Response of canola to seed-placed liquid ammonium thiosulfate and ammonium polyphosphate

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INTRODUCTION

Canola has a relatively high requirement for sulfur because of its high content of sulfur containing proteins and deficiencies can reduce crop yields and oil production. Excess application of fertilizer can negatively affect seedling development and emergence, through ammonia toxicity and/or osmotic damage if placed too near the seed (O'Donovan et al., 2008). Canola seedlings are much more sensitive to seed-placed fertilizer than other crops such as wheat (Qian and Schoenau, 2010). Sulfur was applied as ammonium thiosulfate (ATS). ATS contains 12% N and 26% S. When applied to soils, ATS cannot be directly utilized by the plant but converts to sulfate rapidly in the soil so is quickly available for plant uptake. Phosphorus was applied as ammonium polyphosphate (APP) solution (10-34-0). APP contains both orthophosphates and polyphosphates. Studies have shown that when ATS was banded in direct contact the seed, germination and seedling damage occurred. However, there is little information on relative tolerance of canola to combinations of seed-row placed liquid sulfur and phosphorus fertilizer banded to the side of the seed.

OBJECTIVES

The objectives of this research were to determine the effects of seed-placed ammonium thiosulfate (ATS) and ammonium polyphosphate (APP) fertilizer on *Brassica* species emergence under controlled-environmental conditions.

MATERIALS AND METHODS

Two canola *Brassica napus* L. (cv. 5770 LL, 45H26 RR), one *Brassica rapa* L. (cv. ACS-C18), and one canola quality *Brassica juncea* (cv. 8571) cultivars were selected for this study. Tray experiments were conducted using a phosphorus-deficient Brown Chernozemic loam textured soil from southwestern Saskatchewan. This soil was selected because there was no history of herbicide application so there was no concern with herbicide residue or carryover to affect germination. The soil was collected in the fall of 2010 from a field that has been in continuous alfalfa for ten years (pH 7.7, OM 3%). Six treatments consisting of an unfertilized control and five rates of seed-placed S (10, 20, 30, 40 and 50 kg S ha^{-1}) applied as ammonium thiosulfate (ATS 12-0-0-26) were applied alone and in combination with three rates of seed-placed P_2O_5 (0, 15 and 30 kg P_2O_5 ha^{-1}), applied as ammonium polyphosphate (APP 10-34-0).

Plants were grown in plastic trays (52cm x 26cm x 6cm) containing 5.4 kg of uniformly mixed, air-dried soil at 20 degrees C. The soil in each tray was leveled to a height of 5cm over the individual rows and packed. Seeds were sown into plastic trays at a depth of 1.25cm with 6 rows per tray, creating a seed bed utilization of approximately 15 %.

ATS and APP were applied to the soil using a 3cc syringe and applied in a concentrated band uniformly down the seed-row 10 mm to the side of the seed. The trays were kept at 80-100% field capacity moisture content under 24 h of room lighting. Emergence counts were taken over a two week period. Plants were harvested 14 DAS. Plant biomass samples were washed in deionized water after cutting at the soil surface and oven-dried at 45°C for 4 d to a constant weight. Plant emergence are recorded as a percentage of the control (100 %), where no sulfur was applied.

RESULTS AND DISSCUSION

Considerable variations in emergence of cv. 5770 occurred across all treatments. There was no significant difference within cultivars on emergence when sulfur was applied alone as ATS (Figure 1). ATS placed in the seed-row did not reduce emergence below 90 percent for all cultivars. Although emergence decreased by 5 to 10% with increasing sulfur rate compared to control. Addition of 15 to 30 kg ha^{-1} of seed-placed APP alone or along with 40 to 50 kg S ha^{-1} further reduced emergence for most cultivars. *B. rapa* and *B. juncea* were generally more sensitive to injury from seed-row placed sulfur and phosphorus than *B. napus* cultivars. *B. rapa* showed very good tolerance to ATS and APP when APP was applied at 15 kg P_2O_5 ha^{-1} with emergence increasing when 10 to 30 kg S ha^{-1} was applied with phosphorus compared to when sulfur and phosphorus was applied alone. There was an increase in time to emergence with increasing rate of S applied as ATS (data not shown) which could affect crop maturity.

STATISICAL ANALYSIS

Data was analyzed using analysis of variance (ANOVA) using the GLM procedure in SAS. (SAS Institute, Inc., 2008). Least significant difference (LSD 0.05) was used to determine differences between treatment means.

CONCLUSIONS

Brassica cultivars and species differed in their sensitivity and responsiveness to seed-placed ATS and APP. *B. napus* cultivars were most tolerant to seed-placed ATS and APP while *B. rapa and B. juncea* were the most sensitive. Seed size and seed color was correlated with seed-placed S tolerance. In general, small seeded cultivars were more prone to germination damage than larger seeded *B. napus* cultivars. Yellow-seeded canola was slightly more prone to reduced emergence with seed-placed ATS and APP than black-seeded cultivars. Further research will need to be performed in field trials under a wide range of soil and environmental conditions where yield and quality can be measured under field conditions.

