Evaluation of an Organic No–Till Rotation: Oat Crop Agronomy Farm Trial, 2010

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Introduction

The Rodale Institute (Kutztown, PA) 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 x 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 experimentation in Iowa.

Due to the fact that organic production of crops primarily relies on tillage for weed management, much attention has been focused on an organic no-till system. Tillage may be problematic for soil quality by increasing erosion and carbon loss, but also increasing labor and energy use (Pimentel et al., 2005). Mixed results have occurred in Iowa and across the nation since the inception of roller experimentation. In 2007, no-till organic soybeans were yielded 45 bu/acre, compared to 50 bu/acre in the tilled organic soybeans (Delate et al. 2007). Organic no-till corn in Iowa was not competitive in 2007 with yields as low as 10 bu/acre compared with a 124 bu/acre average for the tilled corn. In Pennsylvania, however, yields have been reported as high as 153 bu/acre after planting corn into a rolled hairy vetch cover crop (Mischler et al., 2010). In 2009, corn and soybeans were planted into hairy vetch and rye cover crops, respectively, in the Integrated Organic Program project (Delate et al., 2010). Corn and soybean yields in 2009

Materials and Methods

Following the crop rotation in 2008–2009 (spring wheat-winter rye-soybean; and spring wheat-hairy vetch-corn), oats were no-till drilled into the no-till plots without any tillage event, while the conventional tillage plots received pre-plant tillage. ‘Spurs’ oats were planted on April 5, 2010, at a rate of 3 bushels/acre using a John Deere no-till drill. Stand and weed counts were taken in the oats on May 17. Weed biomass, including the biomass of volunteer cover crops was taken on July 7. Due to competition and re-growth of cover crops, the no-till oats could not be harvested for grain and were instead harvested for biomass on July 27. This biomass was stored and used in 2011 as an organic mulch in a vegetable crop project. The conventionally tilled oats were combined on July 16. Soil samples were taken on August 26, 2010, in all plots to compare soil quality. Soils were evaluated at the USDA-ARS National Laboratory for Agriculture and the Environment (Ames, IA).

Results and Discussion

<u>Oats</u>

Oat stand in the tilled winter rye-soybean-oat treatment was greater than in the tilled hairy vetch-corn-oat treatment (Table 1). Plant populations in the no-till hairy vetch-corn-oat plots were equal to the tilled counterpart, but the no-till winter rye-soybean-oat treatment was lower than the tilled counterpart. Weed suppression was considered inadequate, with an average of 18 broadleaf weeds/sq. ft., with no differences between treatments (Table 1). Grass weeds were greater in the no-till winter rye-soybean-oat treatment compared to the other treatments.

On July 7, oat biomass averaged 2.7 tons/acre in the tilled plots compared to 0.21 tons/acre in the no-till plots (Table 2). The tilled winter rye-soybean-oat treatment, which had the highest crop stand, also had the greatest biomass at 3.4 tons/acre. The appearance of volunteer rye and hairy vetch crops was observed in no-till plots planted to these cover crops in 2008: the no-till winter rye-soybean-oat plots and the hairy vetch-corn-oat plots had approximately 2 tons/acre of rye and hairy vetch biomass, respectively, on July 7 (Table 2). Weed biomass near harvest was greatly reduced in the tilled treatments (despite early-season high levels of weeds and no tillage in plots) and greatest in the no-till winter rye-soybean-oat plots (Table 2). Many of the weeds were perennial species, including dandelion, Canadian thistle and other species. Oat grain yield was only obtained in tilled plots, averaging 60.3 bu/acre, with the highest yield obtained in the winter rye-soybean-oat plots (74.9 bu/acre) (Table 1). The oatlage in the no-till plots averaged 0.27 tons/acre, with no difference between rotations.

Discussion

The oat crop in the long-term rotation was not as successful as other organic oat crops across the state, which averaged 82 bu/acre compared to 60 bu/acre in this experiment. Extensive rainfall throughout the season increased disease pressure and poor drainage in plots. Volunteer winter rye and hairy vetch provided competition with the oat crop, leading to minimal grain fill in the no-till plots. In addition, perennial weed species emerged, particularly in no-till plots. Because of extensive weed populations, it was decided that a light disking on September 2, 2010, in all plots was necessary before planting hairy vetch and winter rye cover crops for the next season.

Literature Cited

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Table 1. Oat crop parameters in organic no-till experiment, ISU Agronomy Farm, Boone, Iowa, 2010.

Tillage treatment	Rotational treatment	Stand (plants/ft^2)	Broadleaves (weeds/ft^2)	Grass (weeds/ft^2)	Yield (bu/ acre)* (tons/acre)
		5/17/2010	5/17/2010	5/17/2010	
Conventional Till	Winter rye-soybean-oat	32.67a	19.83	13.58b	74.92a*
	Hairy vetch-corn-oat	22.83b	4.25	5.08b	45.59b*
No-Till	Winter rye-soybean-oat	13.25c	13.00	30.25a	5.83
	Hairy vetch-corn-oat	14.50bc	33.00	4.33b	5.10
	LSD 0.05	9.45	NSD	11.83	13.76*

Table 2. Oat, cover crop and weed biomass in organic no-till experiment, ISU Agronomy Farm, Boone, Iowa, July 7, 2010.

Tillage treatment	Rotational treatment	Oat biomass (tons/acre)	Volunteer rye biomass (tons/acre)	Volunteer hairy vetch biomass (tons/acre)	Weed biomass (tons/acre)
Conventional Till	Winter rye-soybean-oat	3.39a	0.00b	0.04b	0.01
	Hairy vetch-corn-oat	1.94b	0.00b	0.02b	0.00
No-Till	Winter rye-soybean-oat	0.14c	1.87a	0.00b	0.38a
	Hairy vetch-corn-oat	0.28c	0.00	1.69a	0.16b
	LSD 0.05	0.61	0.60	0.63	0.21