# Can we increase yield with adopting tile drainage in Fargo-Clay soil?

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## Background

Soil water management is a key to maintain and improve corn production and productivity. Soil aeration, compaction, nutrient loss, soil temperature, salt movement are key properties of soil for corn (*Zea mays*) and Soybean (*Glycine max* L.) production in Fargo Clay soil. Adoption of conservation practices can induce beneficial changes to soil properties. Installation of tile drainage system is huge investment that offers tremendous opportunity for increasing corn yield, but there is need of consideration of tillage and crop rotation for reducing nutrient loss and soil compaction.

## Objectives

- Determine the effect of different tillage practices and tile drainage and crop rotation on corn and soybean yield.
- Compare corn, soybean and sugarbeet yield under different tile spacing and depth combination.
- Measure water table depth (cm), volumetric water content, soil temperature in response to different tile depth and spacing of tile drainage.

## Methods

This on-farm experiment is located at Casselton, North Dakota (N 46°49'23 .7972", W 97°13' 4.949") on Fargo silty clay soil type. Tile drains were installed on 2013.

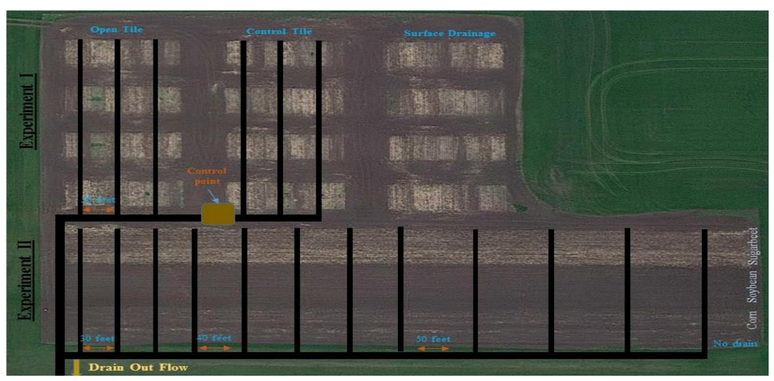


*Figure 1. Tile drain line for Experiment I and II.*

*Table 1. Basic soil properties of experimental site*

| Soil properties | |
|---|---|
| pH | 6.4 |
| EC (ds $m^{-1}$) | 0.7 |
| $NO_3$-N (lb/ac)-2 feet | 19 |
| Olsen-P (ppm) | 48 |
| K (ppm) | 470 |
| Ca (ppm) | 4720 |
| Mg(ppm) | 900 |
| Na (ppm) | 14 |
| CEC (Meq/100g) | 29.6 |

## Experiment-I. Interactive effects of tile drainage, tillage and crop rotation

Three drainage systems, (1) surface drained only (SD), (2) open-tile (OT)-without control box), and (3) control-tiled (CT) - with control box, were placed in three strips, as main plot. Under each strip, two rotations, (1) continuous-corn (CC) and (2) corn-soybean (CS), were randomized as sub-plot, and under each sub-plot, three tillage practices, (1) chisel (CH), (2) strip-till (ST), and (3) no-till practices (NT) were randomized with four replications. Corn and soybean were planted every year. Three drainage treatments were 30-feet apart. Individual plot size is 30-feet by 11 feet wide with 22-inch row spacing. Recommend fertilizer and cultural management practices were followed. Fertilizers were applied in fall.

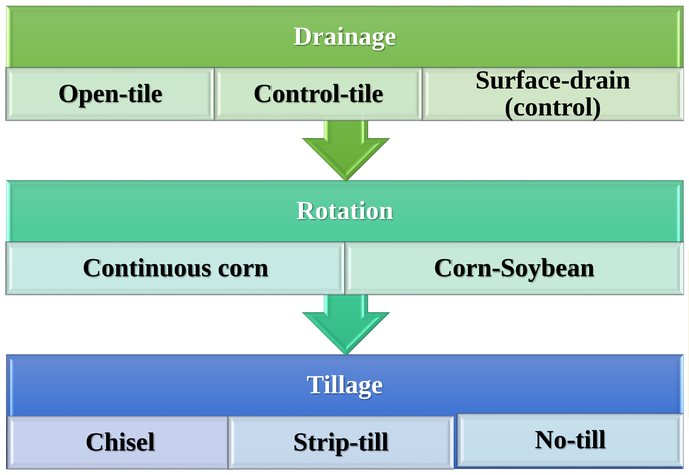


*Figure 2. Treatment layout for experiment I- Interactive effect of drainage, crop rotation and tillage practice.*

