Conservation Tillage and Organic Farming – Mutually exclusive?

In recent years conservation tillage practices have gained prominence among producers wanting to address environmental concerns such as wind and water erosion, nutrient leaching, loss of organic matter, and reduced biological diversity. More and more many of these low-till and no-till technologies have become centered on the use of herbicides – leaving organic farmers out of the picture. In fact, many believe that the principle to not use herbicides has left organic crop production "forever shackled to clean cultivation" and go on to characterize organic farming as erosive and environmentally destructive because of its perceived reliance on excessive tillage for weed control. The remainder of this article will debunk these myths and highlight just how organic farmers have and continue to be pioneers in conservation tillage.

Long-before the term conservation tillage was coined, many organic farmers put to rest their moldboard plows in favour of the chisel plow. Chisel plowing is a form of mulch tillage, in which residues are mixed in the upper layers of the soil, leaving significant residue on the surface to reduce erosion. Further innovations including sweep cultivators and disk harrows were also popularized by organic farmers. The creation of highly specialized cultivators and planters, designed to work in heavy crop residues gave rise to ridge tillage technology. Ridge tillage is characterized by the maintenance of permanent ridge beds across the entire field and has widespread adoption by those producing row crops like corn, soybeans, cotton, and sunflower.

No where is it more evident that organic farmer innovations are leading the way in conservation tillage than when we look at mulch systems. Advances in cover crop research have permitted organic producers to experiment with both living and killed mulches as a form of weed suppression. A killed mulch system has evolved, centered on the concept of growing a dense cover crop, killing it, and planting into the residue. The dense biomass provided by the killed cover crop not only protects and builds the soil, it also provides substantial weed suppression by occupying niches making them unavailable for weed invasion and by out competing weeds for light and nutrients.

Mulches are used in conventional farming systems for similar benefits, but herbicides are the primary tools used in killing the cover crops. In contrast, organic producers favour mechanical technologies or use weather stress to weaken cover crops. Mowing, undercutting, and rolling are popular mechanical choices among many organic farmers. Sickle bars and flail mowers appear to be fairly effective in that they can cut close to the soil surface and lay down the cover uniformly over the desired area. However flail mowers tend to chop the biomass more finely leading to rapid decomposition and shorter-term coverage. Undercutting uses a specialized blade that both severs the roots of the cover crop and flattens the biomass on the soil surface simultaneously. Its advantage is that it achieves a good kill while not chopping the cover crop, resulting in a more persistent, weed suppressive mulch, however it does involve some tillage. Rolling, which can be equated to mechanical lodging has the advantage that suitable equipment can usually be found on the farm and can be done at relatively fast field speeds. Often a more economical way to kill the cover crop is by letting Mother Nature do the work for you.

Cover crops such as millet, buckwheat, berseem clover, alfalfa (fall dormancy > 7), and annual medic will be reliably killed by winter temperatures leaving a dense mulch that can be planted into the following spring.

Living mulches represent another alternative in reducing tillage in organic systems. In this article, I am differentiating between interseeding and seeding into a living mulch. In interseeding, two species are planted at the same time - one a low-growing smother crop to suppress weeds and reduce erosion, while the other species being the cash crop. In living mulch systems the cash crop is established into an existing cover crop, that remains living for all or part of the growing season and perhaps perennially. Successful living mulch systems must manage a balance between weed suppression and competition with the cash crop for light, water, and nutrients. Ideally, the living mulch would be shadowed by the cash crop initially, and would then regain full dominance of the agroecosystem following harvest.

Selecting species as cover crops is dependent upon if their use is for living or killed mulch systems. In general, selection of cover crops in killed mulch systems favour, dense, tall-growing species, that can easily be killed and leave considerable biomass. Winter annuals, hairy vetch, fall rye, and medics are popular. In particular, rye has had considerable interest not only for its winter hardiness and ability to generate biomass, but also due to its allelopathic characteristics. Rye produces chemicals that inhibit germination and growth of several broadleaf and grassy species. In contrast, living mulches tend to favour species that are typically prostrate in growth habit and are often perennial. Ideally, living mulch cover crops are rapid in establishment (providing early weed and erosion control), are tolerant to high traffic, drought, and low fertility. Popular choices include Dutch white and Ladino clover, canola, and perennial ryegrass. Particular interest has been shown in Kura clover as an effective choice as a living mulch. Research initiated at the University of Manitoba by Dr. Martin Entz is looking at means to suppress Kura clover during the seeding and establishment phase of the cash crop.

There is no doubt that research and development of cover crops is making considerable inroads in the application of conservation tillage for organic systems, however for many producers the benefits of cover crops are not entirely evident. Many farmers fear competition between the cover crop and cash crop for nutrients and water will translate in reduced yields for the cash crop. Work reported from the Nova Scotia Agricultural College by Dr. Ralph Martin showed that potatoes grown with cover crops had greater soil moisture than those grown without. Although increased soil moisture cannot be directly interpreted as available water for the cash crop, it is important to note that in this trial there were no significant differences in yield between the cover crop and no cover crop treatments.

Making conservation tillage work in organic systems is no cookie-cutter recipe. Many of the approaches are not generically “field-ready” and will require significant research to ensure more widespread adoption. Very little low-till and no-till research has been done under conditions typical of organic farms. Conditions following crop rotation, natural nitrogen recycling, lack of herbicide carry over, enhanced beneficial populations will

have tremendous effect on the outcome of conservation tillage technologies in organic systems. The Organic Agriculture Centre of Canada will be initiating research this summer on various cover crops, intended as green manures, but through their management may serve an additional benefits by demonstrating weed-suppressive abilities. The intended research is directed to those organic producers seeking an alternative N source other than animal manures. Cover crops and cash crop will be planted in alternating strips, and at an appropriate stage of development the cover crop will be harvested (chopped) and placed on the cash crop. The chopped cover crop can provide both short and long-term sources of available N, while maintaining residue cover between the cash crop row spaces, reducing soil erosion and weed invasion.

Organic conservation tillage systems have had a long history, but at the same time are in their infancy. Innovative strategies have and will continue to be part and parcel of organic agriculture. Many of the existing technologies are still somewhat reliant on cultivation to manage weeds, but even as such, these somewhat imperfect systems are still contributing greatly to the sustainability of organic agriculture and should be pursued by both producers and researchers.

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