The Effect Of Zinc Fertilizer Rates, Forms, And Application Method On Field Pea Growth In A Range Of Prairie Soils

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INTRODUCTION

- Zinc (Zn) is an essential nutrient for many plant metabolic components: enzymes, proteins, chlorophyll, growth hormones, and cell membranes.
- Cream-coloured necrosis on pea leaf margins indicates a Zn deficiency.
- Sometimes Zn is applied to pulse crops within a rotation in western Canada, however, little is known regarding the possible interaction of different soil applied Zn fertilizers with other micronutrients, such as banded copper (Cu) for a previous cereal crop.

OBJECTIVE

- Examine the effect of different rates, forms, and application methods of Zn fertilizer on the yield and Zn uptake of field pea grown in a variety of prairie soils, with and without residual soil Cu fertilizer from a prior wheat crop.

MATERIALS & METHODS

- A three-factor (soil type, Zn and residual Cu fertilizers) factorial experiment was arranged in a completely randomized design, with four replicates.
- Fifteen soils (12 mineral and 3 organic) were collected from Alberta, Saskatchewan, and Manitoba; representing the diversity of arable soil types in the prairies, along with varying initial available soil Zn levels.
- Field pea (*Pisum sativum*; CDC Sage) was seeded and grown to maturity.
- Eight fertilizer treatments: unfertilized Control; two foliar applications of 0.25 kg Zn/ha (either $ZnSO_4$ or chelated-Zn; applied at flowering); two banded applications of either $ZnSO_4$ or chelated-Zn (rates of 2.5 and 0.5 kg Zn/ha, respectively); residual banded $CuSO_4$ and chelated-Cu (5 and 1 kg Cu/ha, respectively); and banded $ZnSO_4$ + residual banded $CuSO_4$.
- Fertilizer N, P, K, and S applied to all pots to prevent any deficiencies.
- Measurement variables: pea yield (grain and straw), tissue Zn concentration and uptake (grain and straw).

RESULTS & DISCUSSION

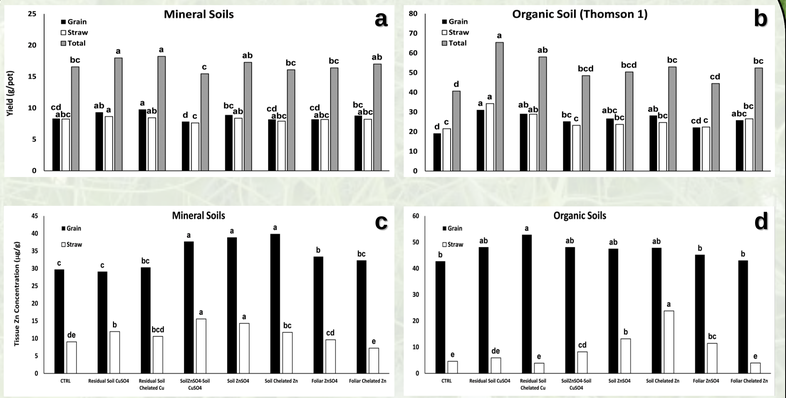

Figure 1. Mean (n = 4) field pea yield and tissue zinc (Zn) concentration in above-ground yield components, with and without the addition of Zn fertilizer and residual copper (Cu) fertilizer from the previous year, when grown to maturity in 12 mineral soils and 3 organic soils within a greenhouse. The Zn and Cu fertilizer treatments consisted of either banded $ZnSO_4$, $CuSO_4$, and chelated-Zn and Cu (0.5 to 5 kg/ha, depending on form and soil type) or foliar applications of $ZnSO_4$ or chelated-Zn (0.25 kg Zn/ha; applied at flowering stage). For each component, bars with the same letter are not significantly different (P >0.05) using LSD.

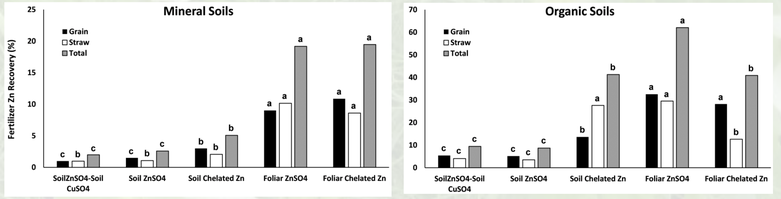

Figure 2. Mean (n = 4) percent zinc fertilizer recovery in above-ground yield components of field pea when grown to maturity in 12 mineral and 3 organic soils within a greenhouse. See Fig. 1 caption for treatment details. For each component, bars with the same letter are not significantly different (P >0.05) using LSD.

- The average extractable Zn level of the soils used was above the critical level (1.5 and 0.5 mg Zn/kg, respectively); consistent with the lack of pea growth response (any yield component) to added Zn fertilizers observed with the mineral soils (Fig. 1a) and two organic soils (data not shown).
- However, for one organic soil (Thomson 1), banded Zn (sulfate or chelated) and foliar chelated-Zn fertilizers did increase grain yield (Fig. 1b); explained by a lower extractable Zn amount and greater carbonate content.
- Interestingly, residual Cu fertilizer (sulfate or chelated) from the previous wheat crop increased pea grain yield on the mineral soils and one organic soil (Figs. 1a and b). Pea is tolerant of low soil Cu levels, but this could be related to the fungicidal properties of Cu to suppress root disease.
- Although the residual $CuSO_4$ did not affect $ZnSO_4$ recovery, the peas growing with residual $CuSO_4$ + $ZnSO_4$ in mineral soil had less biomass compared to $ZnSO_4$ alone. Negative Cu-Zn interactions were also reported in wheat under low P conditions (Rahman, 2017; Soils & Crops Poster).
- Soil banded Zn fertilizer was generally more effective at increasing the Zn concentration of pea grain and straw compared to foliar applied Zn (Figs. 1c and d), but rates of soil applied Zn were greater than foliar application.
- The Zn fertilizer recovery by pea ranged from 2-62% (Fig. 2), with greater recovery in foliar applications vs. soil banding; due to lower rates and lack of fixation by soil components. Greater recoveries of banded chelated vs. sulfate forms, primarily reflect differences in rates and fixation potential.

CONCLUSION

- With the exception of an organic soil, the Zn fertilizer treatments had limited effects on pea yield, due to adequate soil Zn fertility. Observed beneficial effects of Cu applied for wheat the previous year, coupled with a negative interaction between Cu and Zn, merit further investigation.

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