

# **Feasibility of a New Granular Rapid Release Elemental S (RRES) Fertilizer in Preventing S Deficiency in Canola on a S-deficient Soil**

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## ***Rationale***

- Canola is the major cash crop in the Parkland region. Being a high protein oilseed crop, it has high requirements for S.
- As S is immobile in plants, deficiency of S at any growth stage can cause a considerable reduction in seed yield.
- In order to prevent seed yield loss due to S deficiency, a constant supply of available S to canola plants is thus needed throughout the growing season.
- Sulphate is the only form of S which is available to plants.
- There are a wide variety of commercial fertilizers that contain elemental S (ES), which may cost less per unit of S than sulphate-S fertilizers.
- However, the effectiveness of these fertilizers depends on how quickly the ES is oxidized in soil to plant-available sulphate.
- In our previous research, granular ES fertilizers were found not effective in the first year of application, and also were not consistently as effective as sulphate-S fertilizers in improving seed yield of canola on S-deficient soils, even after multiple annual applications, particularly when applied in spring (Table 1).
- Fall-applied elemental S usually produced greater seed yield than spring-applied elemental S, most likely because of dispersion of elemental S particles in soil and its subsequent oxidation to sulphate-S.

Table 1. Effect of gypsum, elemental S and other sulphate-S fertilizers on increase in yield (kg ha<sup>-1</sup>) of canola seed or grass forage DMY

Experiment	Year	Yield increase (kg ha <sup>-1</sup> )		
		ES	Gypsum	K <sub>2</sub> SO <sub>4</sub>
<b>Grass (DMY) (15 kg S ha<sup>-1</sup>) Alberta</b>	Yr 1	357	1696	2401
	Yr 2	195	1256	722
	Yr 3	1533	4646	4271
		ES - Spring	ES - Fall	Sulphate-S
<b>Canola seed (20 kg S ha<sup>-1</sup>) Tisdale, SK</b>	Yr 1	6	45	851
	Yr 2	94	572	783
	Yr 3	196	349	363
	Yr 4	268	590	1068
<b>Canola seed (15 kg S ha<sup>-1</sup>) Porcupine plain, SK</b>	Yr 1	6	602	2087
	Yr 2	677	1405	1191
	Yr 3	274	498	803
	Yr 5	891	1114	1444

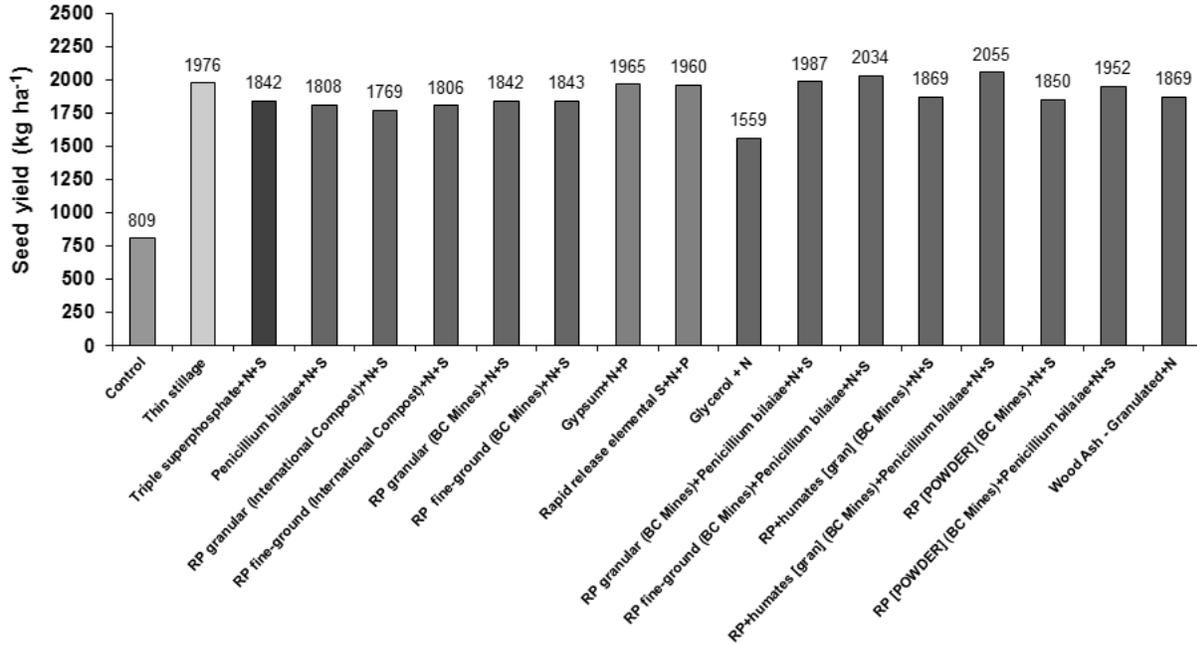
- In our other experiments with spring applied S in S-deficient soils, the S deficiency in canola was prevented by broadcast/spread surface-application of elemental S fertilizers that contained S particles in suspension or powder formulation producing seed yield comparable to sulphate-S fertilizer (Table 2).
- Dispersion of elemental S particles from granular elemental S fertilizers in soil to enhance microbial oxidation of elemental S particles to sulphate-S in soil was considered as the major problem for lack of effectiveness of granular elemental S fertilizers.