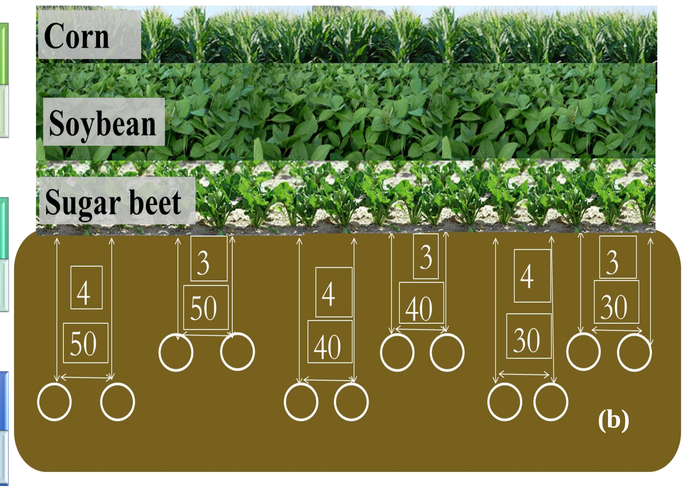


*Figure 3. Treatment layout for experiment II- Tile spacing and depth combination for three crops.*

## Experiment II. Tile depth and spacing combinations

Corn-sugarbeet-soybean rotation were followed along three strips. Under each strip, we have 4 replications of six rows (22 inch row spacing). Two tile lines were installed at three tile spacing, 30-, 40-, and 50-feet and at two depths, 3-feet and 4-feet. Only surface-drained plot (control) of 50-ft long was laid out at the end of each strip.

## Results

***Experiment I***

**Table 2. Main plot (Tile), sub plot (rotation) and sub-sub plot (tillage) and their interaction effect on yield (Mg $ha^{-1}$) at 95% significance level during 2015-2016**

| Effect | Corn | | Soybean | |
|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 |
| Tile | 0.0233* | NS | 0.0168* | NS |
| Rotation | <.0001* | <.0001* | --- | --- |
| Tile*Rotation | 0.0034* | NS | --- | --- |
| Tillage | NS | 0.0002* | NS | 0.0281* |
| Tile*Tillage | 0.0002* | NS | NS | NS |
| Rotation*Tillage | 0.0047* | NS | --- | --- |
| Tile*Rotation*Tillage | 0.0023* | 0.0209* | --- | --- |

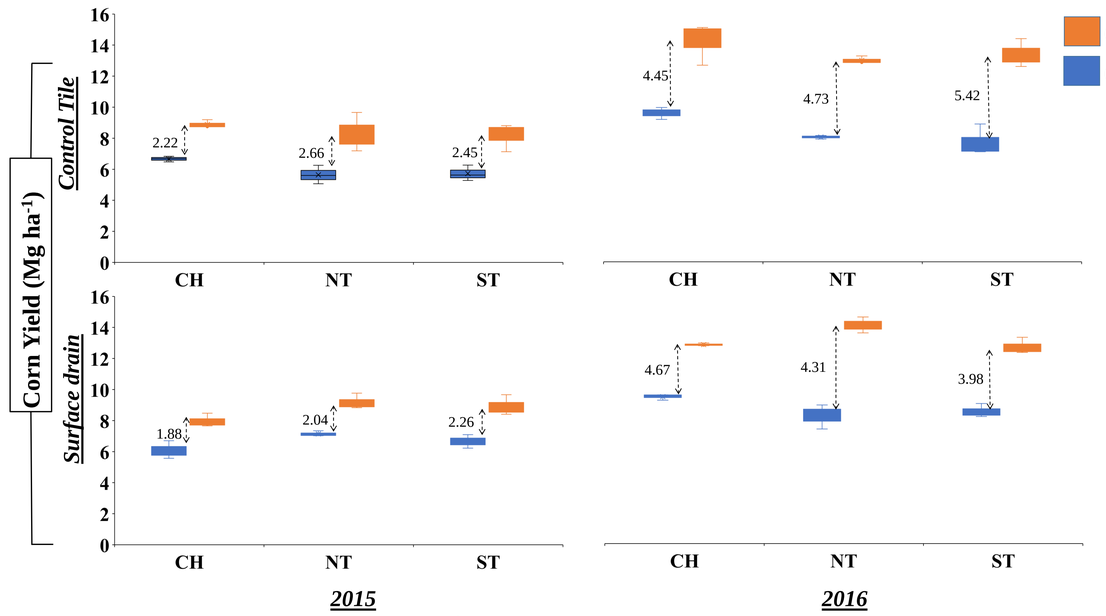


*Figure 4. Corn yield difference (Mg $ha^{-1}$) between continuous corn and corn soybean rotation under different drainage (open, control and surface drain) and tillage practices (chisel, strip and no-till) in year 2015 and 2016.*

