UNIVERSITY OF WISCONSIN AGRONOMY, SOYBEAN RESEARCH, UNIVERSITY OF WISCONSIN-EXTENSION

Identifying No-Till Soybean Growth and Yield Reductions in a Corn-Soybean Rotation

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Background

No-till farming has many known benefits: reduced erosion, soil water conservation, reduced fuel use, and reduced equipment use. There are two main areas of concern with no-till soybean production compared to conventional tillage soybean production: no-till soybeans tend to have slower early season growth and lower yield. In 2022, the UW Soybean Research Program conducted two experiments to identify the factors that cause slower growth and reduced yield of no-till soybeans. Once trends are identified, recommendations will be made to mitigate the slower growth and reduced yield of no-till soybeans. We will repeat these experiments again in 2023. This report will provide a summary of year one.

Experiment 1

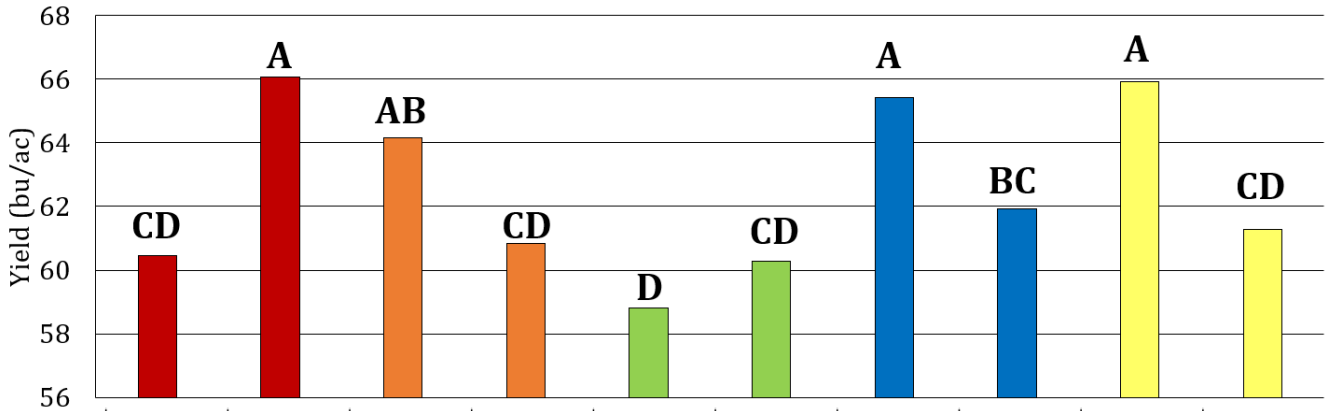
Experiment 1 was conducted at the Arlington Agricultural Research Station in a long term no-till corn-soybean rotation field. A total of ten treatments were tested in small and medium size plots (Table 1).

Table 1 Soybean treatment combinations in Experiment 1

Treatment	Tillage	Nitrogen application Timing/rate	Residue management
1	None	Spring/30 lbs N/ac	None
2	None	-	None
3	None	-	Fall removal
4	None	-	Spring removal
5	None	Spring/30 lbs N/ac	Fall chopped
6	None	-	Fall chopped
7	None	Spring/30 lbs N/ac	Spring chopped
8	None	-	Spring chopped
9	Conventional	-	-
10	None	Fall/30 lbs N/ac	None

Nitrogen was applied with a broadcast hand sprayer as 28-0-0 urea ammonium nitrate solution seven days before planting or in fall. Conventional tillage consisted of fall chisel plow and spring field cultivator. Plots were planted on May 9 at 140,000 seeds/ac, and the soybean variety was Asgrow AG22XF2 that was treated with fungicide and insecticide. Soybean row spacing was 30 in., and the stand was recorded for each plot. Sensors were placed one inch below the soil surface in each plot of two replications to measure soil moisture and temperature. Prior to planting, soil samples were taken from each plot to measure the level of soybean cyst nematode eggs and basic soil nutrient levels: pH, OM, P, K, Ca, Mg, B, Mn, and Zn. Three different soil samples were taken during the growing season from each plot. Nitrate (NO_3) and ammonium (NH_4) were analyzed from the top twelve inches of soil to assess the availability of nitrogen from our nitrogen application. Carbon dioxide (CO_2) respiration and potentially mineralizable nitrogen (PMN) were also measured. Higher levels of CO_2 respiration and PMN in the top six inches of soil would indicate higher levels of soil biological activity. Soil samples for NO_3, NH_4, CO_2 respiration, and PMN analysis were taken three times during the growing season: 10 days after planting (DAP), 40 DAP, and 60 DAP. Fractional green canopy cover was measured during the growing season using the Canopeo App which measures the percent greenness in an image. Images were taken from each plot six times during the growing season: 44 DAP, 51 DAP, 59 DAP, 64 DAP, 70 DAP, and 88 DAP. Soybean growth stages were tracked from planting until mid-August. Plots were harvested on October 5 using a research plot combine, and yield, moisture, and test weight were measured.

