# Yield Response Of IDC Tolerant And Susceptible Soybean Varieties To Fe Fertilization In Marginally Fe-Deficient Soils Following Simulated Flooding


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## INTRODUCTION

- Iron (Fe) is essential for different plant metabolic components (e.g., several enzymes and chlorophyll) associated with biological N fixation, respiration, and photosynthesis.
- Iron deficiency chlorosis (IDC) is an abiotic stress that can reduce soybean yield. Symptoms are interveinal chlorosis and/or brown necrotic patches on young leaves (V1-V3 stage; Figs. 1a and b).
- Flooding of soils can induce IDC by increasing soil bicarbonate levels, which neutralize the organic acids released by plant roots that are intended to increase soil Fe availability and uptake.

## OBJECTIVE

- Examine the effect of soil flooding on the growth of two soybean varieties, differing in their IDC tolerance, in two IDC prone soils, with and without varying rates, forms, and application methods of Fe fertilizer.

## MATERIALS & METHODS

- A four-factor (variety, Fe fertilizer, soil type, and soil moisture) factorial pot study experiment was used, set up in a completely randomized design, with four replicates. Two soybean varieties used: McLeod (IDC tolerant) and Moosomin (IDC susceptible). The Fe fertilizer treatments varied in rate (0.1, 0.25, and 5 kg Fe/ha), form (salt and chelated), and application method (seed-placed and foliar applied at the V2-V3 growth stage).
- Orthic Dark Brown (O.DBC; silt loam; 2% OC) and Black (O.BLC; loam; 5% OC) Chernozems were used, having similar E.C. (0.7 mS/cm), pH (7.5), and extractable levels of 20 mg/kg $NO_3^-$-N and 18 mg/kg Fe (DTPA).
- The soil moisture treatments included growing soybeans at field capacity with and without a three-day saturation period (at the V2-V3 growth stage), to simulate flooding following a significant June rainfall event (Fig. 1c).
- Variables: soybean grain and straw yield (this poster); plant uptake of Fe.

## RESULTS & DISCUSSION

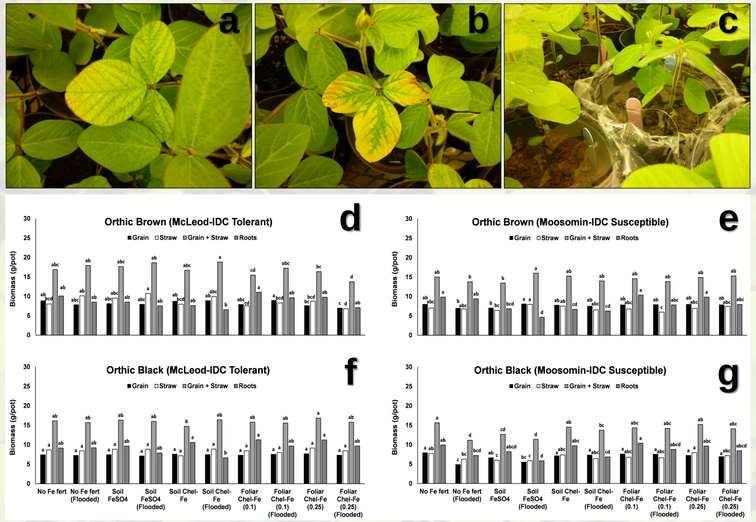


*Figure 1. The growth of two soybean varieties (differing in IDC tolerance) on two Chernozemic soils (differing in organic matter content), with and without a three-day flooding event (at the V2-V3 growth stage) and Fe fertilizer addition varying in rate, form, and application method. The Fe fertilizer treatments included seed-placed Fe sulphate or chelated-Fe (5 and 0.25 kg Fe/ha, respectively) or foliar application of chelated-Fe (0.1 kg and 0.25 kg Fe/ha). For each variety and variable, columns with the same letter are not significantly different (P >0.05) using LSD.*

- Regardless of soil type, there were minor and variable effects of the different Fe fertilization practices, with or without flooding, on the above-ground growth of either soybean variety (Figs. 1d-g and Table 1).
- Flooding alone decreased Moosomin (IDC susceptible) grain yield 26% on the O.BLC. Fertilization of Moosomin with soil or foliar applied chelated-Fe increased grain and straw yield on the flooded O.BLC soil (Fig. 1g).

**Table 1. ANOVA summary comparing the effect of varying the rate, form, and application method of Fe fertilizer on the growth of two soybean varieties, differing in their sensitivities to IDC, with and without a three-day simulated flooding event.**

| | Grain Yield | Straw Yield | Total Biomass | Harvest Index | Root Biomass |
|---|---|---|---|---|---|
| Effect | | | *P-value* | | |
| Soil | <0.0001* | 0.2921 | <0.0001 | **0.0026** | **0.0118** |
| Variety | <0.0001 | <0.0001 | <0.0001 | **<0.0001** | **0.0029** |
| FeFert | 0.0054 | 0.1291 | 0.8808 | 0.0012 | **<0.0001** |
| Flood | 0.0139 | 0.8277 | 0.2762 | 0.1009 | **<0.0001** |
| Soil*Variety | 0.8035 | 0.6659 | 0.8335 | 0.5596 | 0.5507 |
| Soil*FeFert | 0.2016 | 0.0798 | 0.0037 | 0.5665 | 0.1113 |
| Soil*Flood | 0.0868 | 0.0525 | 0.0177 | 0.7573 | 0.4359 |
| Variety*FeFert | 0.0258 | **0.0116** | 0.0017 | 0.5597 | 0.2296 |
| Variety*Flood | 0.1641 | **0.0338** | 0.0186 | 0.5367 | 0.7571 |
| FeFert*Flood | 0.0004 | 0.1396 | 0.0317 | **0.0262** | 0.8791 |
| Soil*Var*FeFert*Flood | **0.0193** | 0.1135 | **0.0224** | 0.4910 | 0.7902 |

[a]Significant (*P* <0.05) effects are highlighted in bold. If there are significant interaction effects, then main effects are ignored.

- Foliar Fe did not affect root growth; however, seed-placed Fe (salt or chelated), with or without flooding, decreased root growth by 25% (Fig. 1), which may be a symptom of Fe toxicity, particularly in saturated soil.
- The growth response to Fe fertilizer was influenced by variety (IDC tolerant not responsive), soil type (O.BLC responsive), and fertilizer form (chelated > salt). There was no effect of increasing rate. The DTPA extractable Fe was not able to distinguish differences in response between the two soils.

## CONCLUSION

- With the exception of Moosomin (IDC susceptible) growing on the flooded O.BLC, the Fe fertilizer treatments had limited effects on the grain yields of either soybean variety.
- Seeding an IDC tolerant variety or foliar application of chelated-Fe only to areas affected by flooding are suggested IDC mitigation options.


## ACKNOWLEDGEMENTS

- We are grateful to ADF for the funding, along with the logistical support provided by J. Anderson, B. Barlow, C. Fatteicher, R. and R. Hangs, S. Roberts, and L. Rudd.