Soybean response to management of corn residue quantities through removal, tillage, planter type and nitrogen application

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Introduction

Soybean growers in the northern climates are concerned about the effect of heavy amounts of corn residue on the performance of no-till soybean. Heavy amounts of corn residue on the soil surface may result in 1) delayed soil warming and plant development [1]; 2) reduced available nitrogen (N) for early plant growth due to elevated immobilization rates [2] and 3) interference with seed drill performance [3]. Due to the environmental benefits attributed to NT and reduced till, it is imperative that residue management strategies be investigated to ensure the continued use of these systems.

Figure 1. Soybean plants growing through corn residue relative to bare soil

Figure 2. Seeding soybeans with a John Deere 1560 no-till drill

Objectives

To evaluate soybean seed yield response to starter N fertilizer in varying tillage systems and levels of residue removal.
To evaluate soybean seed yield response to planter type under varying tillage systems and levels of residue removal.

Materials and Methods

Two, three-way factorial experiments were conducted across two locations in mid-Western ON, Canada in both 2011 and 2012. The trial was designed as a split-split block, with tillage (NT, Fall RTS (2X), Fall and Spring RTS, Stalk chop + NT, Fall disk with spring cultivate, Fall disk and cultivate, Moldboard plow, *Spring RTS (2X), *Stalk chop + Fall and Spring RTS, and *Fall disk ripper with spring cultivate) as the main effect, residue removal (No removal (NR), Intermediate removal (IR) and Nearly complete removal (NCR)) as the sub-plot effect and either planter type (drill vs. row unit) or starter nitrogen (0 kg/ha vs. 56 kg N/ha) sown with the row unit as the split-split plot effect. (*indicates tillage treatments used in the nitrogen comparison.)

Figure 3. Kearney row unit planter used for seeding the plots

<u>Field Measurements</u>

-Surface residue assessment
-Soil moisture and temperature
-Plant development
-Population
-Nodulation assessment
-Soil nitrate
-Yield components and yield

Statistical analysis: An ANOVA was generated with proc mixed in SAS version 9.3. Two models were implemented to separately evaluate the plots with nitrogen or planter type effects. LSMEANS were computed using Tukey's Multiple Range Test (α=0.05)

Results and Discussion

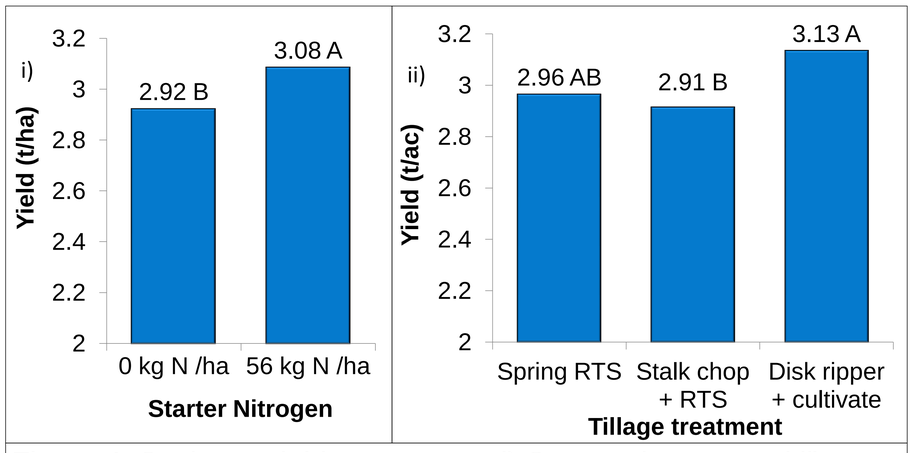

Figure 4. Soybean yield response to i) Starter nitrogen and ii) Tillage systems, from 4 locations in Ontario, Canada, 2011 and 2012. (Yields with same letter are not significantly different according to a Tukey's Multiple Range Test, α=0.05)

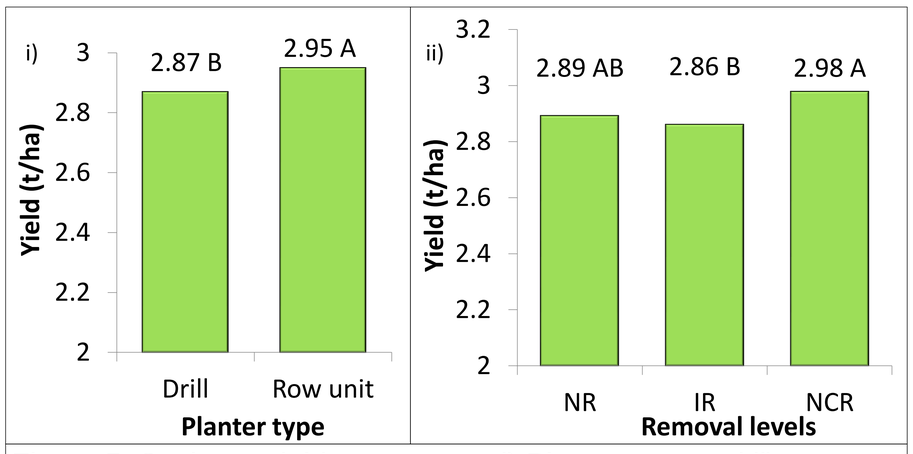

Figure 5. Soybean yield response to i) Planter type and ii) corn residue removal, across 4 locations in Ontario, Canada, 2011 and 2012. (Yields with same letter are not significantly different according to a Tukey's Multiple Range Test, α=0.05)

Figure 6. Soybeans in stalk chopped and RTS'd ground with (right) and without (left) nitrogen fertilizer

Figure 7. No-till soybean plants in no residue removal (left) versus nearly complete removal (right)

<u>Nitrogen model results</u>

-Soybean seed yield responded positively to nitrogen fertilizer, increasing yield by 5.6% (p=0.0022). As depicted in Figure 6. plots applied with N appear more lush and darker green than those without N.

-Soybean yield in the reduced till system was equivalent to the disk ripper treatment.

-Although stalk chopping may have facilitated tillage operations, it did not improve yield

-Removing corn residue resulted in similar yields as NR in these three tillage systems

<u>Planter type model results</u>

-The planter increased yield by 2.8% (p=0.0388) over the drill

-As observed in Figure 7. soybean plant growth was visibly different between the NR and NCR levels. However Figure 5.ii) indicates that there was no significant yield difference between NR and NCR

-Soybean yields were not different between NT and CT. This may be attributed to late planting in 2011 and the dry growing season in 2012

Conclusion

Soybean performance was similar regardless of whether corn residues were managed through tillage or residue removal or both. However yields were improved through the use of a row unit planter and starter nitrogen. Therefore, it appears that residue is not limiting soybean yield; but rather limitations of seed placement with the drill and early season nitrogen availability are hindering soybean yield.

References

[1] Yusuf, R., Siemens, J., Bullock, D. 1999. Growth analysis of soybean under no-tillage and conventional tillage systems. Agron. J. 91(6):928-933
[2] Muhammad, W., Vaughan, S., Dalal, R., Menzies, N. 2011. Crop residues and fertilizer nitrogen influence residue decomposition and nitrous oxide emission from a Vertisol. Biol Fertil Soils 47:15 – 23
[3] Torbet, H., Ingram, J., Prior, S. 2007. Planter aid for heavy residue conservation tillage systems. Agron J. 99:478-480.

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