Significant differences in yield were measured between treatments at the Arlington site. Four treatments produced the greatest soybean yield ranging from 64 to 66 bu/ac on average: 1)no-till with spring N, 5)no-till residue chopped in fall with spring N, 7)no-till residue chopped in spring with spring N, and 9)conventional tillage. The conventional tillage treatment yielded 5.5 bu/ac more than the no-till soybean treatment. The addition of spring nitrogen produced 3.5 to 4.5 bu/ac more when compared to no spring nitrogen (Figure 1). Removing the residue in fall produced the greatest fractional green canopy cover 44 days after planting, but yields were not different compared to no residue removal treatments. When comparing fractional green canopy cover of no-till and conventional tillage soybeans, no differences were seen throughout the growing season. There were no differences in fractional green canopy cover between any of the treatments at 59 days after planting until the end of the growing season (Table 2). Analysis of the soil samples and soil sensor data is not yet completed.



Treatment	2	9	1	10	3	4	5	6	7	8
Tillage	NT	CT	NT	NT	NT	NT	NT	NT	NT	NT
Nitrogen	-	-	+Spring	+Fall	-	-	+Spring	-	+Spring	-
Residue					fall removal	spring removal	fall chopped	fall chopped	spring chopped	spring chopped

Figure 1 Soybean yield in Experiment 1. Treatments with the same letter are not significantly difference.

Table 2 Canopeo data from Experiment 1. Data indicate fractional green canopy cover. Treatments with the same letter are not significantly different.

	Fractional green canopy cover % (DAP*)					
Treatment	**44**	**51**	**59**	**64**	**70**	**88**
1- NT Spring N	18^{BCD}	31^{BC}	56	69	82	96
2- NT	15^{BCD}	26^{BC}	57	64	77	91
3- NT Fall removal	33^{A}	51^{A}	71	85	90	98
4- NT Spring removal	22^{BC}	38^{ABC}	60	76	83	93
5- NT Fall Chopped Spring N	25^{AB}	40^{AB}	62	77	87	97
6- NT Fall chopped	20^{BCD}	34^{ABC}	79	72	84	95
7- NT Spring chopped Spring N	21^{BCD}	35^{ABC}	66	73	86	97
8- NT Spring chopped	13^{CD}	24^{BC}	58	62	78	95
9- CT	15^{BCD}	31^{BC}	64	76	88	97
10- NT Fall N	12^{D}	21^{C}	48	57	71	94

*DAP, days after planting

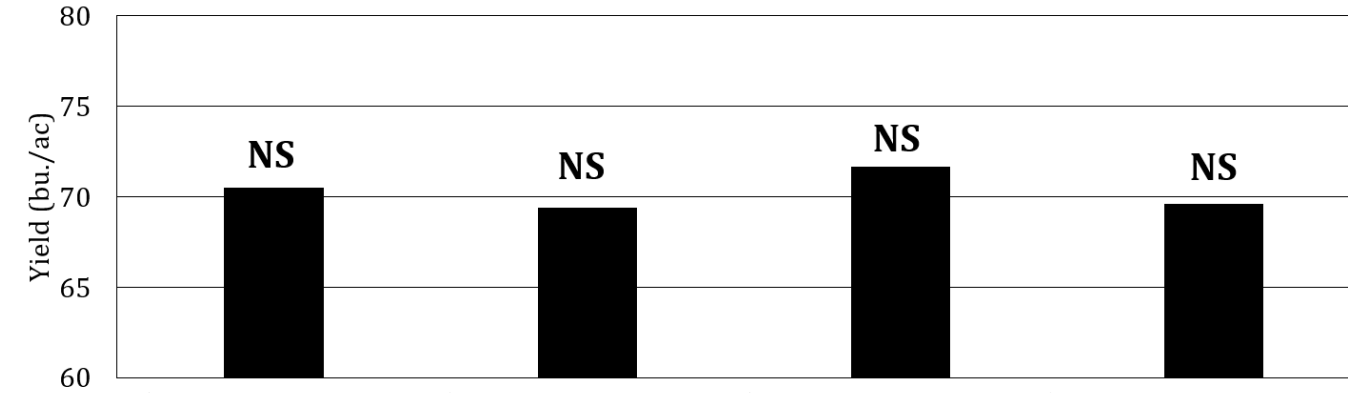
Experiment 2

Experiment 2 was conducted in large plots at a farm near Columbus, WI. The field is in a long term no-till corn-soybean-wheat rotation. Four treatments were replicated six times (Table 3). Plots were 15 feet wide and 50 feet long, and the row spacing was 15 in. Plots were planted on May 10 at 160,000 seeds/ac, and the soybean variety was Pioneer P18A73E. Nitrogen treatments were applied eight days before planting. Plots were harvested on October 5 using a research plot combine. Similar measurements as Experiment 1 were taken at Columbus excluding the Canopeo images.

Table 3 Soybean treatment combinations in Experiment 2

Treatment	Tillage	Nitrogen application Timing/rate	Residue management
1	None	Spring/30 lbs N/ac	None
2	None	-	None
3	None	Spring/30 lbs N/ac	Fall removal
4	None	-	Fall removal

The treatments at the Columbus site had no difference in yield. The yield of the treatments ranged from 69 to 72 bu/ac (Figure 2).



Treatment	1	2	3	4
Tillage	NT	NT	NT	NT
Nitrogen	+Spring	-	+Spring	-
Residue			fall removal	fall removal

Figure 2 Soybean yield in experiment 2. NS indicates no statistical difference in yield.

Both experiments will be repeated in 2023.

This is a preliminary report meant to relay preliminary findings. More data will be released once the trial is complete. This data is not for publication.

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