Soybean Seeding Rates by Tillage - No-Till vs. Vertical Till

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Objective

To determine a minimum seeding rate to maximize economic soybean yield under no-till and vertical tillage situations.

Background

Crop Year: 2013
Location: Farm Science Review MCAC
County/Town: Madison/ London
Soil Type: Kokomo, Crosby, Miami, Lewisburg
Drainage: Pattern tiled 70 foot spacing
Previous Crop: Corn
Tillage: No till or Vertical tillage, by treatment
Soil Test: OM 3.2%, CEC 15, pH 6.5, BpH 6.9
Bray P1 50ppm, K 165ppm
Planting Date: May 15
Variety: Asgrow AG3631RR2Y with Acceleron seed treatment
Fertilizer: None in 2013
Seeding Rate: 50 to 250 thousand seed/A
Harvest Date: September 30

Methods

Soybean yield is used as the measure of tillage and seeding rate effects. This study was designed as a randomized complete block with four replications of each treatment. Tillage treatments were blocked, with seeding rates randomly assigned within each block. The trial was conducted in large plots of 720 feet long by 40 feet wide (0.65 A) for each treatment at the Ohio State University Farm Science Review Molly Caren Agricultural Center near London, Ohio.

Variables evaluated:

1. Tillage –
    - A Great Plains Turbo-Till was used for the vertical till treatment and compared to no till planting. Planting for both treatments was accomplished with a no-till capable John Deere 1790 planter with 15-inch rows.
2. Seeding rate –
    - Five seeding rates of 50, 100, 150, 200 or 250 thousand seeds per acre were compared. The 1790 planter has variable seeding rate capability, but was set to each seeding rate as planned. Seed cost is $57 per 140,000 seed unit or approximately $20 per 50,000 seeds.

Tillage with the Great Plains Turbo-Till unit was done on May 14, set at about two inches deep. The seeding rates were set from the cab as each treatment was planted. Stand counts (population estimates) were made 30 days after planting in each plot by measuring 17.4 feet length and counting plants in two rows. Lodging on a 1 to 10 scale, with 1 erect and 10 being flat, was determined from the combine at harvest. A John Deere combine S550 with GreenStar yield monitor was used to harvest a 25 foot pass in each 40 foot planted strip; grain was weighed, moisture determined and recorded. Yield was corrected for moisture content to 13%.

Results

Main effects are presented in Tables 1 and 2 for lodging, plant stand and yield. There were no significant interactions between tillage and seeding rate for any of our measurements for yield ($p = 0.8727$). Table 1 presents tillage effects and Table 2 seeding rate effects. An indication of NSD indicates no significant differences between the treatments. An LSD (least significant difference) was determined at a 5% confidence level.

Table 1. Tillage effects on plant lodging, plant stand and soybean yield, London Ohio 2013.

Tillage type	Lodging (1-10)	Stand (thou. pl/A)	Yield (bu/A)
No-till	2.1	99.7	57.2
Vertical tillage	2.0	104.6	59.3
LSD (0.05)	NSD	1.2	0.7

Table 2. Seeding rate effects on plant lodging, plant stand and soybean yield, London Ohio 2013.

Seeding rate (s/A)	Lodging (1-10)	Stand (thou. pl/A)	Yield (bu/A)
50,000	1.0	34.1	51.2
100,000	1.2	66.4	57.4
150,000	1.6	101.3	59.6
200,000	2.9	137.9	61.4
250,000	3.6	171.1	61.7
LSD (0.05)	0.1	1.9	1.1

Summary

Tillage with a vertical tillage tool was considered as a possible way to increase populations over no-till planting. As noted in Table 1, there were significant yield differences by tillage ($p = 0.0479$). The Turbo-Till vertical tillage tool produced greater yield than the no-till system. Plant stands were also slightly increased for the vertical tillage system, while a significant increase in plant number per acre this typically would not lead to a soybean yield increase. There were no differences in the lodging scores.

Table 3, takes an economic look at the impact of the use of the vertical tillage tool. Using a soybean price of $13 per bushel and a tillage cost price of $15.27[1], the net return for the soybean crop produced with the tillage showed an increased profit of $12 per acre - less than the equivalent of one bushel per acre. To summarize the value of the vertical tillage tool; while there was a statistically significant plant population and yield increase, there was little agronomic or economic reason for its use.

Table 3. Economic impact of tillage operation on net return per acre, London, Ohio 2013. Tillage cost is average of two rates[1].

Tillage	Yield (bu/A)	Tillage cost	Gross return ($/A)	Net return
No-till	57.2	na	$743.60	$743.60
Vert. till	59.3	$15.27[1]	$770.90	$755.63

Of greater interest was maintaining yield while reducing seed cost. The current Farm Science Review practice is to plant 155,000 seeds per acre. As shown in Table 2, increasing seeding rates did significantly increase yield ($p < 0.0001$). Comparing the 150,000 seeding rate to higher and lower seeding rates indicates that, yes, we can improve our yield by increasing the seeding rate and there would likely be a yield loss with a lowering of seeding rates. Plant lodging increased significantly with increasing seeding rates. In this trial with a somewhat dry late season, lodging even at the highest level, with a score of 3.6, likely did not impact yield and did not slow harvest.

Taking a look at the economics of the seed costs, shown in Table 4, indicates that yes we can improve our net return per acre with a 200,000 seeding rate over 150 thousand seeds per acre – by $3 per acre. Making a change in a production practice for a $3 difference would seldom provide an agronomic value. There may be a case made that reducing the seeding rate to 100,000 seeds per acre would provide more economic and agronomic value with reduced handling costs, reduced interest cost, reduced wear and tear on mechanisms, etc. But maintaining a seeding rate around 150,000 seed per acre can be justified as a way to reduce risk when conditions for a greater stand loss may occur.

Table 4. Economic impact of seeding rate on net return per acre, London, Ohio 2013. Soybean price here is $13 per bushel.

Seeding rate (thou. sd/A)	Yield (bu/A)	Seed cost ($/Acre)	Gross ($/Acre)	Net return (less seed cost)
50	51.2	$20.36	$665.60	$645.24
100	57.4	$40.71	$746.20	$705.49
150	59.6	$61.07	$774.80	$713.73
200	61.4	$81.43	$798.20	$716.77
250	61.7	$101.79	$802.10	$700.31

Reference

[1]The farm custom rate charge used here for vertical tillage is $15.27 for 2013 as calculated by averaging the value from two state custom rate surveys:
Indiana - http://www.extension.purdue.edu/extmedia/ec/ec-130-w.pdf
Iowa - http://www.extension.iastate.edu/agdm/crops/pdf/a3-10b.pdf

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