

The Effect of Seed-Row Placed Controlled-Release P (CRP) Fertilizer on Crop Emergence under Controlled Environment Conditions

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Introduction

Seed-row placed phosphorus fertilizer is an efficient means of applying phosphorus. However high rates of seed-placed phosphate fertilizer can reduce germination and emergence, as some crop seeds are sensitive to fertilizer salts.

Controlled-release P fertilizer allows P to be released at a slower rate, and may reduce the salt effect and injurious impact on seed germination and/or seeding emergence. With the narrow openers and wide row spacing that is becoming common place in today's seeding equipment, low seedbed utilization and increased risk of injury from seed-place fertilizer is of particular concern.

Objectives

To compare controlled release P fertilizer (Agrium Inc. CRP) and conventional MAP fertilizer when placed in the seed-row at different rates, as to its effect on emergence.

Materials and Methods

Soil: Haverhill loam (Table 1).

Table 1. Some characteristics of the soil used for seed-placed P fertilizer evaluation

Soil	pH	EC mS cm ⁻¹	Texture	Organic C g kg ⁻¹	Available P* kg ha ⁻¹
Haverhill	7.4	1.04	loamy	20.8	18.0

*Measured by modified Kelowna method

Crops:

2005 – canola, mustard, flax, alfalfa and yellow pea

2006 - wheat, canola, oat, flax, canary seed, mustard, brome grass and alfalfa.

Seed rates: Table 2

Table 2. The crops tested in the study

Crop	Variety	Seed Rate kg ha ⁻¹
Wheat	Prodigy	112
Oat	Triple Crown	134
Argentine Canola OP non HT	Sprint	12
Yellow Pea	Carneval	410
Flax	CDC Valor	35
Oriental Mustard	Cutlass	11
Alfalfa	Beaver	10
Canary seed	Common Itchless	40
Bromegrass	Knowles	40

Fertilizer:

Source -

Conventional MAP – NH₄H₂PO₄ (12-51-0)

Controlled-release MAP – NH₄H₂PO₄ coated to control fertilizer release rate (Agrium Inc.)

Rates:

2005 – 0, 20, 30, 40, 60 and 80 kg P₂O₅ ha⁻¹.

2006 - 0, 10, 20, 30, 40, 60, 80 and 100 kg P₂O₅ ha⁻¹.

Laboratory Study:

Tray: mixed soil in a tray (60 cm long and 40 cm wide) for twelve treatments.

Replications: 4

Seeding tool: knife opener with a 15% seedbed utilization and on-row packing.

Moisture: near field capacity after seeding and fertilization, and then watering once daily as required simulating rainfall.

Temperature: 20°C

Light: 18-hour day length and 6 hour night period.

Plant material after counting is then crushed and ground for dry matter yield determination

Results and Discussion

A significant impact on emergence was observed in the treatments with conventional P fertilizer at rates of 30 to 40 kg P₂O₅ ha⁻¹ and above for all the 5 crops tested in 2005, and similar results were obtained in 2006 for the 8 crops tested (Tables 3 and 4).

Table 3. Percentage of emergence* as affected by different rates of conventional MAP fertilizer for wheat, oat, canary, bromegrass, and canola.

Fert. rate Kg P ₂ O ₅ ha ⁻¹	Wheat	Oat	Canary	Bromegrass	Canola	
	2006	2006	2006	2006	2006	2005
0	93a	92a	83a	69a	95a	96a
10	95a	89a	79a	68a	98a	98a
20	91a	89a	79a	59ab	95a	90ab
30	89ab	86a	73ab	58ab	91a	83b
40	91a	81a	68bc	57ab	73b	69c
60	80b	78a	59	50b	48c	48d
80	64c	61b	53cd	26c	43c	46d
100	52d	58b	38d	23c	36c	

For each crop, means in columns followed by a different letter are significantly different at $p < 0.05$.

