

**Utility of Interseeded Winter Annual Cereal Rye in Organic Food-Grade Soybean
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INTRODUCTION: Growers typically rely on tillage for weed control in organic food-grade soybean production systems. Disadvantages with crop systems that rely on tillage include increased erosion risk (Edwards et al. 1993, McGregor et al. 1999), loss of soil structure, decrease in soil organic carbon levels (Studdert and Echeverria, 2000) and increases in machinery and fuel costs (Lu et al. 1999). Weil et al. (1993) found that mineralizable nitrogen decreased with increasing intensity of tillage in five Maryland cropping systems.

Spring-planted winter annual cereal rye, interseeded with soybean, has been identified as a possible alternative weed control method in conventional soybean production systems. Unlike fall planted winter annual cereal rye, spring planted winter annual cereal rye remains vegetative and does not rapidly elongate (Ateh and Doll, 1996). The less aggressive growing pattern of spring planted winter rye makes it more appealing as an interseeded cover crop than fall planted winter rye. Conceivably, an ultra high planting density of soybean could be used to further reduce the competitive affect of the interseeded winter annual cereal rye.

The use of rye in field cropping systems has many advantages including increased surface residue for erosion control (Kessavalou and Walters, 1997), reduced soil compaction (Raper et al. 2000), and suppressed weed emergence (Blum et al. 1997). In conventional soybean production systems, the availability of herbicides to control the interseeded rye affords the grower a management option in the event that the rye becomes too competitive with interseeded soybean. The objective of this study was to determine if interseeding winter annual cereal rye in the spring with soybean is a viable management practice in organic drilled and row planted soybean production systems.

OBJECTIVES: Investigate weed control in drilled and row planted organic soybeans inter-seeded with spring-planted winter annual cereal rye.

EXPERIMENTAL PROCEDURES: Two separate experiments were designed. One experiment investigated a drill planted system using a 7.5 inch row spacing, and the second experiment involved a row planted system using a 30 inch row spacing. The experimental design for each study was a randomized complete block with four replications. The treatment design in each study was a two-factor factorial. In the drill planted system the first factor was soybean planting density (180000, 360000, and 540000 plants/acre) and the second factor was the presence or absence of interseeded rye. In the row planted system, the first factor was whether or not row cultivation was used

and the second factor was the presence or absence of interseeded rye. In both systems, the interseeded rye treatments consisted of 112 lb/acre rye (Wheeler var. Michigan Agricultural Experiment Station, East Lansing, MI) planted with a drill in 7.5 inch row widths the same day the soybeans were planted. In the row planted experiment, row cultivation (Case International model 183 cultivator, Racine, WI) was conducted on the indicated treatments when the soybeans were approximately at the V4 growth stage. The soybean variety used was NK 19-T19. In each year of the study, all plots were rotary hoed (Case International model 181MT, Racine, WI). Consistent with local organic practices, the rotary hoeing occurred 7, 12, and 21 days after planting (DAP) in 2000; 9, 19, and 25 DAP in 2001; and 11, 13, and 19 DAP in 2002. Planting dates were June 7, May 20, and May 30, for 2000-02, respectively. In all experiments, no herbicides were used and management was consistent with organic growing systems.

RESULTS:

Table 1. Drill planted system early and late season biomass, soybean plant density, and grain yield as affected by soybean planting density and interseeded rye.

Year	rye (lb/A)	Planting density (seeds/A)	Early season biomass			Late season biomass			harvest plant	
			soybean (lb/A)	rye (lb/A)	weeds (lb/A)	soybean (lb/A)	rye (lb/A)	weeds (lb/A)	density (plants/A)	yield (bu/A)
2000	112	180000				3751	3263	34.8	134083	38.3
	112	360000				4597	216	22.8	221884	45
	112	540000				4359	144	0	294711	44.9
	0	180000				3505	0	268.8	104817	37.8
	0	360000				5082	0	16.2	204869	42.4
	0	540000				4530	0	6.4	285182	43.9
			lsd				1481	121	247	53231
2001	112	180000	160.2	690	104.7	699.4	1128.8	63.9	117161	12.3
	112	360000	279.5	802.5	23.5	1275.5	919.8	101.7	236325	20
	112	540000	436.3	693.4	57.4	1946.4	710.5	40.3	285893	25.6
	0	180000	186.9	0	128.7	2111.9	0	1191.6	101640	15.9
	0	360000	411.1	0	73.6	3248.6	0	540.3	226812	27.5
	0	540000	811.9	0	88.7	2907.1	0	340.2	300413	31.29
			lsd	403.3	185.8	155.8	810	440.3	848.2	67883
2002	112	180000	619.8	371.3	33.9	6849	0.8	293	178596	35.2
	112	360000	781.5	422.8	6.3	6206	0	36	239580	39.9
	112	540000	586.5	373.3	9.5	6594	0	563	320166	41.2
	0	180000	1043.7	0	188.4	7767	0	654	165528	43.6
	0	360000	1255.6	0	62.7	8809	0	75	259182	48.9
	0	540000	1433.1	0	10.7	7902	0	149	383328	46.9
			lsd	453.1	311.3	191	2698	1.4	1098	122582

