Tillage and Fertilization in Soybean: Are They Always Necessary to Increase Grain Yield?

Trial Objective

- Reduced tillage might benefit soybean production by helping with soil preparation and water management. Furthermore, adequate and balanced plant nutrition is a key factor in maximizing plant growth and grain yield. However, it is unclear if either tillage or fertilization is always needed to achieve higher soybean yields.
- This study aimed to evaluate the effect of tillage and fertilization on soybean grain yield.

Experiment/Trial Design

Location	Soil Type	Tillage Type	Previous Crop	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)	Row Spacing (inches)
Gothenburg, NE	Hord Silt Loam	Strip-till, No-till	Corn	5/22/23	9/29/23	90	120,000	30

- The trial design was a randomized complete block with four replications and three treatment factors:
  - » Tillage:
    - – Strip-till
    - – No-till
  - » Fertilization:
    - – Not fertilized
    - – Fertilized with nitrogen (N), phosphorus (P), sulfur (S), and zinc (Zn)
    - – Seed treated with cobalt and molybdenum (CoMo) + inoculant (I)
  - » Maturity Group:
    - – Each block had a different XtendFlex® soybean product with a maturity group rating of either 2.8 or 3.2.
- Soybean plants were fully irrigated throughout the growing season.
- One 0- to 8-inch depth composite soil sample per block was taken prior to fertilization on 5/4/2023 (Table 1).
- The trial was strip-tilled on 5/4/2023 according to treatments.
- Fertilized plots received 29 lb/acre N, 60 lb/acre P_2O_5, 25 lb/acre S, and 0.25 lb/acre Zn on 5/4/2023. Fertilizer was deep banded (9-inch depth) with a strip-till machine for strip-till plots and surface banded for no-till plots.
- Weeds were controlled uniformly across the study area.
- Plots were combine harvested and grain moisture content, test weight, and total weight data were collected. A Fisher's Least Significant Difference statistical analysis was performed.

Tillage and Fertilization in Soybean: Are They Always Necessary to Increase Grain Yield?

