

Soybean Response to Various Management Inputs under Tile Drained Conditions

Principle Investigator

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Research objectives

1. Evaluate yield and growth differences between soybean varieties grown on tile vs. non-tiled conditions.
2. Evaluate yield and growth characteristics between different rates of inputs applied to soybean varieties.

Benefit of the research to ND soybean farmers

From the 1990's through 2015 excess water during parts of the growing season has significantly impacted crop production in the region. Besides acres not seeded due to water logged conditions, excess water caused yield losses on acres that were harvested. Application of seed treatments, nitrogen, sulfur, and / or foliar fungicides to soybean on tilled or non-tilled ground may impact the soybean yield but financial returns will depend on the cost of the practices. It is important for producers to know the most economic soybean management practices.

Materials and methods

The design of the experiment was a randomized complete block with a split-plot restriction of tilled and non-tilled soil conditions as the main plots.

Table 1. Descriptions of the treatments applied in 2015.

Treat- ment	Variety	Relative Maturity	Seed Treat- ment	Fertilizer and other Treatments	Timing Application
1	1 and 2	0.4 and 0.9	No	None	--
2	1 and 2	0.4 and 0.9	Yes	None	--
3	1 and 2	0.4 and 0.9	Yes	N 50 lb/a	R2
4	1 and 2	0.4 and 0.9	Yes	S 25 lb/a	Just after seeding
5	1 and 2	0.4 and 0.9	Yes	Foliar Fungicide	R2
6	1 and 2	0.4 and 0.9	Yes	S 15 lb/a	Just after seeding
7	1 and 2	0.4 and 0.9	Yes	Biological	Seed applied
8	1 and 2	0.4 and 0.9	Yes	N 50 lb/a + S 15 lb/a	As trt 3 and 6
9	1 and 2	0.4 and 0.9	Yes	Fung. + Biological	As trt 5 and 7
10	1 and 2	0.4 and 0.9	Yes	N + Fung. + S + Biological	As trt 3, 5, 6 and 7

The treatments investigated were two soybean varieties AG0434 (0.4) and AG0934 (0.9) in combination with 10 input-based treatments (Table 1). The seed treatment was Acceleron. The 50 lb. N was applied as Urea at the full bloom stage, R2. The sulfur was

applied as ammonium sulfate (21-0-0-24S). The rate was 15 lb. S per acre (which also included 13 lb N as ammonium) and 25 lb. S per acre (which also included 22 lb. N as ammonium). The foliar fungicide was Priaxor at a rate of 4 oz. per acre. The biological was TagTeam and was seed applied.

The 2015 research was planted on May 4 with a small plot seeder with 14 inch row spacing and harvested with a plot combine. Weed and insect management took place to eliminate weed and insect competition when needed. In addition to measuring yield, soybean plants were evaluated for greenness, height, and other growth characteristics.

Results 2015

The second half of the 2015 season was very dry and this resulted in no significant yield difference between soybean grown on tilled or non-tilled ground. The later maturing (0.9) variety was significantly greener, taller, and yielded more with 53.6 bu/a compared with the earlier maturing (0.4) variety, which yielded 48.3 bu/a.

Across both varieties, the control (treatment 1) yielded significantly lower (47.9 bu/a) than any of the other treatments, which combined yielded on average 51.3 bu/a. With a seed treatment the soybean yield was significantly higher by 2.7 bushels, or 5.6%, compared with the control.

The highest yield (55.7 bu/a) of all treatments was reached with the later maturing variety receiving a seed treatment, and 50 lb. N at the R2 (full bloom growth stage) compared with the late maturing variety control (no seed treatment and no other treatment), which yielded 50.3 bu/a.



Plots were planted with a 4 row x 14 inch planter.



Trial was planted on May 4, 2015.

Combined analysis 2014-2015

A similar trial was planted in 2014 and data from 2014 and 2015 were combined. There was no significant difference between no tile and tile when averaged across treatments and varieties (Table 2).

Table 2. Plant density, vigor, green score, height, oil, protein, test weight and yield for tile and no tiled ground, across varieties, treatments and years (2014-2015) at Fargo, ND.