*Refers to % of planted seeds that emerged over 20 days

Table 4. Percentage of emergence* as affected by different rates of conventional MAP fertilizer for mustard, flax, alfalfa and yellow pea

Fert. rate Kg P ₂ O ₅ ha ⁻¹	Mustard		Flax		Alfalfa		Yellow pea
	2006	2005	2006	2005	2006	2005	2005
0	70a	73a	67ab	69a	72a	71a	97a
10	63ab	70a	69a	63ab	69a	70a	76ab
20	66ab	65a	65ab	64ab	67a	66a	75ab
30	55b	43b	54bc	56b	71a	54b	72b
40	41c	33b	42cd	44c	46b	45b	56b
60	38cd	12c	33de	23d	44b	26c	28c
80	34cd	7c	22e	10e	39b	11d	19c
100	27d		21e		29b		

For each crop, means in columns followed by a different letter are significantly different at $p < 0.05$.

*Refers to % of planted seeds that emerged over 20 days

For the controlled release P (CRP) fertilizer, no negative impact was observed even at rates up to 80-100 kg P₂O₅ ha⁻¹ with the exception of yellow peas where a trend towards decrease in the emergence counts was noted at the rate of 60 kg P₂O₅ ha⁻¹ (Tables 5 and 6).

Table 5. Percentage of emergence* as affected by different rates of controlled-released MAP fertilizer for wheat, oat, canary, bromegrass, canola

Fert. rate Kg P ₂ O ₅ ha ⁻¹	Wheat	Oat	Canary	Bromegrass	Canola	
	2006	2006	2006	2006	2006	2005
0	93a	92a	81a	69a	95a	90a
10	93a	92a	80a	66a	95a	
20	95a	89a	83a	69a	93a	92a
30	93a	89a	78a	62a	86a	
40	89a	89a	75a	60a	91a	96a
60	89a	89a	73a	66a	86a	92a
80	91a	86b	75a	56a	91a	94a
100	91a	81b	74a	58a	84a	

For each crop, means in columns followed by a different letter are significantly different at $p < 0.05$.

*Refers to % of planted seeds that emerged over 20 days

Table 6. Percentage of emergence* as affected by different rates of controlled-released MAP fertilizer for mustard, flax, alfalfa and yellow pea

Fert. rate Kg P ₂ O ₅ ha ⁻¹	Mustard		Flax		Alfalfa		Yellow pea
	2006	2005	2006	2005	2006	2005	2005
0	70a	72a	67a	60a	72a	64a	88a
10	68a		68a		71a		
20	70a	67a	69a	56a	72a	60a	91a
30	73a		72a		67a		
40	70a	62a	69a	60a	67b	63a	81a
60	71a	75a	71a	60a	72b	51a	63a
80	68a	65a	65a	59a	71b	71a	59a
100	66a		65a		71b		

For each crop, means in columns followed by a different letter are significantly different at $p < 0.05$.

*Refers to % of planted seeds that emerged over 20 days

Canola, flax, alfalfa and mustard have been reported to be relatively sensitive to seed placed P. No negative impact was observed for these crops for the controlled-release seed placed P up to 80-100 kg P₂O₅ ha⁻¹, implying improved crop safety for controlled-release P fertilizer compared to conventional P fertilizer. A reduced salt-effect/damage potential from a CRP product would be of benefit in potentially allowing more urea and potash to be seed-row placed along with phosphorus in single shoot systems.

This experiment only evaluates seed-placed P fertilizer alone, not in combination with some seed-placed N and K as may be used in the field. Further tests are required with combination of P and other nutrients.

Conclusion

Controlled-release P fertilizer placed in the seed row had no negative impact on the counts of emergence of the majority of crops tested in 2005 and 2006 even at rates up to 80-100 kg P₂O₅ ha⁻¹, while conventional P fertilizer resulted in some decreased emergence evident at the rates between 30 and 40 kg P₂O₅ ha⁻¹. The P availability and yield response from CRP fertilizer in comparison MAP is currently being investigated.

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