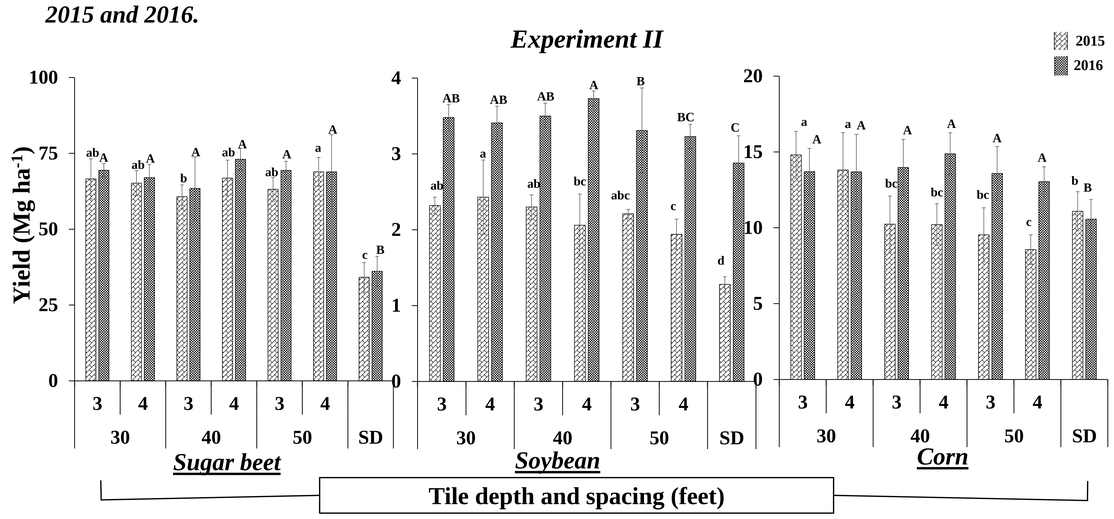


*Figure 5 . Effect of different tile spacing (30-, 40- and 50-ft) and spacing (3- and 4-ft) on sugar beet, soybean and corn yield (Mg $ha^{-1}$) during 2015-16 growing season. Different capital letters indicate significant difference in means for particular year.*

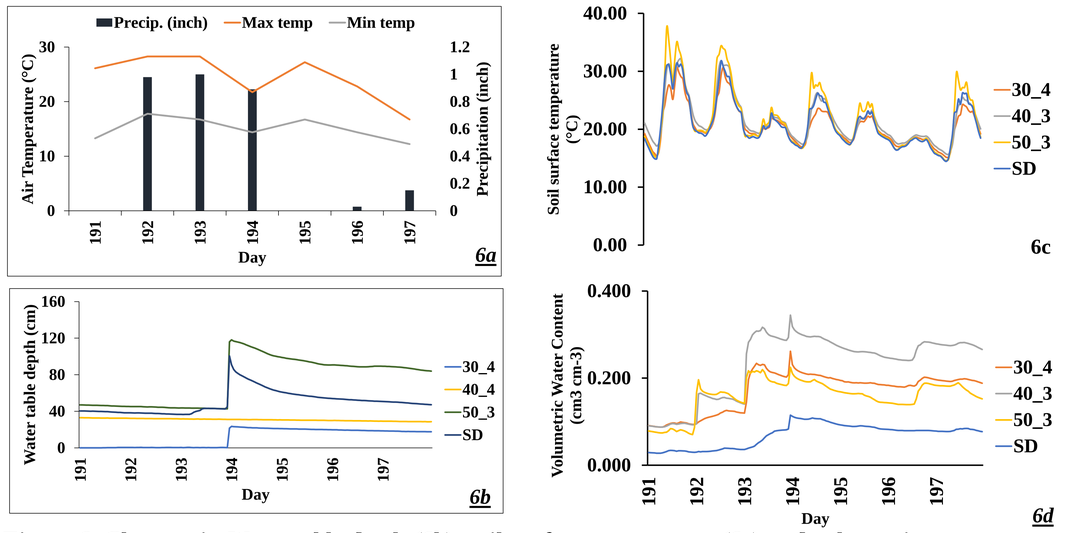


*Figure 6. Changes in Water table depth (6b), soil surface temperature (6c) and volumetric water content (6d) at different tile depth and spacing for corn after rainfall in certain period of time (6a) for 2016 (8 days).*

## Conclusion

***Experiment I***

- Tile*rotation*tillage had significant impact on corn yield for both years. Tile with CS rotation under strip tillage recorded substantially higher corn yield than other combination.
- Corn yield with CS was significantly higher than CC under strip-till for 2015-16. Tile drainage following strip-till and CS rotation can be recommended in Fargo clay soil without compromising soybean yield.

***Experiment II***

- Tile spacing and depth had significant effect on sugarbeet, soybean and corn yield for 2015-16. Sugarbeet recorded highest yield under 4-ft tile depth irrespective of spacing whereas soybean yield noted highest under 30-ft spacing regardless of depth. Corn yield showed no response in different tile depth and spacing.
- Comparatively seasonal volumetric water content increased with decreasing tile spacing whereas surface temperature respond inversely. The rate of water drained after rainfall was higher in close (30-ft) spacing compare to wide (50-ft) spacing and lower depth (3-ft).