	Plant density	Vigor scale 1-9	Green scale 1-5	Height	Oil	Protein	Test Weight	Yield
	Plants/acre	9 most vigorous	1 = green 5=brown	--cm--	---%---	---%---	lb/bu	bu/a
No Tile	189294	5.6	2.0	56.2	18.9	32.1	59.7	51.1
Tile	185278	6.1	1.9	57.2	19.0	32.0	59.4	52.2
Mean	187286	5.8	2.0	56.7	19.0	32.0	59.5	51.6
CV %	24.9	87.3	68.4	23.9	2.1	2.8	1.5	22.6
LSD 0.10	NS	NS	NS	NS	NS	NS	0.2	NS

However, analyzing the varieties with and without tile provided some additional insights. The two varieties responded differently to the tile and no tiled conditions. Both varieties had more vigor, were greener, and the earlier variety was taller on tiled ground. The yield for the early variety grown on tiled ground was significantly higher (4%) than on the ground with no tile (Table 3).

Table 3. Plant density, vigor, green score, height, oil, protein, test weight and yield for tile and no tiled ground for the early and late varieties, across treatments and years (2014-2015) at Fargo, ND.

Tile	Variety	Plant density	Vigor scale 1-9	Green scale 1-5	Height --cm--	Oil ---%---	Protein ---%---	Test Weight lb/bu	Yield bu/a
		Plants/acre	9 most vigorous	1 = green 5=brown					
No tile	early	191332	5.4	2.2	51.9	19.0	31.7	59.6	46.9
Tile	early	187349	6.0	2.0	53.5	19.0	31.6	59.3	48.8
No tile	late	187256	5.8	1.9	60.6	18.9	32.5	59.7	55.2
Tile	late	183206	6.2	1.7	60.9	19.0	32.4	59.5	55.6
Mean		187286	5.8	2.0	56.7	19.0	32.0	59.5	51.6
CV %		20.2	21.7	23.2	9.0	1.8	1.4	1.2	7.3
LSD 0.10		NS	0.3	0.1	1.3	NS	0.1	0.2	1.0

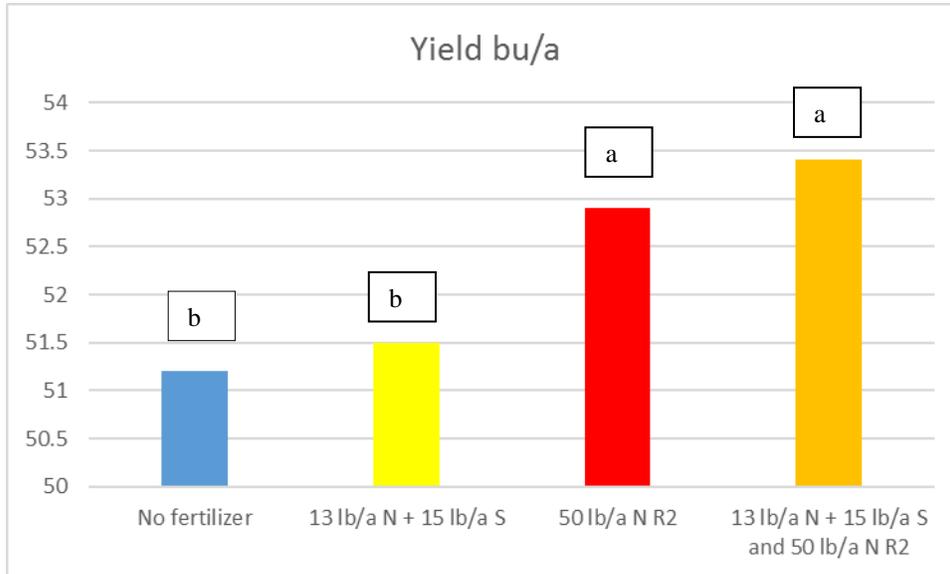
Table 4. Plant density, vigor, green score, height, oil, protein, test weight and yield for treatments across tile and varieties, and years (2014-2015) at Fargo, ND.