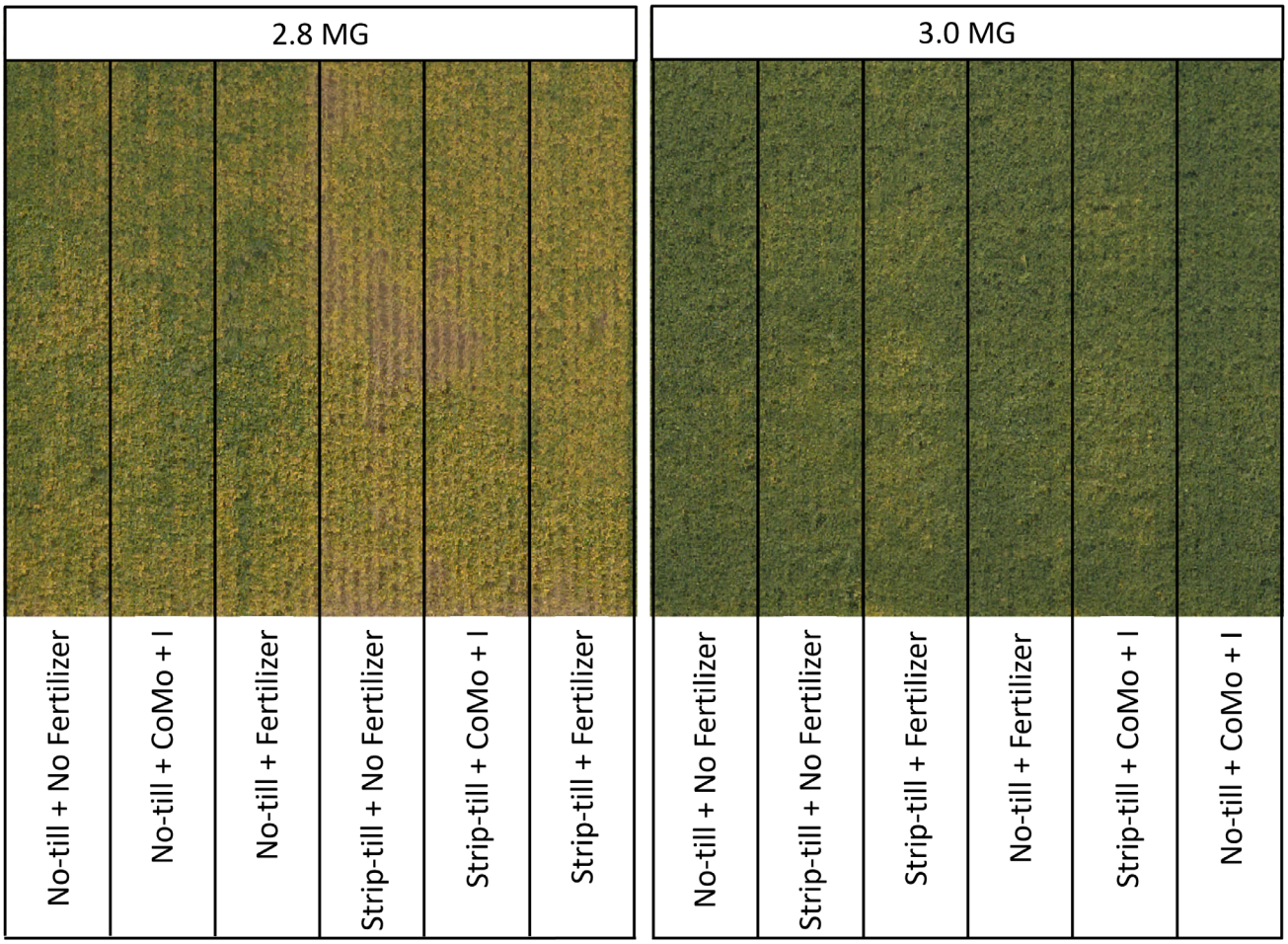


Figure 1. Aerial image from the soybean tillage and fertilizer trial in Gothenburg, NE. Picture taken on 09/15/2023.

Table 1. Soil sample results (0 to 8 inches).

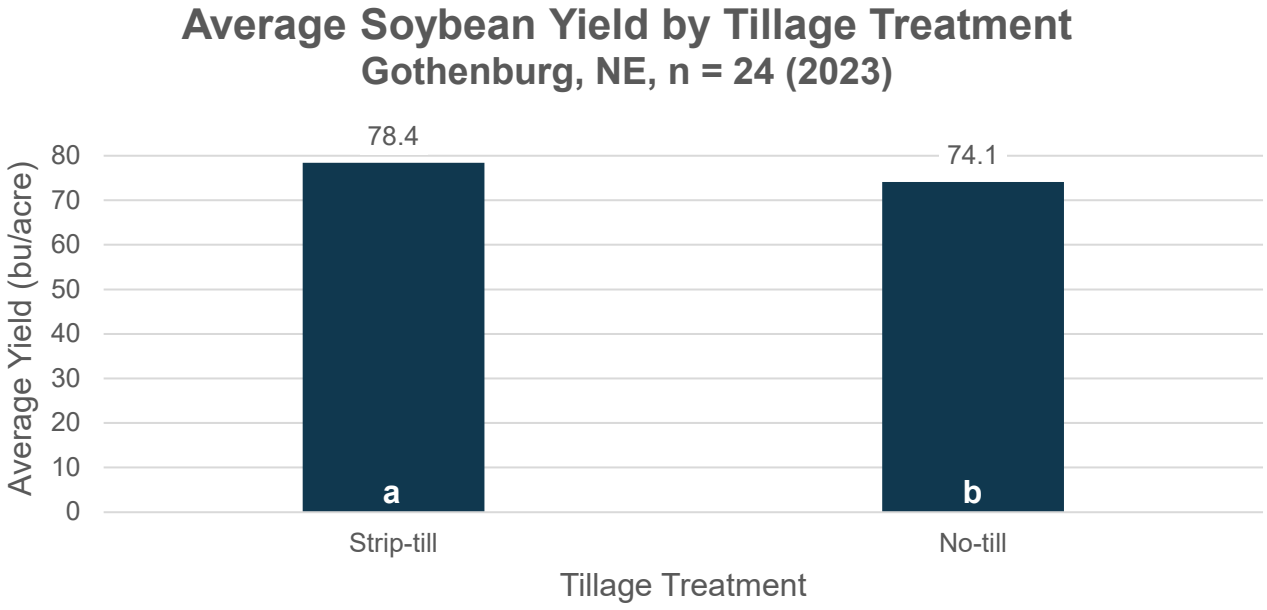
Soil Sample	Organic Matter LOI (%)	Nitrate-Nitrogen (ppm)	Phosphorus Mehlich-III (ppm)	Sulfate-Sulphur (ppm)	Zinc (ppm)
Rep 1	3.7	12.7	58	9.4	1.15
Rep 2	3.1	19.8	45	15.1	1.5
Rep 3	3.2	30	36	22.5	1.31
Rep 4	3.3	12.4	39	14.9	1.34

