

Introduction

- Seed-row placed fertilizers for pulses typically include phosphorus (P), but sometimes nitrogen (N) and sulfur (S) as well, in the form of blends (e.g. MAP + urea or ammonium sulfate) as well as combination NPS fertilizer products (e.g. ammonium phosphate sulfates).
- Knowledge of tolerance and response of pulse crops to seed-row placed multi-element fertilizers is of interest when meeting this year's fertilizer nutrient requirements as well as when attempting to maintain fertility over several cycles of a rotation.

Study Objectives

- To evaluate the effect that seed-row placed N, P and S containing fertilizers applied at different N rates have on emergence and growth of pulse crops. This poster covers results on emergence of black bean, lentil and chick pea.

Materials and Methods

- Study Soil:** Brown Chernozem belonging to Haverhill Soil Association: loam, pH 6.7, O.M. 3%, NO₃-N: 8 ppm, MK-P: 11 ppm. SO₄-S: 10 ppm.
- Study Design:** Completely randomized block design, replicated four times. Trays measuring 73.0 cm length X 16.0 cm width X 16.0 cm deep, split into three separate compartments. Seed bed utilization ~10%.
- Fertilizer Treatments: Applied at rates of: 0, 10, 20 and 30 kg N ha⁻¹:**
 - ✓ **Monoammonium Phosphate (MAP) (11-52-0-0)**
 - ✓ **50:50 Blend of MAP (11-52-0-0) + Urea (46-0-0-0) = 28-26-0 blend analysis**
 - ✓ **50:50 Blend of MAP (11-52-0-0) + Ammonium Sulfate (21-0-0-24) = 16-26-0-12 blend analysis**
 - ✓ **Microessentials-15 (MES 15) (13-33-0-15)**
 - ✓ **Ammonium Phosphate Sulfate (APS1) (12-45-0-5)**
 - ✓ **Ammonium Phosphate Sulfate (APS2) (16-20-0-13)**
 - ✓ **Ammonium Phosphate Sulfate (APS3) (16-20-0-12) with 15 % organic matter**
 - ✓ **Control (No N, P or S fertilizer)**

- Seeding:** Fertilizer applied in seed-row (Fig. 1a): followed by seeding (10 seeds compartment⁻¹) of black bean (CDC Blackstrap), small red lentil (CDC Maxim) and desi chick pea (CDC Consul) (Fig.1b). Compartments thinned to 3 plants each after final emergence count, 14 days after seeding. Plants harvested 30 days after seeding (Fig.1c).

- Emergence Counts:** Plant emergence counts conducted at 5, 10 and 14 days after seeding.

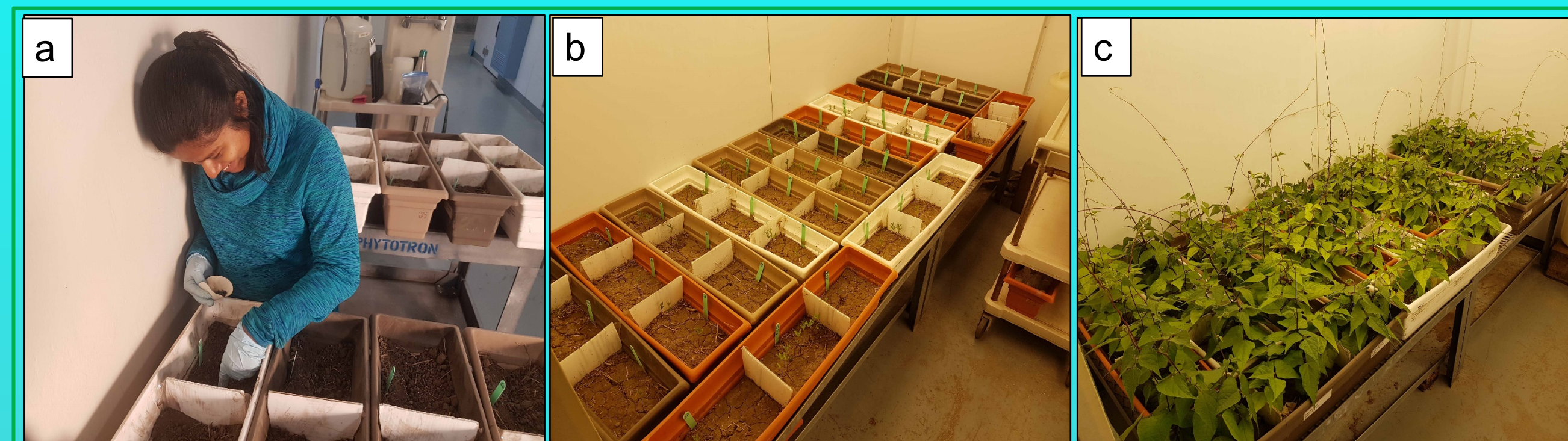


Fig. 1. Black bean, lentil and chick pea were fertilized (a), seeded (b) and grown (c) in a controlled environment chamber at 23° C in 18 hr daylight cycle and 18° C in 6 hr night cycle.