Seed treatment	Fertilizer and other inputs	Plant density	Vigor scale 1-9	Green scale 1-5	Height --cm--	Oil -%--	Protein ---%---	Test Weight lb/bu	Yield bu/a
		Plants/acre	9 most vigorous	1 = green 5=brown					
No	None	180489	5.5	2.1	54.9	19.0	32.0	59.2	49.6
Yes	None	187917	5.7	1.9	56.2	18.9	32.1	59.6	51.2
Yes	N 50 lb/a	181707	5.6	2.0	55.8	19.0	32.1	59.7	52.9
Yes	Foliar Fungicide	189992	5.6	2.0	55.0	18.9	32.0	59.4	50.4
Yes	S 15 lb/a	194633	6.1	2.1	59.0	18.9	32.1	59.5	51.5
Yes	Biological	184676	5.4	2.0	56.2	19.0	32.0	59.5	52.0
Yes	N 50 lb/a + S 15 lb/a	187438	6.1	1.9	57.6	19.0	32.0	59.6	53.4
Yes	Fung. + Biological	194827	5.9	1.9	57.1	19.0	32.0	59.8	51.6
Yes	N + Fung. + S + Biological	189979	6.5	1.9	57.3	19.0	32.0	59.5	52.9
Mean		187962	5.8	2.0	56.6	19.0	32.0	59.5	51.7
CV %		19.7	16.3	19.2	8.6	1.4	1.3	1.2	6.2
LSD 0.10		NS	0.4	0.2	2.0	NS	NS	0.3	1.3

In the beginning of the season a number of treatments resulted in more vigorous and greener plants than the control. The control plots ended up with shorter plants compared with treatments that had sulfur included. The control yielded 49.6 bushels per acre. Adding just seed treatment significantly increased the yield to 51.2 bushels per acre, a 3% increase. Foliar fungicide or biological treatment yields were not different to the only seed treated treatment (Table 4).

The second treatment (only seed treatment, blue bar) is compared with the some of the fertilizer treatments (Graph 1). There were significant yield differences between the no

fertilizer treatment and the application of 50 lb. N at the R2 growth stage (3.3% increase in yield) and the combination of 13 lb. N + 15 lb. S at planting with 50 lb. of N at R2, resulting in a 4.3% yield increase. However, the additional revenue from extra yield was not enough to pay for the extra input costs.

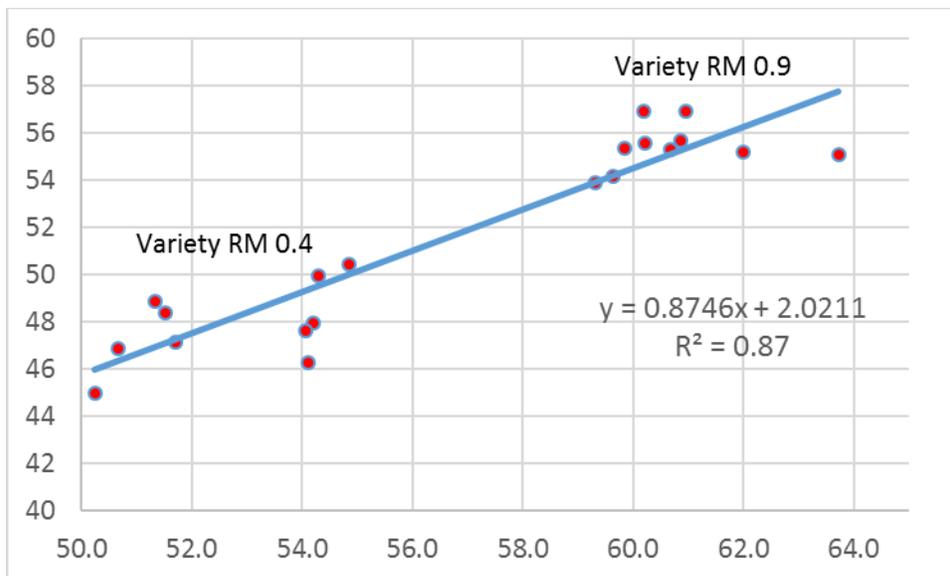


Graph 1. Soybean yield across tile, varieties and years for selected treatments.

Bars with similar letters are not significantly different.

Bars with different letters are significantly different.

There is a relationship with the yield and crop height. The earlier variety was shorter than the later variety but there was a tendency for the treatments resulting in taller plants to be also higher yielding (Graph 2).



Graph 2. Plant height in cm on the x-axis and soybean yield in bushel per acre on the y-axis averaged over treatments and years 2014-15, near Fargo, ND.

Conclusions

It is important to select an appropriate full season variety, which yielded 12% more compared with the early season variety. Soybean varieties respond different to tile or no tile drainage conditions. In this trial the early variety yielded significantly more with tile compared with no tile.

Seed treatment resulted in a significant yield increase and an increase in net return (Extra revenue from the yield increase minus the cost of seed treatment).

Although there were slight significant increases in yield for some of the other treatments compared to the only seed treated treatment (the second control, treatment 2), the extra expense of the input was not compensated for by the yield increase and resulted in a lower net return.