Public Abstract
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Organic certification requires that producers use practices that enhance or maintain soil quality, which is a composite view of the soil's physical, chemical and biological properties and processes that sustain productivity, environmental quality and support a fully functional biological system. Improving plant health through soil health and fertility is a major goal of organic production and should be emphasized in a weed management system. However, most organic producers manage weeds through multiple tillage and cultivation practices
Tillage leads to soil organic carbon (SOC) loss due to oxidation or mineralization, leaching and translocation, and accelerated erosion. It also reduces crop residue by increasing the rate of microbial breakdown via residue burying. Soil organic carbon is one of the most important constituents of the soil due to its capacity to affect plant growth as both a source of energy for microorganisms and a trigger for nutrient availability through mineralization
Although research on soil quality in organic systems is not uncommon, many studies compare soil quality in organic production to that of conventional management systems. Fewer studies have examined the effects on soil quality indicators of different types of organic management and almost no studies have measured soil quality in organic no-till. In organic no-till, a cover crop is grown to reproductive stages then crimped and left on the soil surface to provide weed control. The cash crop is then no-till planted into the cover crop residue.
The objective of this dissertation was to quantify soil quality indicator levels under contrasting organic practices and to provide scientific information that can lead to development of best management practices for organic no-till and transitioning to organic production. Four studies examining crop yield, soil quality and weed control were conducted in Boone County, MO on a Mexico silt loam soil (fine, smectitic, mesic Vertic Epiaqualfs) from 2012-2014. In study one, the effects of three organic production systems and four poultry compost rates on crop yield and SOC on a claypan soil were determined. Organic no-till was compared to a tilled organic system using a winter cover crop and to a system using tillage and no cover crop in a wheat (Triticum aestivum L.)-corn (Zea mays L.)-soybean (Glycine max L.) rotation. Cover crops included cereal rye (Secale cereale L) and hairy vetch (Vicia villosa L.). Achieving a cover crop biomass sufficient for weed suppression was a challenge when soil fertility declined during the study. Corn yield was reduced 30% in 2013 in no-till plots compared to tilled although plant populations were nearly equal, indicating the N tie-up may be significant in crimped cover crops. Soybean grown after cover crops yielded less in the 2012 drought than when no cover crop was grown. When there was adequate soil moisture and weed control from the cover crop, soybean grown under organic no-till was competitive with tilled treatments. Optimum timing of cover crop crimping for acceptable weed control was more successful in a soybean production system compared with corn. Also, organic no-till in this study was more successful in soybean and wheat than in corn when the cover crop biomass was sufficient to suppress weeds.
In study two, soil quality indicators were measured on the treatments described in study one. These indicators included aggregate stability (AgStab), ?-glucosidase (BG) activity, permanganate oxidizable carbon (POXC), total organic carbon (TOC), total nitrogen (TN), PLFA biomass and soil P and K levels. A soil quality index was determined for each treatment using the Soil Management Assessment Framework (SMAF). AgStab, TOC and BG were generally less in TNCC than in cover crop treatments. Increased compost rates led to greater TN, P and K levels and to improved SQ index scores. PLFA biomass was not affected by compost rate but was greater in treatments with high amounts of residue from crops or from

cover crops. POXC was impacted by compost rate and crop residue but not by TCCP. All soil quality indicators showed differences between years, with highest levels in 2013, the year with the highest and greatest distribution of precipitation. Differences in SQ index between treatments were significant but minor, which may be a result of the short-term nature of the study. Cover crops tended to mitigate the negative effects of tillage on soil in this study and cover crops impacted soil quality more when grown in conjunction with soybean than with corn or wheat.

To determine the effect of crop rotation and tillage practices on weed control and soil quality during the transition into organic row cropping, in study three we examined seven transitional rotational cropping systems. All rotations utilized a fall planted winter cover mix prior to spring planting and included the grain crops corn, soybean, winter wheat, grain sorghum [Sorghum bicolor (L.) Moench] and the summer cover crops sorghum-sudangrass [Sorghum bicolor (L.) Moench × Sorghum sudanense (Piper) Stapf.] and sunn hemp (Crotalaria juncea L.). The seven rotational systems were: 1) Cover crop only (CCO), which was established as three years of winter and summer cover crops with no intervening cash crop; 2) Modified cover crop treatment (MCC), which utilized one year of a sorghum-sudangrass summer cover crop followed by grain sorghum in year two and corn in year three; 3) Modified conventional tillage (MCT), one year of sorghum-sudangrass in the summer followed by winter wheat and a soybean double-crop in year two and corn in year three; 4-5) Conventional tilled corn/soybean (CONVCS) and sorghum/soybean (CONVSS); and 6-7) No-till corn/soybean (NTCS) and sorghum/soybean (NTSS). Soil quality indicators measured included aggregate stability (AgStab), ?-glucosidase (BG) activity, permanganate oxidizable carbon (POXC), total organic carbon (TOC), total nitrogen (TN), PLFA biomass and soil P and K levels. Weed biomass and total weed seeds were also determined. Conventionally tilled soybean yield was a greater percentage of conventional, non-organic yield than wheat, corn or grain sorghum because soybean did not experience low fertility constraints following termination of synthetic fertilizer use and before compost began actively releasing N for crop nutrition and growth. Although CCO led to lower numbers of weed seeds, it did not significantly decrease weed biomass. Soil quality indicators were not significantly different in the CCO system compared to the other treatments. Organic no-till was difficult to manage and is not recommended for use when transitioning to organic production.

To determine the effects of planting into a cover crop in organic no-till, study four was conducted to compare corn germination and emergence rates at different planting times. A cereal rye and hairy vetch cover crop mix were terminated by either rolling/crimping or mowing. Corn was planted at four planting times in relation to cover crop termination: before cover crop termination into a standing cover crop (SCC), immediately after either rolling/crimping the cover crop (AT), one week after cover crop termination (1WAT) and two weeks after termination (2WAT). Stand density counts were recorded as a measure of efficacy of each treatment. Germination and emergence of corn in an organic no-till system was significantly impacted by planting times and cover crop termination method. Population reduction in corn planted in the organic no-till ranged from 36% to 80% compared to the number of seeds planted. The likely cause of reduced plant density in organic no-till was due to difficulty of planting in cover crops. Plant population was highest in corn planted into a standing cover crop, then decreased as the time between termination and corn planting increased. Corn planted immediately after the cover crop was mowed showed a population decrease of 42% overall and 98% in 2012 when compared to corn planted immediately after crimping the cover crop. Delaying corn planting one or two weeks after cover crop termination showed no benefit and led to decreased corn plant populations.