Strip Tillage and Starter Nitrogen Management for Cover Crop Adoption in Central Iowa

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Introduction

The use of cover crops has numerous environmental benefits. However, farmers remain hesitant to change their current production practices mainly due to cost of implementation and potential yield drag. Aiming to design best management practices (BMPs) for the adoption of cereal rye between soybean and corn cropping system, this trial was conducted to evaluate if strip tillage and starter fertilizer can be implemented to increase corn seedling vigor, and hence decrease the negative impact of residual effect of rye on plant health and yield of the subsequent corn season.

Materials and Methods

These trials started with planting of Elbon cereal rye in the fall of 2018. For the first year, the cover crop was drilled. In the second year, all plots were broadcasted. Termination occurred approximately five days before corn planting. Treatments included two tillage systems—no-till and strip-till—and three nitrogen rates at planting. Besides the plots with rye growth, these fields had a no cereal rye check for both tillage treatments. This trial is part of a larger trial at the ISU Northern Research Farm, Kanawha, Iowa.

Results and Discussion

Cereal rye biomass accumulation was very different between years due to weather and seeding method. The fall of 2018 and 2019 were both cooler and wetter falls that limited fall growth (data not shown). Cereal rye broke dormancy about 30 days earlier in spring 2020 (early March) compared with the spring of 2019 (early April). These extra 30 days of growth accumulated about 940 heat units (GDD50), approximately 400 higher than the previous year. Hence, the comparisons between treatments differed greatly between research years.

In 2019, the tillage system had a non-significant influence in rye biomass (Table 1), However, in 2020 the tillage influence was very strong (P-value < 0.0001) with no-tillage attaining 3,621 lb/acre and strip-tillage only 2,008. This is approximately 15 times more growth than in 2019.

The main effect of tillage and starter N was detected on radicle and seminal root rot incidence and severity in 2020 only (Table 2). In general, radicle and seminal root disease was greater on seedlings from no tillage plots compared with seedlings from strip-tillage plots. Seedlings from check plots (no rye, no starter N) showed significantly less disease than seedlings following cereal rye regardless of N addition. Addition of starter N (70 or 35 lb N/ac) did not reduce root rot incidence or severity on corn seedlings following a cereal rye cover crop.

In 2019, both main effects of tillage and starter N had significant effect on corn yield (Table 1). Strip-tillage averaged 12 bushels/acre more compared with no-tillage. The 0 and 35 lb N/acre with cereal rye had comparable yields to the no cereal rye, no starter N check treatment, however, the 70 lb N/acre starter N treatment was significantly inferior (P-value < 0.0001). In 2020, corn yields were suppressed compared with 2019, which is probably due to more cereal rye biomass and moderate drought conditions. The suppressed yields resulted in no tillage or starter N influence on grain yield.

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Table 1. Cereal rye biomass accumulation and following corn yields for no-tillage and strip-tillage with three starter N rates following cereal rye compared with a no-/strip-tillage control with no cereal rye, Boone, IA.[1]

	Cereal rye biomass lb/acre		Corn yield bushels/acre	
	2019	2020	2019	2020
No-tillage (NT)	188	3621 A	204 B	174
Strip-tillage (ST)	143	2008 B	216 A	176
	P = 0.0665	P < 0.0001	P = 0.0007	P = 0.9005
No rye, no starter			218 A	180
0 lb N/acre	184	3119	215 A	180
35 lb N/acre	153	2650	213 A	176
70 lb N/acre	160	2674	194 B	164
	P = 0.5428	P = 0.3864	P < 0.0001	P = 0.6240
NT, no rye, no starter			213	176
NT, 0 lb N/acre	217	4017	206	186
NT, 35 lb N/acre	178	3380	210	176
NT, 70 lb N/acre	170	3463	188	160
ST, no rye, no starter			223	184
ST, 0 lb N/acre	150	2219	224	174
ST, 35 lb N/acre	128	1920	216	175
ST, 70 lb N/acre	151	1886	200	169
	P = 0.6450	P = 0.8977	P = 0.5898	P = 0.8720

[1]P-values within boxes are used to compare biomass of the main and interaction effects within each column.
[2]Biomass accumulation or corn yields that are significantly different at P < 0.05 have different letters following the yield values within each box.

Table 2. Treatment effect (tillage method and starter nitrogen rate) on root disease of corn seedlings planted following cereal rye cover crop in field experiment, Boone, IA.

Treatment	Radicle incidence (%)[x]	Radicle severity (%)[y]	Seminal incidence (%)	Seminal severity (%)	Radicle incidence (%)	Radicle severity (%)	Seminal incidence (%)	Seminal severity (%)
	2019				2020			
No-tillage	13.5	1.2	7.3	0.5	37.2	3.7	21.9	2.0
Strip-tillage	12.5	1.3	4.5	0.6	21.5	3.0	13.5	1.1
P-value	0.7433	0.7855	0.2376	0.8021	0.0012	0.3056	0.0607	0.0596
No rye control	14.6	1.7	5.6	0.8	11.1 B[z]	1.12 B	4.2 C	0.2 C
High	14.6	1.3	4.2	0.2	31.3 A	3.2 AB	19.4 B	1.2 BC
Medium	11.8	1.0	7.6	0.6	43.1 A	5.3 A	32.6 A	3.1 A
Low	11.1	1.0	6.3	0.4	31.9 A	3.7 A	14.6 BC	1.6 B
P-value	0.8014	0.7362	0.7599	0.5517	0.0001	0.0037	0.0005	0.0007

[x]Root rot incidence was calculated as the number of seedlings with lesions on the radicle and seminal root tissue.
[y]Root rot severity was calculated as the percentage of roots covered with lesions on the radicle and seminal root tissue.
[z]Values followed by the same letter within a column are not significantly different at P value 0.05.