Table 1. Black bean plant emergence count (percent of plants emerged) at 5, 10 and 14 days after seeding. Means followed by the same letter are not significantly different at $P \leq 0.10$.

Nutrient Source	5 Day Emergence Count Nitrogen Fertilizer Rate			10 Day Emergence Count Nitrogen Fertilizer Rate			14 Day Emergence Count Nitrogen Fertilizer Rate		
	10	20	30	10	20	30	10	20	30
MAP	72.5 abc	60.0 bcdef	55.0 def	85.0 bcde	82.5 bcde	67.5 f	85.0 bc	82.5 bc	67.5 d
MAP+Urea	75.0 ab	65.0 abcdef	80.0 a	87.5 bcd	80.0 cde	100.0 a	87.5 abc	80.0 bcd	100.0 a
MAP+ Ammonium Sulfate	80.0 a	70.0 abcd	52.5 ef	92.5 ab	82.5 bcde	75.0 ef	92.5 ab	82.5 bc	77.5 cd
MES-15	70.0 abcd	77.5 a	60.0 bcdef	92.5 ab	82.5 bcde	77.5 def	92.5 ab	82.5 bc	77.5 cd
Ammonium Phosphate Sulfate 1	70.0 abcd	57.5 cdef	50.0 f	82.5 bcde	67.5 f	67.5 f	82.5 bc	67.5 d	67.5 d
Ammonium Phosphate Sulfate 2	70.0 abcd	67.5 abcdef	65.0 abcdef	77.5 def	80.0 cde	77.5 def	77.5 cd	80.0 bcd	77.5 cd
Ammonium Phosphate Sulfate 3	77.5 a	80.0 a	70.0 abcd	82.5 bcde	88.0 abc	85.0 bcd	90.0 abc	88.0 abc	85.0 bc
Control (0 kg N ha ⁻¹)		67.5 abcdef			82.0 bcde			82.0 bc	
LSD (0.10)	17.32			12.49			12.65		
F value	1.38			2.20			2.10		
P > F	0.16			0.01			0.00		

Table 2. Small red lentil plant emergence count (per cent of plants emerged) at 5, 10 and 14 days after seeding. Means followed by the same letter are not significantly different at $P \leq 0.10$.

Nutrient Source	5 Day Emergence Count Nitrogen Fertilizer Rate			10 Day Emergence Count Nitrogen Fertilizer Rate			14 Day Emergence Count Nitrogen Fertilizer Rate		
	10	20	30	10	20	30	10	20	30
MAP	52.5 abc	20.0 ef	22.5 def	60.0 cdef	47.5 fgh	35.0 hi	60.0 cde	47.5 efgh	35.0 gh
MAP+Urea	42.5 abcde	47.5 abcd	40.0 abcde	57.5 def	67.5 bcd	57.5 def	57.5 cdef	67.5 bcd	57.5 cdef
MAP+ Ammonium Sulfate	32.5 cdef	30.0 cdef	7.5 f	52.5 defg	52.5 defg	25.0 i	52.5 defg	55.0 def	25.0 g
MES-15	35.0 bcde	47.5 abcd	27.5 cdef	60.0 cdef	60.0 cdef	37.5 ghij	60.0 cde	67.5 bcd	40.0 fgh
Ammonium Phosphate Sulfate 1	40.0 abcde	47.5 abcd	17.5 ef	75.0 abc	50.0 defg	35.0 hi	80.0 ab	50.0 defg	35.0 gh
Ammonium Phosphate Sulfate 2	37.5 abcde	20.0 ef	35.0 bcde	75.0 ab	52.5 defg	47.5 efgh	75.0 abc	57.5 cdef	47.5 ef
Ammonium Phosphate Sulfate 3	60.0 ab	62.5 a	37.5 abcde	65.0 bcd	55.0 bcde	55.0 def	65.0 bcde	55.0 def	60.0 cde
Control (0 kg N ha ⁻¹)		42.5 abcde			57.50 def			90.0 a	
LSD (0.10)	26.41			17.28			17.20		
F value	1.47			3.71			3.87		
P > F	0.11			<0.0001			<0.0001		

Table 3. Desi chick pea plant emergence count (per cent of plants emerged) at 5, 10 and 14 days after seeding. Means followed by the same letter are not significantly different at $P \leq 0.10$.

