research Farm in Aurora, NY. The other systems use tillage methods more typical of organic but vary in the intensity of weed management, and the amount of cover crops, and soil inputs used. Such replicated field trials provide a unique opportunity to explore how ridge tillage compares to other organic management methods. Few vegetable growers have experimented with ridge tillage, but this approach shows promise for vegetable production in our experiment. Below is a look at how ridge tillage works and how we have adapted ridge tillage methods in the vegetable experiment.

What is ridge till and when is it used?

Ridge till is a conservation tillage system developed in the Midwest for grain production. It was first investigated in the 1950s as a management system that does not require primary tillage, thereby reducing erosion and energy use. In an organic ridge till system, soil is scraped off the ridge just before planting or with an attachment on the planter. The soil is cultivated as needed for weed control and the ridge is rebuilt, either at the last cultivation (in corn and beans) or after the crop is harvested. Typically, only the top two to three inches of soil are disturbed, and residues are kept near the surface. Use of ridge tillage in conventional agriculture has decreased in recent years as more grain farmers have converted to no-till pr zone till practices, but ridge-tillage may have potential to help reduce tillage and improve soil quality in organic production. The ridge scraper used in the Organic Vegetable Cropping Systems Experiment was made by Sukup, but is no longer produced by that company. A similar devide is made to attach to a Buffalo corn planter.

Why use Ridge till?

Managed properly, ridge till can achieve nearly the same erosion control as no-till systems while still allowing for cultivation. It can be beneficial in improving soil quality, conserving fuel, and reducing labor demand. In ideally-managed systems, early season primary and secondary tillage are eliminated, allowing for rapid planting in spring. Moreover, even after scraping, the ridge is elevated about three inches above the inter-row areas, allowing better drainage and warmer soil for early planting. Less fuel is used in these systems as well, since the tillage is always shallow. When soil is scraped off the top of the ridge, much of the previous year's weed seed is thrown in between the rows, where weeds can be easily cultivated out. Since the ridge bases are not disturbed and never get wheel traffic, better soil quality can be expected in the row.

How we have adapted ridge tillage for vegetables

In the vegetable experiment, we often scrape and re-ridge the plots an extra time before planting summer crops, to improve weed management. This results in more total tillage than a "purer" ridge system, but allows us to keep weeds in check with only shallow tillage. Since the ridge scrapers so not mount on our vegetable planters, we scrape and plant in two passes. We use Sukup brand ridge scrapers, originally made for field crops. Once the crop is planted, it is cultivated with normal equipment. We sometimes have to adjust the cultivator height an inch or so, since crops have been planted on scraped-off ridges and are slightly higher than the valleys.

We use hilling discs on the cultivator to ridge up crops like sweet corn, or a potato hiller for other crops. For lettuce and cabbage we wait to hill up until after harvest. For planting fall cover crops, we find that the best approach is to drill the cover crops and then re-create the ridges. We find that hairy vetch can be easily killed by scraping the ridge and by wheel traffic in the inter-row valleys, but that winter grains are harder to kill. So we commonly use a mixture of hairy vetch and winter killed oats before a summer planted crop, or a mixture of oats and field peas before a spring planted crop.

Fig. 1. Scraping ridges with hairy vetch before planting cabbage

Ridge till results so far

In the vegetable experiment at Freeville, the main cash crops in rotation over the past four years have been sweet corn, cabbage, lettuce, and potato. We have two entry points into the rotation, so that in any given year, we grow two of the four main crops. There are four different organic vegetable cropping systems. The ridge till system (V4) is most similar to system V2, in that N is primarily obtained from cover crops rather than compost, and one cash crop is grown per season. The two systems differ mostly in the type of tillage used.

Table 1. Organic Vegetable Cropping Systems.

