Effect of Boron Fertilization on Yield of Canola Following Wheat and Pea on Fourteen Prairie Soils

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INTRODUCTION

- Boron (B) is an essential micronutrient involved in many aspects of plant growth (e.g., cell membranes, hormone metabolism, and reproduction).
- Canola is the prairie field crop for which B fertilizer recommendations are most commonly made.
- Sometimes other micronutrients, such as copper (Cu) and zinc (Zn), are applied to cereals and pulses preceding the canola crop. However, little is known regarding the possible interaction(s) of residual fertilizer Cu and Zn with applied B.

OBJECTIVE

- Examine the effect of different rates and application methods of B fertilizer on yield of canola grown in diverse prairie soils with, and without, residual soil Cu and Zn from fertilization of preceding wheat and field pea crops.

MATERIALS & METHODS

- A four-factor (soil type, Cu and Zn fertilizer applied to preceding crops, and B fertilization) factorial experiment was arranged in a CRD, with 4 reps.
- Fourteen soils (12 mineral and 2 organic) were collected from Alberta, Saskatchewan, and Manitoba; representing the diversity of arable soil types in the prairies, along with varying initial available soil B levels.
- Canola (*Brassica napus*; InVigor® L252) was seeded and grown to maturity in the greenhouses located at the U of S research facility on Preston Avenue.
- Nine fertilizer treatments applied to canola: unfertilized Control; boric acid banded (1 and 0.5 kg B/ha; mineral and organic soils, respectively) or foliar applied (0.25 kg B/ha; at flowering stage); residual banded $CuSO_4$ or chelated-Cu (5 and 1 kg Cu/ha, respectively) applied to wheat; banded boric acid in combination with residual banded $ZnSO_4$ (2.5 kg Zn/ha) or chelated-Zn (0.5 kg Zn/ha) applied to field pea; banded boric acid with, and without, residual banded $CuSO_4$ and $ZnSO_4$.
- Fertilizer N, P, K, and S were applied to all pots to prevent any deficiencies.
- Measurement variables: canola grain and straw biomass.

RESULTS & DISCUSSION

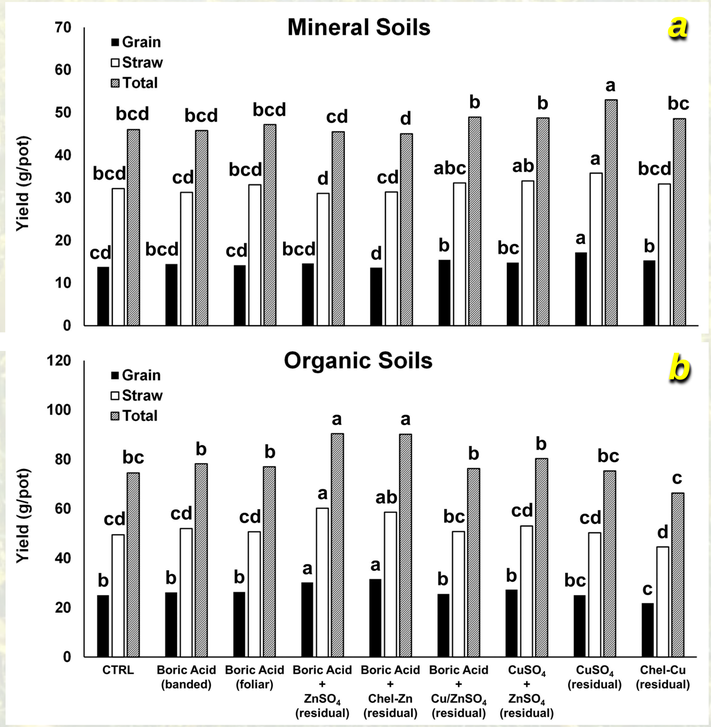

Figure 1. Mean above-ground canola yield components, following boron (B) fertilization with, and without, residual copper (Cu) and zinc (Zn) fertilizers from the previous two years, when grown to maturity in 12 mineral soils (a; n=48) and 2 organic soils (b; n=8) within a greenhouse. Boric acid was either banded (1.0 and 0.5 kg B/ha, depending on soil type) or foliar applied (0.5 kg B/ha; at flowering stage). Residual Cu and Zn banded fertilizers consisted of $CuSO_4$, $ZnSO_4$, along with chelated Cu and Zn (0.5 to 5 kg/ha, depending on the form and soil type). For each component, bars with the same letter are not significantly different (P >0.05) using LSD.

- The average hot water extractable (HWE) B level of the 14 soils (1.1 mg B/kg) was above the soil test critical level (0.4 mg B/kg), which is consistent with the lack of overall canola growth response to added B fertilizer (Fig. 1).
- Canola yield response to B fertilization is often inconsistent and difficult to predict. Likewise, in our study, grain yield increased as much as 37% on two sandy (fine sand/sandy loam) acidic (pHs of 5.6/6.4) mineral soils with low organic matter content (< 2%), along with HWE B levels close to the critical level (0.5/0.4 mg B/kg). However, canola growing on three similar soils, with lower initial B levels (< 0.4 mg B/kg), showed no response.
- Foliar B, applied as boric acid, was ineffective (Fig. 1); possibly due to B immobility in the plant tissue.
- Residual Cu fertilizer (especially the chelated form), applied to the wheat crop two years ago, had small but significant contrasting effects on the grain yield of canola (Fig. 1): increased yields with mineral soils (18%; probably due to root disease inhibition) and decreased yields with organic soils (24%; likely related to reduced Zn supply; data not shown).
- Residual Zn fertilizer (both forms), from field pea fertilization the previous year, increased canola yield on the organic soils in combination with B (Fig. 1b).

CONCLUSION

- Soil properties and a HWE index of soil B availability appear to be of some value in predicting canola yield response to fertilizer B. Canola grown on two sandy, acidic mineral soils with low organic matter and low HWE B levels responded positively to banded B.
- The observed contrasting beneficial and deleterious effects of Cu fertilizer applied for the preceding crop grown (mineral and organic soils, respectively), and positive response to residual Zn (organic soils), merit further investigation.

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