Nutrient Source	5 Day Emergence Count Nitrogen Fertilizer Rate			10 Day Emergence Count Nitrogen Fertilizer Rate			14 Day Emergence Count Nitrogen Fertilizer Rate		
	10	20	30	10	20	30	10	20	30
MAP	40.0 ab	7.5 ef	7.5 ef	77.5 abc	45.0 f	47.5 ef	80.0 ab	45.0 g	50.0 efgh
MAP+Urea	25.0 abcdef	25.0 abcdef	12.5 def	62.5 cdef	55.0 def	47.5 ef	75.0 abc	55.0 defg	52.5 defgh
MAP+ Ammonium Sulfate	45.0 a	37.5 abc	20.0 bcdef	90.0 a	62.5 cdef	70.0 bcd	90.0 a	70.0 bcd	77.5 ab
MES-15	37.5 abc	22.5 abcdef	20.0 bcdef	70.0 bcd	77.5 abc	55.0 def	70.0 bcd	80.0 ab	57.5 cdefg
Ammonium Phosphate Sulfate 1	12.5 cdef	15.0 cdef	5.0 f	82.5 ab	67.5 bcd	47.5 ef	82.5 ab	67.5 bcde	47.5 fg
Ammonium Phosphate Sulfate 2	22.5 abcdef	20.0 bcdef	30.0 abcde	65.0 bcde	77.5 abc	65.0 bcde	65.0 bcdef	82.5 ab	65.0 bcdef
Ammonium Phosphate Sulfate 3	35.0 abcd	22.5 abcdef	20.0 bcdef	80.0 ab	75.0 abc	72.5 abcd	80.0 ab	75.0 abc	78.0 ab
Control (0 kg N ha ⁻¹)		25.0 abcdef			75.0 abc			90.0 abc	
LSD (0.10)	23.24			18.68			18.75		
F value	1.49			2.44			4.23		
P > F	0.11			0.00			<0.0001		

Table 4. Black bean, small red lentil and desi chick pea plant biomass 30 days after seeding as affected by fertilizer rate (kg N ha⁻¹). Means followed by the same letter are not significantly different at $P \leq 0.10$.

Nutrient Source	Black Bean 30 Day Plant Biomass Nitrogen Fertilizer Rate			Small Red Lentil 30 Day Plant Biomass Nitrogen Fertilizer Rate			Desi Chick Pea 30 Day Plant Biomass Nitrogen Fertilizer Rate		
	10	20	30	10	20	30	10	20	30
MAP	6.2 i	8.0 def	9.4 abc	1.44 abc	1.40 abcd	1.80 abc	2.31 bcdef	2.45 abcde	2.38 abcdef
MAP+Urea	5.6 ij	7.6 efg	8.4 cde	0.80 e	1.09 cde	1.27 cde	2.03 ef	2.09 ef	2.14 def
MAP+ Ammonium Sulfate	6.5 ghij	8.2 cde	8.7 bcde	0.90 de	1.24 cde	0.88 de	2.35 bcdef	2.11 def	2.75 abc
MES-15	6.8 fghi	7.7 efg	9.9 ab	1.19 cde	1.44 abc	1.87 a	2.26 bcdef	2.83 ab	2.67 abcd
Ammonium Phosphate Sulfate 1	6.6 ghij	8.1 cde	10.5 a	1.25 e	1.81 ab	1.18 cde	2.55 abcde	2.74 abc	2.93 a
Ammonium Phosphate Sulfate 2	6.3 hij	8.2 cde	9.3 abc	0.82 gh	1.25 cde	1.31 cd	2.03 ef	2.09 ef	2.38 abcdef
Ammonium Phosphate Sulfate 3	5.9 ij	7.6 efg	8.6 cde	1.43 abc	1.32 cd	1.35 bcd	2.47 abcde	2.25 cdef	2.40 abcdef
Control (0 kg N ha ⁻¹)		4.9 j			0.95 de			1.92 f	
LSD (0.10)	1.26			0.46			0.55		
F value	6.29			2.14			2.07		
P > F	<0.0001			<0.0001			0.01		

Results and Discussion

- Black bean could tolerate 10 to 20 kg N ha⁻¹ of most products without significant reduction in emergence (Table 1). Products or blends with lower N analysis and higher analysis of P and S (e.g. 11-52-0, 12-45-0-5) required greater amounts of product to meet the target N rate and therefore had lower safe rate based on N application. Of the three pulse crops, black bean biomass showed the greatest response to fertilization, with 30 day biomass highest in the 30 kg N ha⁻¹ treatments (Table 4).
- Compared to black bean, lentil (Table 2) was less tolerant to seed-row N, P, S fertilizers added at rates above 10 kg N ha⁻¹. Rates of MAP (11-52-0) above 10 kg N ha⁻¹ significantly reduced lentil emergence. MAP+Urea blend produced less injury at a given N rate because of higher N analysis and therefore less total product. MES-15 produced less injury than MAP+AS. APS products also had less injury than MAP+AS. Biomass response to starter seed-placed fertilizer was less in lentil compared to black bean (Table 4).
- Desi chick pea showed similar or slightly less tolerance to the seed-row placed fertilizers (Table 3) compared to lentil when added at equivalent N rate. A similar pattern to lentil was observed for chickpea among the fertilizer forms. The chickpea were quite sensitive to higher rate (20 kg N ha⁻¹ and above). Interestingly, the MAP+ AS did not seem to cause as much injury to chick pea as it did to the red lentil. Chickpea had the lowest biomass response to starter fertilizer (Table 4), with few significant differences among rate or fertilizer type. APS-1 produced the greatest 30 day biomass.

Conclusions

- Of the three pulse crops compared, lentil and desi chick pea emergence were quite sensitive to seed-row placed N at rates above 10 kg N ha⁻¹.
- Combination products appeared to produce less injury than product blends.
- Black bean was most responsive in early season biomass growth to fertilization with starter N, P and S.

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