Table 2. Effect of elemental S formulation and sulphate-S fertilizer on increase in seed yield (kg ha<sup>-1</sup>) of canola

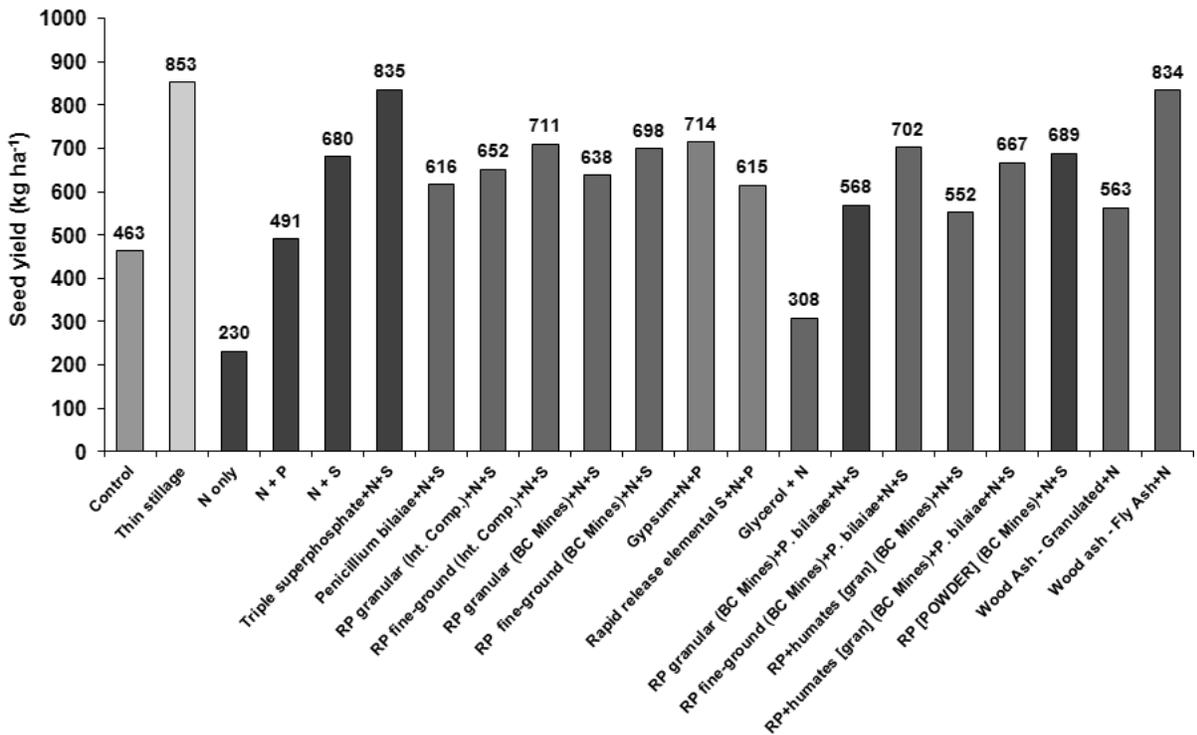
Treatment	Seed yield increase (kg ha <sup>-1</sup> )			
	Porcupine Plain		Canwood	Legal, AB
	2000	2001	2001	2000
<b>ES-90 Granular</b>	0	127	1296	299
<b>Biosul-ES90 Granular</b>	143	256	1518	75
<b>Biosul-ES50 Suspension</b>	784	593	1710	637
<b>Sulphate-S</b>	861	581	1788	430

- Research was completed recently to determine the feasibility of a new granular rapid release elemental S (RRES [micronized ES] - from Sulvaris Inc., Calgary, Alberta, now called Vitasul) fertilizer in preventing S deficiency in canola using relatively a low yielding cultivar (Figures 1, 2, 3 and 4).