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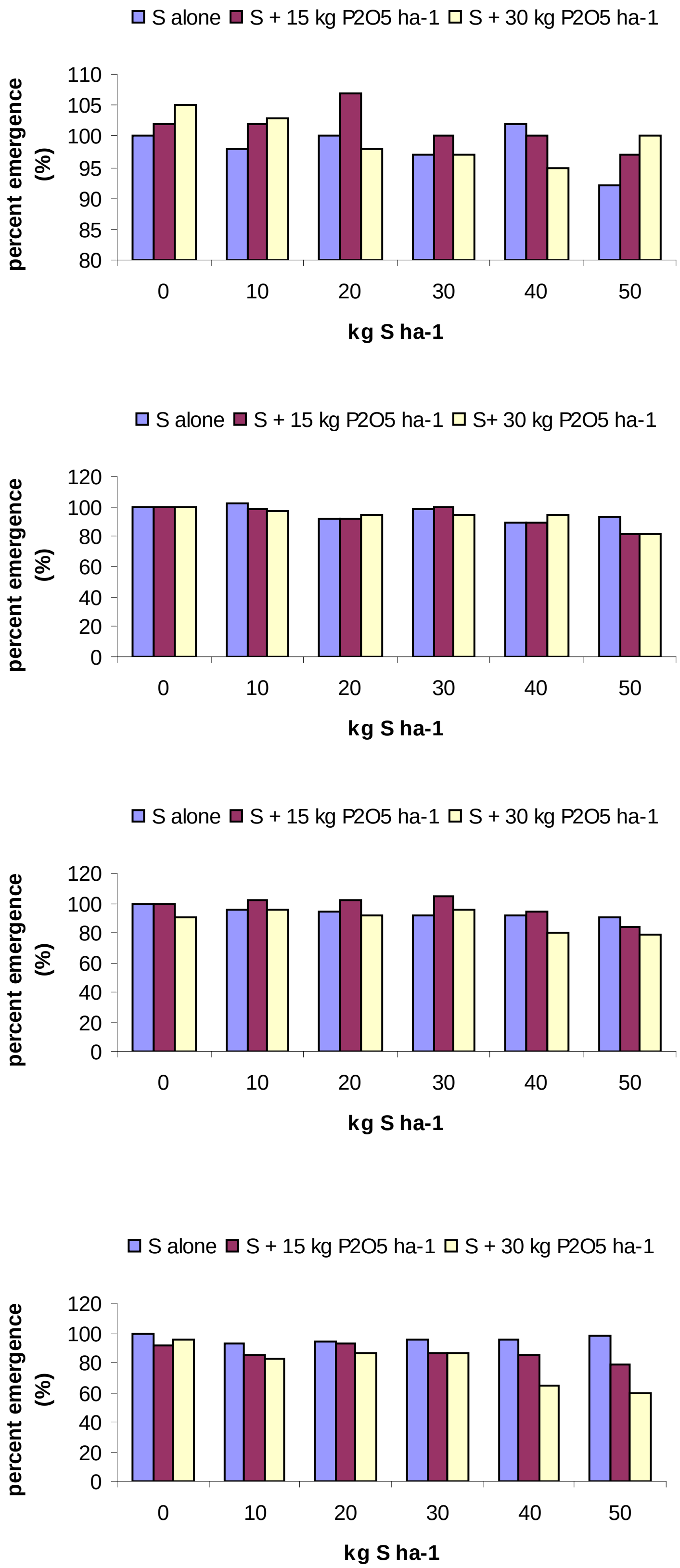

Figure 1: Effect of ATS + APP applied at various S + P rates on the emergence of *Brassica* species Top to Bottom: *B. napus* cv. 5770; *B. napus* cv. 45H26; *B. rapa* cv. ACS-C18; *B. juncea* cv. 8571

Table 2: Mean percent emergence of *Brassica* species expressed as percent of unfertilized control

Cultivar	S kg S ha-1†						S+15P2O5 kg S ha-1†						S+30P2O5 kg S ha1†					
	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
B. napus																		
5770 LL	100ab	98ab	100ab	97ab	102a	92b	102ab	102ab	107a	100bc	100bc	97bc	105a	103a	98a	97a	95a	100a
45H26 RR	100a	102a	92a	98a	90a	93a	99a	98b	92ab	99a	90bc	82c	99a	97ab	95ab	95ab	95ab	82b
B. rapa																		
ACS-C18	100a	95a	94a	92a	91a	90a	99a	102a	102a	104a	94a	84b	90ab	95a	92ab	95a	80b	79b
B. juncea																		
x8571	100a	93a	94a	96a	95a	98a	91a	85a	93a	87a	85a	79a	96a	82ab	87a	86a	65bc	59c

LL- Liberty Link, RR- Roundup Ready
† Means followed by the same letter are not significantly different, p<0.05 by LSD