Table 2: Row planted system early and late season biomass, soybean plant density, and grain yield as affected by mechanical cultivation and interseeded rye.

Year	rye (lb/A)	cult	Early season biomass			Late season biomass			harvest plant	
			soybean (lb/A)	rye (lb/A)	weeds (lb/A)	soybean (lb/A)	rye (lb/A)	weeds (lb/A)	density (plants/A)	yield (bu/A)
2000	112	no								37.4
	112	yes								30.2
	0	yes								48.8
	0	no								42.5
		lsd								12.9
2001	112	no	149.7	786.2	40.3	1079	1107	277	111000	12.6
	112	yes	135.6	659.4	60.3	2350	434	18	122375	29.6
	0	yes	257.2	0	78.2	3710	0	5	113875	35.7
	0	no	274.6	0	100.7	2657	0	1681	121375	22.3
		lsd	78.6	146.9	140	735	399	391	7770	6.8
2002	112	no	377	422	97	4600	55	1453	69250	26.4
	112	yes	434	186	3	5167	0	1131	63250	37.5
	0	yes	892	0	28	6312	0	5.5	70000	47.2
	0	no	716	0	476	4845	0	1782	58000	35.6
		lsd	161	116	422	2010	82	2110	12074	12.6

Table 3. Soybean yield as affected by soybean and rye planting density in the 7.5 inch drill planted system. Effect of soybean planting density is averaged across rye treatments and effect of rye planting density is averaged across soybean planting densities.

Soybean planting density	2000	2001	2002
seeds/acre	bu/acre		
180000	38.0	14.1	39.6
360000	43.7	23.7	44.4
540000	44.5	28.4	44.1
lsd	2.8	3.5	3.2
Interseeded rye			
no	41.4	24.9	46.5
yes	42.8	19.3	38.7
lsd	NS	2.4	2.2

Table 4. Soybean yield as affected by rye planting density and mechanical cultivation in the 30 inch row planted system. Effect of cultivation is averaged across rye treatments and effect of interseeded rye is averaged across cultivation treatments

	2000	2001	2002
Cultivation	bu/acre		
yes	39.5	32.7	42.3
no	40.0	17.4	31.0
lsd	NS	3.5	6.1
Interseeded rye			
no	48.9	29.0	41.5
yes	37.3	21.1	32.0
lsd	5.7	3.5	7.1

Conclusions: Interseeded winter annual cereal rye decreased soybean yield in two of three years in a 7.5 inch row drill planted system and in all three years of the 30 inch row planted system. The one year (2000) that the interseeded winter annual cereal rye did not reduce soybean yield in the drill planted system was characterized with above average precipitation during the growing season, suggesting that moisture stress was a predominate factor in the observed yield reduction. In 2000, increasing soybean planting populations decreased the late season biomass of the interseeded rye. However, during the dryer years of 2001 and 2002, increasing soybean planting density did not significantly reduce late season rye biomass. The interseeded rye reduced late season weed biomass in both the drill planted and row systems in 2001. Removal of the interseeded rye with mechanical cultivation in the row system resulted in an increase in soybean yield. This suggests that some means of terminating the interseeded rye is necessary for effective management across a range of precipitation levels. In 30 inch row organic food grade soybean production systems, this could be accomplished with mechanical cultivation. However, in 7.5 inch drill planted systems, new technology that meets the regulatory criteria for organic foods is needed to effectively terminate the interseeded rye and alleviate the imposed moisture stress.

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