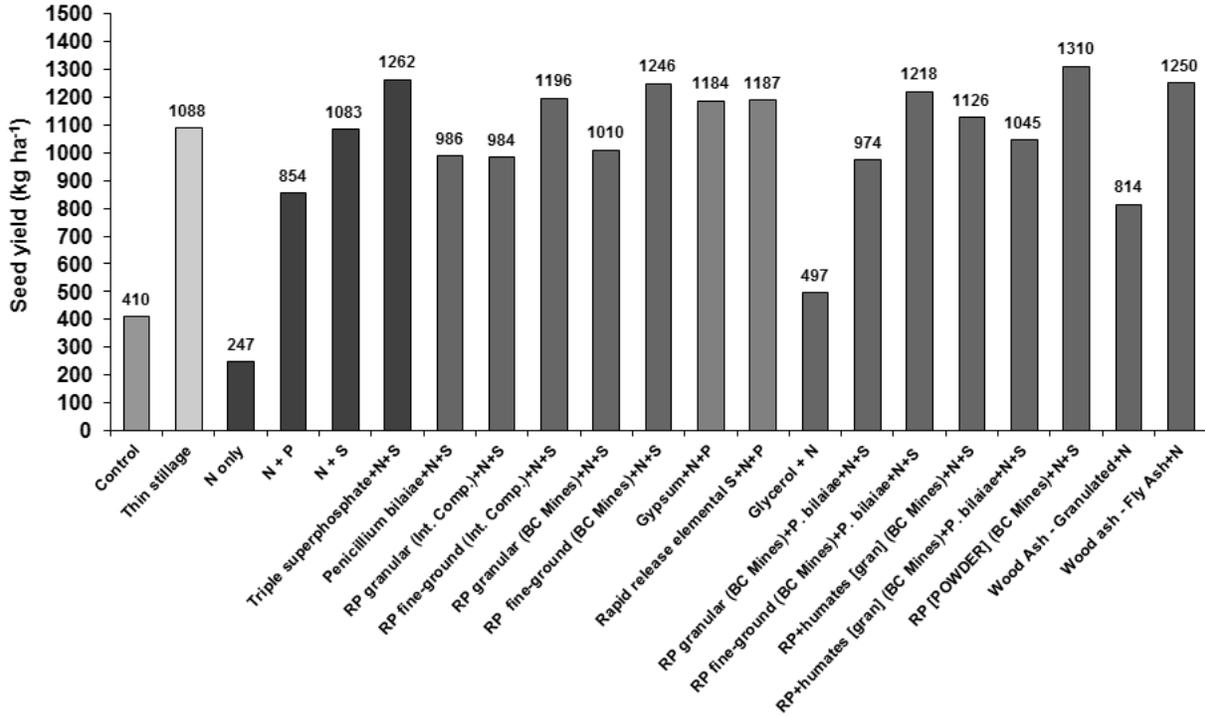
**Figure 1. Alternative Nutrients Sources Study 2009**  
*Treatments with commercial fertilizer applied*



