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

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Abstract
Cover crops for the Organic No–till Plus experiment were planted on September 12, 2005, and consisted of three treatments: 1) a control (no cover crop/tillage used after planting); 2) a cover crop combination of winter wheat (56.25 lb/acre) and Austrian winter pea (18.75 lb/acre), and 3) a cover crop combination of rye (64 lb/acre) and hairy vetch (32 lb/acre). The cover crops were rolled with a roller/crimper mounted, rear-mounted on a tractor on May 25, 2006. 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. Plots planted to the wheat and pea mix were rolled two times, while those in the rye and hairy vetch mix were rolled 2 to 3 times. The corn and soybeans for the experiment were drilled on the same day as rolling (May 25), the soybeans(BR 3F43) at 160,000 seeds/acre and the corn (BR 67M07) at 32,000 seeds/acre. Nine 6-in. Roma tomato seedlings were planted in three replications of each treatment on June 15. Transplants were side-dressed with 0.5 lb/plant of hoop-house compost at the time of transplanting.

Keywords
Horticulture, Agronomy

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Materials and Methods

Cover crops for the Organic No–till Plus experiment were planted on September 12, 2005, and consisted of three treatments: 1) a control (no cover crop/tillage used after planting); 2) a cover crop combination of winter wheat (56.25 lb/acre) and Austrian winter pea (18.75 lb/acre), and 3) a cover crop combination of rye (64 lb/acre) and hairy vetch (32 lb/acre). The cover crops were rolled with a roller/crimper mounted, rear-mounted on a tractor on May 25, 2006. 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. Plots planted to the wheat and pea mix were rolled two times, while those in the rye and hairy vetch mix were rolled 2 to 3 times. The corn and soybeans for the experiment were drilled on the same day as rolling (May 25), the soybeans (BR 3F43) at 160,000 seeds/acre and the corn (BR 67M07) at 32,000 seeds/acre. Nine 6-in. Roma tomato seedlings were planted in three replications of each treatment on June 15. Transplants were side-dressed with 0.5 lb/plant of hoop-house compost at the time of transplanting.

Tomato plant height data were taken by measuring nine plants/plot on June 27, July 11, and August 14, 2006. Weed populations were enumerated in tomato plots on July 20, August 14, and September 13 in a one-square-meter quadrat at three randomly selected areas within each plot. Flower number data were taken on July 11, and fruit number data were taken on July 11 and August 14, by counting the number of fruit and flowers on each plant. Plant populations were taken in soybean and corn plots on June 28. Corn and soybean plant height data were taken by measuring the height of ten randomly selected plants in each plot on August 29, 2006.

The control plots in the tomato experiment received weed suppression techniques involving hoeing on June 27 and a straw mulch application on June 27–28. Tomatoes were irrigated on June 15 and 30, and July 5, 18, and 25, 2006. Disease samples were taken on July 17 and confirmed at the Iowa State University Plant Disease Clinic, Ames, IA.

Tomatoes were harvested on August 14 and 31, and on September 5, 12, 20, and 26, 2006, by selecting all red fruit measuring ≥3 in. on nine plants/plot. Fruit was graded on a scale of 1 to 3, with 1 the highest grade (according to grading for organic tomatoes received at local markets). Soybeans were harvested on October 31, and corn was harvested on November 1, 2006, with a combine.

Results and Discussion

Germination of cover crops was excellent in 2005, and on October 13 (31 days after planting), the legumes in each treatment had an average of 3 in. of growth above ground. The rolling was conducted when small grains in the cover crops were in the dough stage (headed out but not fully developed). The cover crop crushed down well enough, but then proceeded to come back up into place, thus, negating a "crushed" cover where the corn and soybeans would be planted. The most unfortunate event that followed, however, was the lack of rain through June and July. 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 (Table 1) but the tilled treatment and the rye/hairy vetch plants were taller than those in the winter pea/wheat treatment. Although there were no differences in flower number on July 11, fruit number tended to be greater in the tilled treatment in July and August, when fruit numbers averaged 43 tomatoes/plant. Disease symptoms appeared in July and were diagnosed as *Septoria* leaf spot. Despite an overall low rate of disease (less than 8% of plants affected), and no differences among treatments, the tilled treatment tended to show less affected leaves than the cover crop treatments (Table 1).

Both cover crop treatments were excellent in providing 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 winter pea/wheat treatment provided greater management of grass weeds early in the season (July 20) but because of high weed variability, differences among treatments were not significant (Table 2). This effect was reversed at the second sampling date (August 14) when there were higher levels of grass weeds in this treatment. 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 355,579 fruit/acre in the winter pea/wheat treatment to 497,875 fruits/acre in the tilled treatment. Over the six harvest dates, fruit number was greatest in the tilled treatment on September 5 (Figure 1), but harvests were greater in the cover crop treatments at the end of the season (September 26). This result corresponds with other reports where cover crop treatments permit a longer harvest period than a conventional crop. Tomato quality was excellent in all treatments, with an average of 84% in the best grade (Table 3). There was no difference among treatments in No. 1 tomatoes, but a greater number of No. 2 tomatoes in the tilled treatment.