Tillage and Fertilization in Soybean: Are They Always Necessary to Increase Grain Yield?

Understanding the Results

Tillage – Figure 2

- The average soybean yield was 4.3 bu/acre higher under strip-till compared to no-till, regardless of fertilization.
- Soil compaction might be responsible for lower yields in no-till plots. Previous soybean experiments at this location have shown no tillage effect, or even higher yields under no-till when soil structure is not an issue.



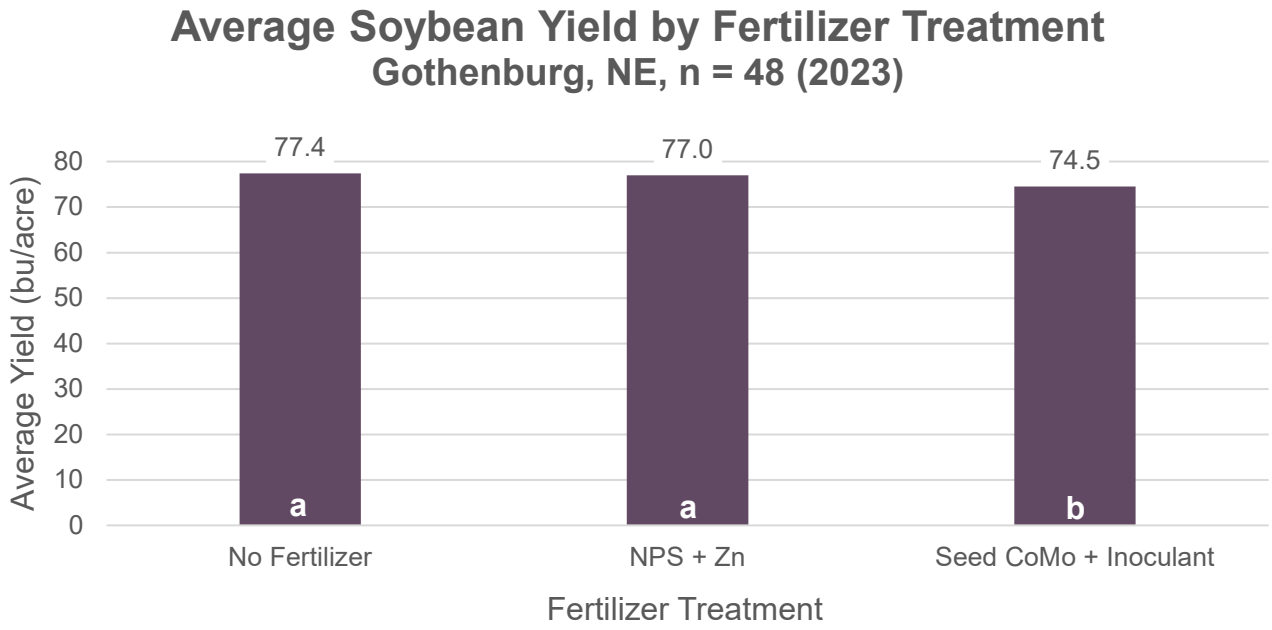
LSD (0.1) = 1.8

Figure 2. Average soybean yields as impacted by tillage at the Bayer Water Utilization Learning Center, Gothenburg, NE (2023).

