An Organic No–Till System for Tomatoes

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Introduction

Organic production increased to 4.1 million in the U.S. in 2005 (USDA-ERS, 2009), with 98,525 acres in organic vegetable crops. This increase, attributed to consumer demand for produce grown without synthetic chemicals, has encouraged many producers to investigate organic methods. In order to meet certified organic requirements and enter the expanding organic market, producers must implement a soil-building plan in accordance with sections 205.203 and 205.205 of the U.S. Dept. of Agriculture (USDA), Agriculture Marketing Service, National Organic Program (NOP) (USDA–AMS, 2009). At the heart of the regulations is the protection or enhancement of carbon and other nutrients in soil organic matter in order to maintain soil fertility and structure in sustainable systems. In addition to issues of soil fertility, weed management is also critical for transitioning or certified organic growers. While plastic mulch is allowed in organic production, many organic vegetable farmers use alternatives, such as straw and natural mulches. In addition to mulches, cover crops are under investigation for their role in helping manage weeds in organic fields.

Nutrient cycling and cover crops

The goal of organic farming is to maximize internal self-regulation of ecosystem processes, including nutrient and carbon cycling to ensure productivity and minimize environmental contamination (Stinner and Blair, 1990; Reganold, 2001). Organic amendments, crop rotations, and cover crops constitute multifunctional management practices that conserve soil organic matter, enhance soil quality, protect soil from erosion, and sequester carbon to help mitigate global climate change. Nitrogen (N) fertility is maintained through synchronization of N mineralization from soil organic N pools and plant uptake of inorganic N. Management of soil organic matter to enhance soil quality and supply nutrients in the long term on an organic farm requires balancing mineralization of carbon and nitrogen for short-term crop uptake and sequestering these nutrients for long-term maintenance of soil fertility and structure. Crop rotations that include forage crops and legumes aid in this process of building soil organic matter. Cover crop roots and residues also can provide food for soil microorganisms and invertebrates that are necessary for nutrient cycling.

The intensive tillage that is often used in organic production can compromise soil quality gains, however. Reducing tillage in organic farming systems is a major challenge for producers because tillage plays a central role in organic weed management. Development of effective organic reduced tillage methods across a range of climates and farming systems is key to improve the environmental and economic sustainability of organic production.

Reduced tillage of cover crops for soil health and weed management

Cover crops planted in the growing season, or for protection of soils in the off-season, can contribute to nutrient cycling and soil quality improvement. Improvements in water infiltration rates and weed management also have been attributed to specific cover crop combinations. Rye (*Secale cereale*) and hairy vetch (*Vicia villosa*) are among the most common cover crops used in organic systems because of their winter hardiness, high residue production, and, in the case of hairy vetch, capacity to fix large amounts of nitrogen (Abdul-Baki et al., 1997). Reduced tillage of cover crops in organic no-till systems has become the goal of many organic producers throughout the U.S. Following the lead of conventional no-tillage systems, organic producers recognize the benefits of reduced tillage on soil physical, chemical and biological properties. Cover crop termination methods developed for organic systems have included tillage, mowing, stalk-chopping and undercutting. Shortcomings associated with tillage include soil organic matter decomposition, as discussed above. Cutting the cover crop through the latter methods can lead to patchy distribution and rapid breakdown of the mulch, providing more opportunities for weed establishment and growth. Rolling or compressing the cover crop with a no-till roller/crimper can help to uniformly deposit cover crop residue and allow for a persistent mulch cover throughout the growing season (Creamer and Dabney, 2002; Morse, 2001).

The Rodale Institute (Kutztown, PA) has distributed no-till roller/crimpers to five U.S. universities to help develop site-specific recommendations for no-till organic production (Hepperly, 2007). The roller consists of a large steel cylinder (10.5 ft wide x 16 in. diameter) filled with water to provide 2,000 lb. of weight. Steel blades are welded in a chevron pattern to crimp and mechanically kill fall-planted cover crops in the spring (see photo). The roller can be rear-mounted or, more ideally, front-mounted on a tractor to permit a 'one pass' operation to crush/kill cover crops and plant/drill crop seeds in one pass of the tractor. A dense, uniform cover crop is needed to create a mulch capable of suppressing weeds to avoid or greatly reduce additional weed control throughout the season. Vegetable crops can be planted into the flattened cover crop, using no-till drilling of seeds, high-residue transplanters, or hand-transplanting. Successful production of organic corn, soybean, tomatoes, pumpkins, and strawberries has been achieved with rolled cover crops in Pennsylvania and Michigan.

No-till roller research in Iowa

Two seasons of research with the no-till roller for organic tomato production at the ISU Neely-Kinyon Farm in Greenfield, Iowa, demonstrated excellent tomato yields with reduced weed pressure. Cover crops were planted in the fall of the year (September to October) and consisted of combinations of rye/ hairy vetch and winter wheat/Austrian winter pea. The cover crops were rolled and killed in late May when the rye/wheat was headed out (at or past anthesis or pollen-shedding) and the vetch/peas were at 20% bloom. Twenty days later, six–inch 'Roma' tomato seedlings were transplanted into the dried mulch on June 15. Transplants were side-dressed with 0.5 lb/plant of organic compost at the time of transplanting. Harvests began in August and lasted until frost. Weed pressure was half that of tilled plots because of the season-long mulch from the rolled cover crops. The hairy vetch/rye combination provided superior mulch cover than the wheat/pea mixture. Disease pressure was also reduced compared to tilled plots because the mulch helps prevent splashing of disease spores. In organic grain trials in Iowa, organic soybeans yielded 45 bushels/acre in the organic no-tilled hairy vetch/rye system–an excellent yield considering no tillage operations for weed management were employed. We are continuing to research organic no-till methods through a five-state USDA-CSREES Integrated Organic Program grant that will focus on the effects of this system on weed management, grain production and soil quality. Regional differences and site specific recommendations for organic no-till vegetables and grains will be presented at the Iowa Organic Conference, December 5, 2009, at the ISU Scheman Building in Ames, Iowa. Please contact Kathleen Delate at kdelate@iastate.edu or 515-294-7069 for more information.

References

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