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Evaluation of an Organic No-Till System for Organic Corn, Soybean, and Tomato Production

Kathleen Delate
Iowa State University, kdelate@iastate.edu

Andrea McKern
Iowa State University

Robert Burcham
Iowa State University

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Abstract

The Rodale Institute began experimenting with an Organic No–Till Plussystem in 2004, where commercial crops(corn,soybean, pumpkin) were no-till drilled or planted into cover crops that were rolled with a roller/crimper. The roller consists of a large steel cylinder(10.5 ft wide × 16 in. diameter)filled with water to provide 2,000 lb of weight. The Rodale Institute supplied Iowa State University with a roller in 2005 forth is experiment.

Keywords

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Disciplines

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Evaluation of an Organic No-Till System for Organic Corn, Soybean, and Tomato Production

Kathleen Delate, associate professor
Andrea McKern, research assistant
Departments of Horticulture and Agronomy
Bob Burcham, ag specialist

Introduction

The Rodale Institute began experimenting with an Organic No–Till Plus system in 2004, where commercial crops (corn, soybean, pumpkin) were no-till drilled or planted into cover crops that were rolled with a roller/crimper. The roller consists of a large steel cylinder (10.5 ft wide × 16 in. diameter) filled with water to provide 2,000 lb of weight. The Rodale Institute supplied Iowa State University with a roller in 2005 for this experiment.

Materials and Methods

Cover crops were planted on October 31, 2006, in three treatments: a control (no cover crop/tillage used after planting); a cover crop combination of winter wheat (56 lb/acre) and Austrian winter pea (19 lb/acre); and a cover crop combination of rye (50 lb/acre) and hairy vetch (25 lb/acre). The cover crops were rolled with a roller/crimper mounted on the front of the tractor on May 23, 2007. Cover crops were crushed at an earlier stage than in 2006, at anthesis (pollen shedding in the small grains). The corn and soybeans for the experiment were drilled in the cover crop treatments in one pass on the same day as rolling (May 23): the soybeans (BR 34A7) at 208,000 seeds/acre and the corn (BR 63H07) at 32,000 seeds/acre. The same soybean and corn varieties were planted in the control plots of the experiment in 30-in. rows, the corn at the same rate as in the cover treatments (32,000 seeds/acre) and the soybeans at 200,000 seeds/acre. After planting, it was evident that the cover crops were not killed by the roller/crimper, therefore the cover crops were mowed on May 31 before the corn and beans emerged. Corn and soybean weed counts were taken on June 7 and June 21. Insect population counts were taken in soybeans on June 7. Corn borer insect counts were taken on July 5, 2007. Corn and soybean plots were harvested on October 29. Soil samples were taken on July 19 and October 26 in all plots to compare soil quality.

Tomato seeds were started in a greenhouse on April 23. Twelve, 8-in. Roma tomato seedlings were planted in four replications of each treatment on June 4. Transplants were side-dressed with 0.5 lb/plant of hoop-house compost on June 27. Tomato plant height data was taken by measuring six plants per plot on June 24, July 3, July 17, and August 1. Weed populations were enumerated in tomato plots on June 20, July 3, July 17, August 1, and August 13 in each plot. Weeds were removed from plots after each weed enumeration. Leaf number data were taken June 24–26, July 3, and July 17; flower number data were taken July 3 and July 17; and fruit number data were taken July 17 and August 13, by counting the number of fruit and flowers on each plant. Tomatoes were irrigated on 14 days in June and July, but no irrigation was needed in August or September.

Tomatoes were harvested on August 20, 27, and 31 and on September 6 and 12, 2007 by selecting all red fruit measuring ≥ 3 in. on nine plants/plot. Fruit was weighed and graded on a scale of 1 to 3, with 1 the highest grade (according to grading for organic tomatoes received at local markets).

Results and Discussion

Germination of cover crops was excellent in 2006. Low rainfall conditions followed corn and soybean planting through June and July, which impacted crop growth, particularly in corn. The cover crop continued to grow but the corn and soybeans suffered from drought and competition for moisture with the cover crop. The tomato performance, however, was excellent, because of irrigation. Tomatoes in both cover crop treatments grew well, and plants in the rye/hairy vetch and pea/wheat mulch were taller than those in the tilled treatment on the first two sampling periods; tomato plant height was equivalent among treatments at the last two periods (Table 1). There were no differences in leaf and flower number on three sampling periods, but fruit number was greater in the pea/wheat treatment in July. Disease symptoms from *Septoria* leaf spot were so low in 2007 that no disease data were collected.

Both cover crop treatments provided some weed suppression (Table 2). The main difference in weed populations between the tilled (control) and rolled cover crop treatments occurred early in the season, when weed management was most critical. The hairy vetch/rye treatment provided greater management of broadleaf weeds early in the season (June 20), as the pea/wheat treatment decomposed at a faster rate than the vetch/rye residue. There was a trend towards fewer broadleaf weeds in the cover crop treatments compared with the control, particularly in the hairy vetch/rye treatment, but because of high weed variability, broadleaf weed differences among treatments were not statistically different in 4 of 5 sampling periods (Table 2). Grass weeds were lowest in the hairy vetch/rye treatment at the end of the season. Although there was no difference in yield between cover crop and tilled treatments (Table 3), there was a trend toward greater fruit harvested in the rye/hairy vetch versus winter pea/wheat treatment. Yields ranged from 547,114 fruit/acre in the winter pea/wheat treatment to 645,269 fruits/acre in the tilled treatment. Tomato quality was high in all treatments, with an average of 87% in the highest grade (Table 3). The greatest number of No. 1 tomatoes was in the hairy vetch/rye treatment, with equal numbers in pea/wheat and the tilled treatments.

Soybean yields in the rolled cover-cropped treatments were successful in 2007, averaging 45 bushels/acre (Table 4). Yields were higher in tilled plots (51 bu/acre), but the organic no-till treatments were impressive because of such high yields with no additional tillage following planting. Following the trend observed with the tomato experiment, both cover crop treatments provided some weed suppression, with the hairy vetch/rye treatment providing greater management of broadleaf weeds, equal to the tilled treatment (Table 4). Soybean grain quality was also excellent, averaging 34% protein, with no differences among treatments (Table 5). Moisture was higher in the no-till treatments and highest in the pea/wheat treatment, but all were below 15% (Table 5).

Corn plants in the no-till treatments suffered from the dry weather more than soybeans in 2007. Plant stands were similar between tilled and no-till treatments, averaging 20,139 plants/acre, but growth was depressed as the season progressed and water became a limiting factor in July. Weeds were also a problem in the no-till system, with broadleaf weed populations five to nine times as high as the tilled treatment (Table 4). There were more grass weeds in the pea/wheat treatment compared with the hairy vetch/rye and tilled treatments. Yields were as low as 10 bushels/acre in the no-till plots compared with 124 bushels/acre in the tilled treatment. Total soil nitrogen, carbon and organic matter were greater in the soybean plots in the pea/wheat treatment compared with the other treatments, however. In corn plots, the opposite was true. Total soil nitrogen, carbon and organic matter were greater in the tilled plots. The organic No-Till Plus system needs greater refinement before recommending it as a broad-scale approach for all regions and appears to be very moisture-sensitive. More organic no-till research will be conducted on-farm in 2008.