Organic corn and soybeans in the crushed cover crop treatments were not successful because of the drought; therefore, yields were not taken. First-year results with the roller/crimper demonstrate promise with irrigated crops, such as tomatoes, and potentially, other vegetables. In years of dry weather, such as 2006, competition for moisture between cover crop and commercial crops will limit the application of the roller. We will repeat this experiment in 2007.

Acknowledgments

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Table 1. Tomato plant data in cover crop treatment trial, Neely-Kinyon, 2006.

	Plant height (cm)			Fruit (number/plant)		Flowers (number/plant)	Disease (%)
Treatment	June 27	July 11	August 14	July 11	August 14	July 11	July 11
No cover	23.67a	46.19a	89.85a	1.11a	43.44a	3.19	4.89
Rye and hairy vetch cover	23.07a	43.61a	85.63ab	0.63b	36.85ab	3.52	6.11
Wheat and winter pea cover	20.41b	38.98b	81.67b	0.22b	29.89b	2.96	7.37
LSD 0.05	1.82	2.74	5.96	0.47	7.66	NS	NS

Means within columns followed by the same letter are not different.

Table 2. Tomato weed populations in cover crop treatment trial, Neely-Kinyon, 2006.

	Weed Populations (weeds/ m^2)					
	July 20, 2006		August 14, 2006		September 13, 2006	
Treatment	Broadleaves	Grasses	Broadleaves	Grasses	Broadleaves	Grasses
No cover	16.00b	18.44	0.11	0.85a	0.56	1.22
Rye and hairy vetch cover	1.22a	10.78	0.11	0.82a	0.22	0.67
Wheat and winter pea cover	0.89a	7.89	0.11	17.52b	0.11	0.78
LSD 0.05	8.79	NS	NS	14.51	NS	NS

Means within columns followed by the same letter are not different.

Table 3. Yield and tomato quality in cover crop treatment trial, Neely-Kinyon, 2006.

		Tomato quality (%)		
Treatment	Yield (fruit/acre)	Grade 1	Grade 2	Grade 3
No cover	497,875	79.53	9.13b	11.34
Rye and hairy vetch cover	441,731	87.74	5.26a	6.99
Wheat and winter pea cover	355,579	85.34	7.14ab	7.52
LSD 0.05	NS	NS	2.74	NS

Means within columns followed by the same letter are not different.

Table 4. Soybean and corn parameters in cover crop treatment trial, Neely-Kinyon, 2006.

	Plant stands (plants/acre)		Plant height (cm)	
Treatment	Corn	Soybeans	Corn	Soybeans
No cover	25,250a	57,000b	248.23a	104.30a
Rye and hairy vetch cover	24,083ab	91,750a	211.93b	68.20b
Wheat and winter pea cover	20,833b	84,750a	191.93c	66.17b
LSD 0.05	3,331	13,168	7.12	3.52

Means within columns followed by the same letter are not different.

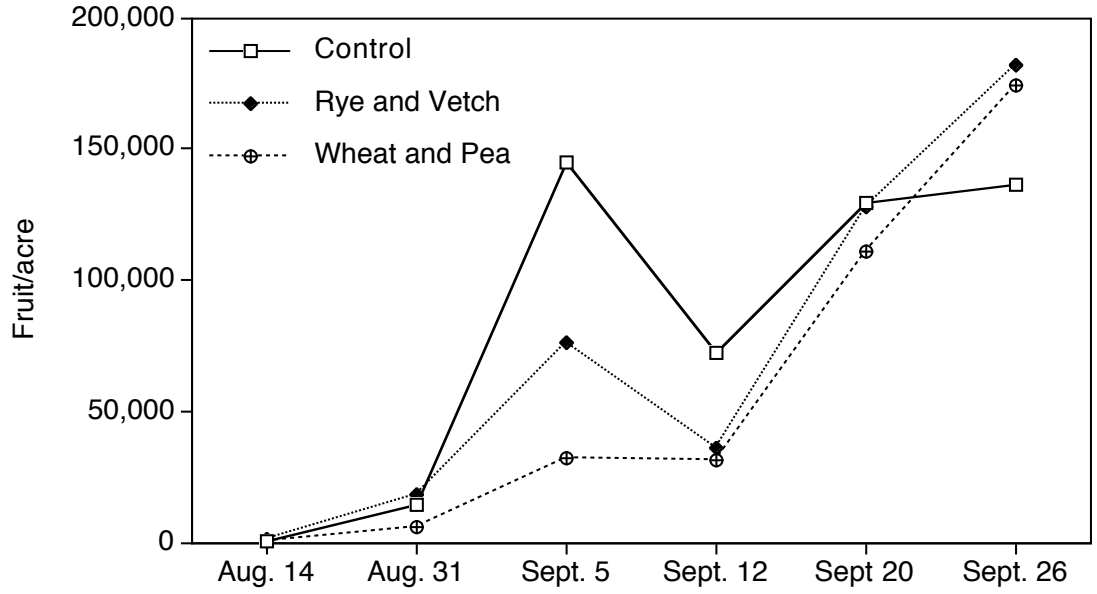

Figure 1. Tomato yield by date in cover crop treatment trial, Neely-Kinyon Farm, 2006.