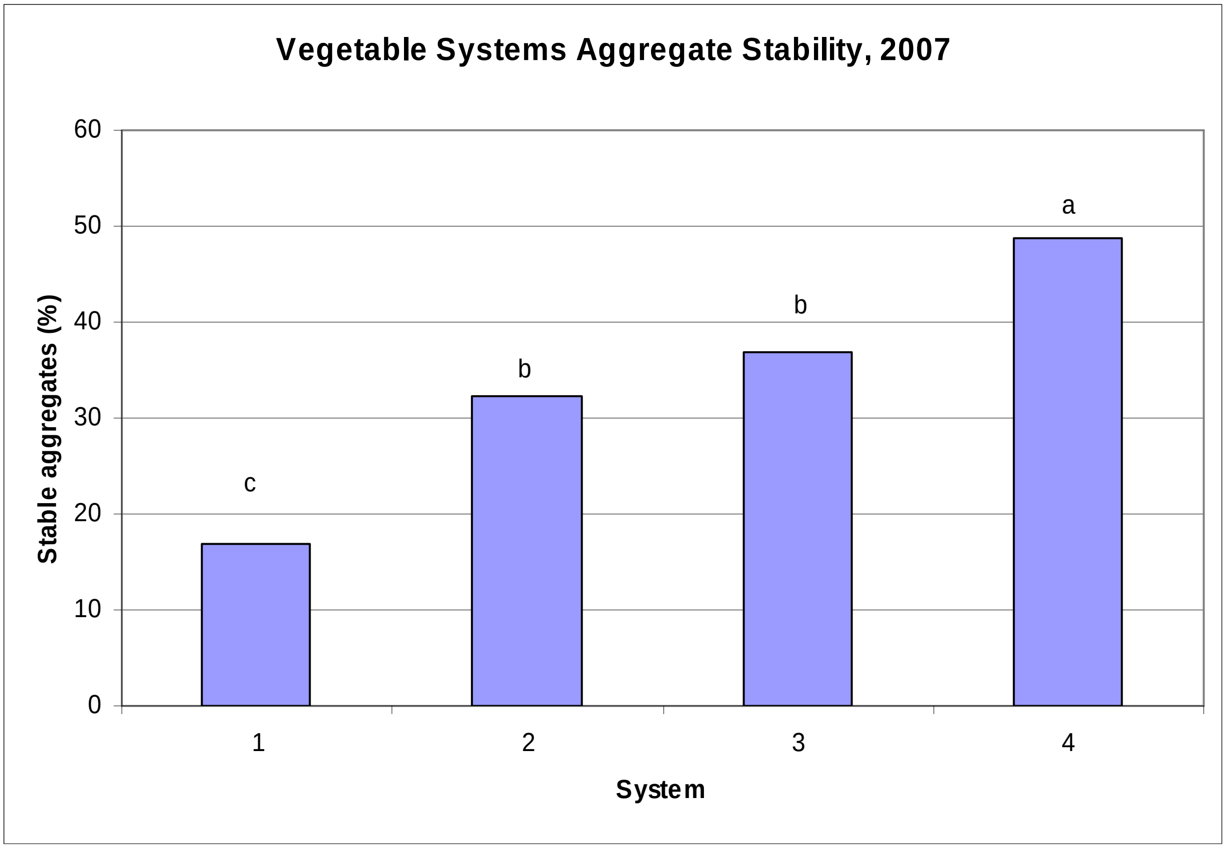
System	Practices	Cash crops
V1	Intensive, high compost input	6 / 4 years
V2	Intermediate, cover crops supply N	4 / 4 years
V3	Extensive, cover crops supply N, fallows for weed management	2 / 4 years
V4	Ridge tillage, cover crops supply N	4 / 4 years

Over the past four years, yield differences between ridge till and the other systems were usually small. Ridge till (V4) cabbage produced very well in both years. Sweet corn yield was a bit below average, possibly due to limited early season N availability, since the vetch was scraped into the inter-row valleys. We expect yields could be improved in ridge till sweet corn with a starter fertilizer. Ridge till had lower lettuce yield than some other systems in 2006, but in 2007 it had the highest lettuce yield of any system. For reasons we do not yet understand, the marketable yield of potatoes was low in the ridge till system in 2007 due primarily to high rates of potato scab.

Weed biomass has generally been somewhat higher in ridge till than in the other systems, but has usually not been sufficient to affect yields. After scraping the ridges to plant the crops, cultivation is done normally until ridges are re-formed at last cultivation (i. e. corn, potatoes) or after harvest. Although we have not yet had a problem with vegetatively spreading perennial weeds, these are a potential threat in any reduced tillage organic system. Growers who wish to experiment with ridge tillage should start with a clean field, and attack any new patches of perennials vigorously before they spread.

Insect pests have shown differences in their preference for V4 crops compared to others in the trial. For example, in 2005 no caterpillar damage was observed in the ridge till system, whereas the other systems had up to 17% damage. In 2006 lettuce, ridge till (V4) showed significantly more tarnished plant bug damage than V1. These differences in the insects may be due to differences in growth and nutrient status of the plants in different systems. For example, development of the sweet corn in the ridge till system was about a week behind that in the other systems, probably due to less N available to the establishing corn seedlings.

We have been measuring several indicators of soil health in the various systems each spring since 2005. One of the most important of these is aggregate stability – the ability of soil crumbs to hold together during a hard rain. Soils with low aggregate stability tend to become massive and crusted whereas soils with high aggregate stability remain loose and crumbly. The ridge till system has retained very high levels of aggregate stability, whereas in some of the other systems, aggregate stability has declined to marginal levels.



Conclusions

Results from the first three years of the Organic Vegetable Cropping Systems Experiment indicate that ridge tillage can be successfully adapted to vegetable production. It offers substantial reductions in tillage intensity, labor for field operations, and fuel use relative to rotary tillage or moldboard plowing. At least so far, the ridge till system shows higher soil quality than alternative systems, probably due to the reduced tillage and retention of crop residues near the soil surface. Except for potatoes, which so far have been trialed only in a single year, crop yields have been generally similar to and occasionally better than the alternative systems. Ridge tillage appears to offer a viable approach for reducing tillage and controlling wheel traffic in organic vegetable production. Much remains to be learned about this exciting production system, and we intend to continue to study this and the other systems.