Subsurface Drainage Effect on Soybean Yield in Clay Soils

Aaron Hoppe (aaron.hoppe@my.ndsu.edu) **and Hans Kandel**
Department of Plant Sciences, North Dakota State University, Fargo, ND 58105

Introduction

- Soil waterlogging decreases the oxygen necessary for plant root growth.
- Soybean [*Glycine max* (L.) Merr.] undergoes negative physical and chemical changes in the plant during soil waterlogging.
- Optimum growth and yield can be significantly reduced.
- Subsurface (tile) drainage can alleviate excess water stress to the plant.

Objectives

- To determine the subsurface drainage effect on soybean plant vigor, iron deficiency chlorosis, percent canopy closure, plant height, and seed yield.
- To determine if foliar-applied fungicide has an effect on percent canopy closure, plant height, and seed yield.

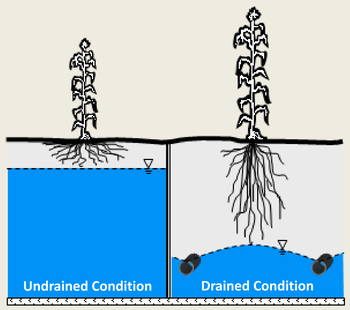

Figure 1. Root growth is found to be greater under drained soil conditions compared with undrained conditions. (Figure from Sands, G. 2001).

Materials and Methods

- Research was conducted at the Northwest 22 (NW22) location near Fargo, ND (Lat. N 46˚55', Long. W 96˚51'), in 2011.
- Experimental design was a randomized complete block with a split-split plot arrangement and four replicates.
- Main plots were with and without subsurface drainage.
- Subplots were with and without foliar-applied fungicide (23.6% pyraclostrobin at a rate of 110 g a.i. ha^{-1} at the R3 growth stage).
- Sub-sub plots were soybean cultivars.
- Ten soybean cultivars were selected based on differences in tolerance to excess moisture conditions and resistance to iron deficiency chlorosis.
- Data were collected for vigor, iron deficiency chlorosis, canopy closure, yield, and height for all treatments.

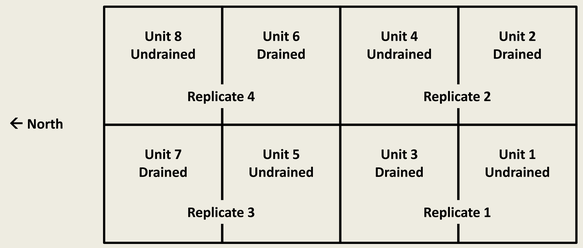

Figure 2. NW22 field research layout with four units having subsurface drainage and four units undrained.

Table 1. Vigor scores, iron deficiency chlorosis, canopy closure, and heights of soybean within drainage treatments near Fargo, ND, in 2011.

	Vg1†	Vg2‡	IDC§	CC¶	H#
	----------1-9---------		---1-5---	---%---	---cm---
Undrained	5.8	5.9	1.6	62.4	63.8
Drained	7.0	7.2	1.5	79.5	73.3
LSD (0.05)	NS	0.7	0.1	10.2	6.9

†Vg1 = first vigor score was visually based with 1 being least vigorous and 9 being most vigorous.
‡Vg2 = second vigor score was visually based with 1 being least vigorous and 9 being most vigorous.
§IDC = iron deficiency chlorosis was visually based with 1 being least chlorotic and 5 being most chlorotic.
¶CC = canopy closure was visually based showing percent of plant coverage between each planted row.
#H = heights at physiological maturity were measured from the ground surface to the top leaf of the plant.

Figure 3. Drained plot area on 27 June, 2011, after 6.4 cm of rain.

Figure 4. Undrained plot area on 27 June, 2011, after 6.4 cm of rain.

Table 2. Vigor scores, iron deficiency chlorosis, canopy closure, and heights of soybean within fungicide treatments near Fargo, ND, in 2011.

	Vg1†	Vg2‡	CC§	H¶
	----------1-9---------		---%---	---cm---
No Fungicide	6.2	6.4	69.4	68.1
Fungicide	6.6	6.7	72.4	69.0
LSD (0.05)	NS	NS	NS	NS

†Vg1 = first vigor score was visually based with 1 being least vigorous and 9 being most vigorous.
‡Vg2 = second vigor score was visually based with 1 being least vigorous and 9 being most vigorous.
§CC = canopy closure was visually based showing percent of plant coverage between each planted row.
¶H = heights were measured at physiological maturity from the ground surface to the top leaf of the plant.

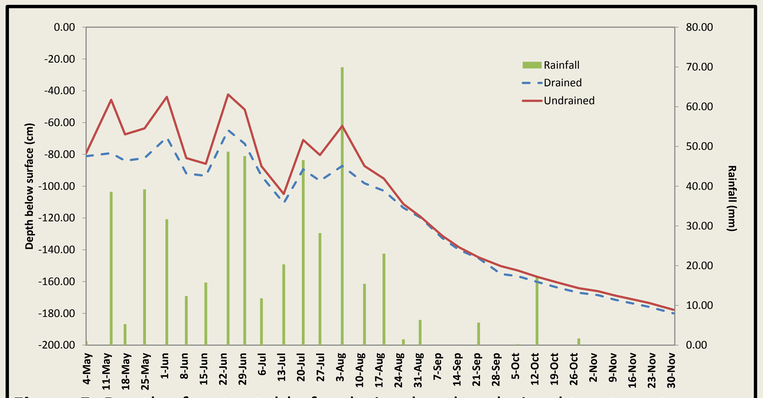

Figure 5. Depth of water table for drained and undrained treatments as affected by rainfall during the 2011 season. Tile depth is at -90 cm.

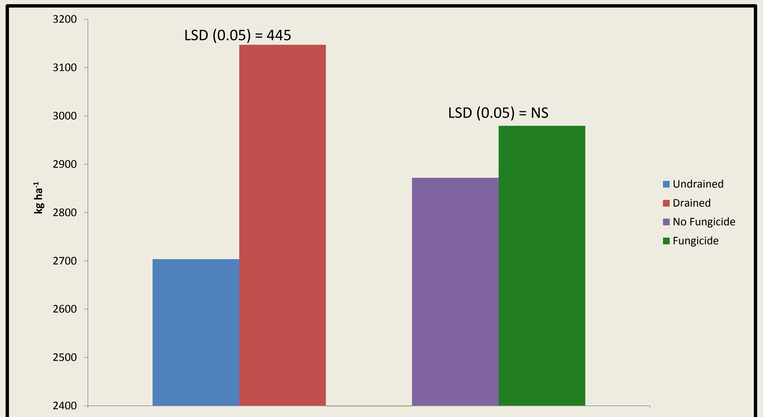

Figure 6. Soybean yield response to drainage and fungicide treatments when averaged across all cultivars.

Results

- Soybean yield was significantly (17%) higher on drained treatments compared to undrained treatments.
- Application of foliar fungicide had no effect on yield.
- No significant interaction between cultivars with drainage or fungicide application was observed.

Conclusions

- Soybean grown on plots with subsurface drainage had increased yields.
- Foliar-applied fungicide had no effect on yield.

Acknowledgement

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References

- Sands, G. 2001. Soil Water Concepts. Ext. Bull. Bu-07644-S. Univ. of Minnesota.
- Ricard, B., I. Couee, P. Raymond, P.H. Saglio, V. Saint-Ges, and A. Pradet. 1994. Plant metabolism under hypoxia and anoxia. Plant Physiol. Biochem. 32:1-10.