Tillage and Fertilization in Soybean: Are They Always Necessary to Increase Grain Yield?

Fertilization – Figure 3

- Fertilization with NPS + Zn did not result in any significant difference in soybean yield. Based on state fertilization guidelines, nutrient concentrations for all reps (Table 1) were well above critical levels for soybean. No yield response is expected when additional fertilization is provided at these starting nutrient levels, and this outcome was seen in this trial.
- Soybean seed treated with CoMo + inoculant resulted in lower yields on average. Although the yield difference was relatively small compared to unfertilized plots (2.9 bu/acre), it was significant. Molybdenum toxicity might be responsible for the yield drop, but further research is needed.



LSD (0.1) = 2.2

Figure 3. Average soybean yields as impacted by fertilization at the Bayer Water Utilization Learning Center, Gothenburg, NE (2023).

Tillage and Fertilization in Soybean: Are They Always Necessary to Increase Grain Yield?

Key Learnings

- Reduced tillage, like strip-till, could be helpful in situations where soil structure is an issue. However, it is still important to consider the difference in costs when choosing strip-till over no-till.
- Soybean yields did not respond to combined nitrogen, phosphorus, sulfur, and zinc fertilization in this trial, regardless of tillage. The lack of yield difference was likely due to soil nutrient levels being well above critical levels for soybean production.
- Fertilization with cobalt and molybdenum + inoculant resulted in slightly lower soybean yields. Previous studies suggest this could be the result of molybdenum toxicity, but further investigation is needed.[1]

Sources

[1]Campo, R.J., Araujo, R.S., and Hungria, M. 2009. Molybdenum-enriched soybean seeds enhance N accumulation, seed yield, and seed protein content in Brazil. Field Crops Research. 110(3): 219–224. https://doi.org/10.1016/j.fcr.2008.09.001

Legal Statements

The information discussed in this report is from a single site, replicated trial. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

No dicamba may be used in-crop with seed with Roundup Ready® Xtend Technology, unless and until approved or specifically permitted, and no dicamba formulations are currently registered for such use in the 2024 season. Please follow https://www.roundupreadyxtend.com/pages/xtendimax-updates.aspx for status updates.

Bayer is a member of Excellence Through Stewardship® (ETS). Bayer products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Bayer's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. Commercialized products have been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all applicable regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Excellence Through Stewardship.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS.

It is a violation of federal and state law to use any pesticide product other than in accordance with its labeling. NOT ALL formulations of dicamba, glyphosate or glufosinate are approved for in-crop use with products with XtendFlex® Technology. ONLY USE FORMULATIONS THAT ARE SPECIFICALLY LABELED FOR SUCH USES AND APPROVED FOR SUCH USE IN THE STATE OF APPLICATION. Contact the U.S. EPA and your state pesticide regulatory agency with any questions about the approval status of dicamba herbicide products for in-crop use with products with XtendFlex® Technology.

Performance may vary, from location to location and from year to year, as local growing, soil and environmental conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on their growing environment.

The recommendations in this material are based upon trial observations and feedback received from a limited number of growers and growing environments. These recommendations should be considered as one reference point and should not be substituted for the professional opinion of agronomists, entomologists or other relevant experts evaluating specific conditions.

Products with XtendFlex® Technology contains genes that confer tolerance to glyphosate, glufosinate and dicamba. Plants that are not tolerant to glyphosate, dicamba, and/or glufosinate may be damaged or killed if exposed to those herbicides. Contact your seed brand dealer or refer to the Bayer Technology Use Guide for recommended weed control programs.