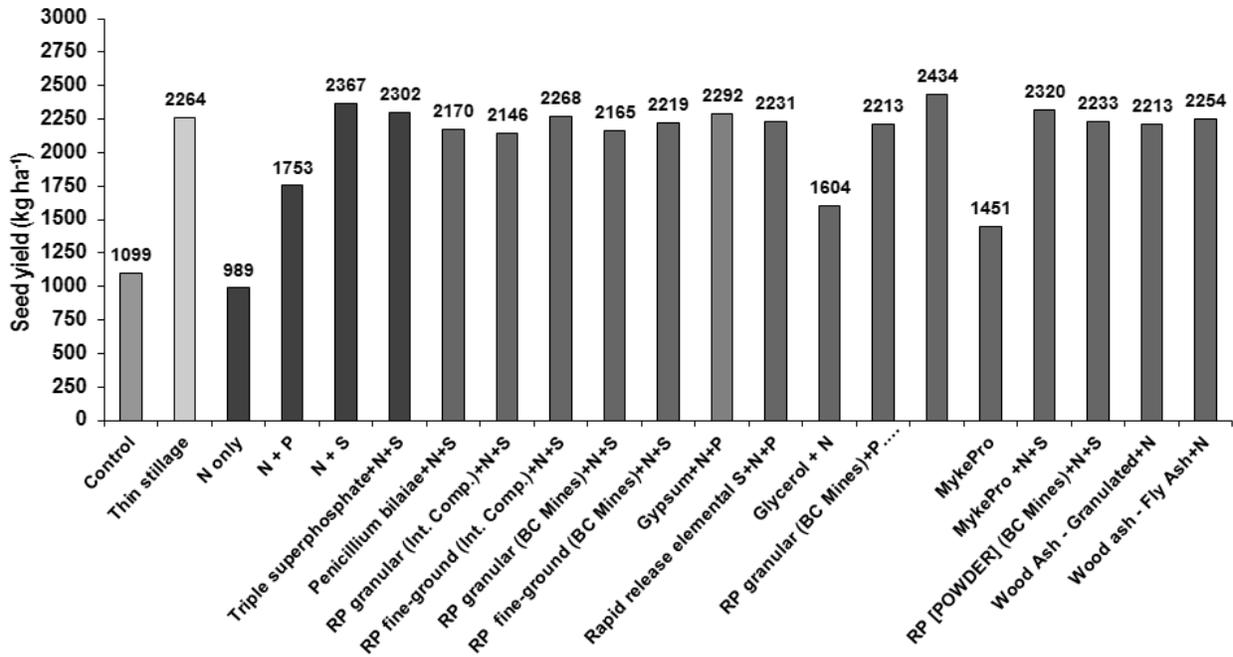
**Figure 2. Alternative Nutrients Sources Study 2010**  
*Treatments with commercial fertilizer applied*



**Figure 3. Alternative Nutrients Sources Study 2011**  
*Treatments with commercial fertilizer applied*



**Figure 4. Alternative Nutrients Sources Study 2012**  
*Treatments with commercial fertilizer applied*



## ***Objective***

The objective of this study is to determine the relative effectiveness of a new granular rapid release elemental S (RRES – now called Vitasul) fertilizer and sulphate-S fertilizer on seed yield, straw yield, oil and protein content in seed, and N and S uptake of canola (under high yield situation using hybrid canola) on a S-deficient Gray Luvisol loam soil near Star City, Saskatchewan.

## ***Materials and Methods***

- A field experiment was established in autumn 2010 on a Gray Luvisol (TypicHaplocryalf) loam soil at Star City, Saskatchewan.
- Soil test sulphate-S– 4.5 mg S/kg in 0-15 cm, 2.3 mg S/kg in 15-30 cm and 1.6 mg S/kg in 30-60 cm soil.
- Soil at this site has shown severe S deficiency in canola in all previous years, and significant increase in forage yield of timothy from S application.
- 11 treatments included two granular S sources (rapid release elemental S [RRES] and potassium sulphate, applied at 20 kg S ha<sup>-1</sup>) and five application time/placement method combinations (broadcast in fall, broadcast in spring pre-tillage, broadcast in spring pre-emergence, side-banded in spring and seedrow-placed in spring), plus a zero-S control.

## ***Treatments:***

1. Control (no S fertilizer)
2. RRES Broadcast Fall
3. RRES Broadcast Spring Pre-Till
4. RRES Broadcast Spring Pre-Emergence
5. RRES Spring Sideband
6. RRES Spring Seedrow-Placed
7. Potassium Sulphate Broadcast Fall
8. Potassium Sulphate Broadcast Spring Pre-Till
9. Potassium Sulphate Broadcast Spring Pre-Emergence
10. Potassium Sulphate Spring Sideband
11. Potassium Sulphate Spring Seedrow-Placed

*Note:* In Treatments 2-11, S was applied at 20 kg S ha<sup>-1</sup>.

Blanket application of 120 kg N, 30 kg P and 20 kg K/ha.

### ***Summary of Results***

- Growing season precipitation was below average (especially in 2011, much above average (very wet) in 2012 and near average (well distributed) in 2013).
- There was a significant seed yield response of canola to applied S in all 3 years (Figures 5, 6 and 7). Compared to zero-S control, seed yield increased considerably with all sulphate-S treatments. Seed yield also increased significantly with all RRES treatments but less than sulphate-S. The seed yield responses to applied S varied with S source and application time-placement combination in different years.
- On the average of 3 years, spring broadcast-incorporated sulphate-S produced significantly greater seed yield than other sulphate-S treatments (which were essentially similar) (Figure 8). On the average of 3 years, fall broadcast RRES or spring broadcast pre-emergence RRES produced greater seed yield than other RRES treatments.
- Oil concentration in canola seed increased with sulphate-S in all 3 years, and increased with RRES in 2012 and 2013 (Figures 9, 10 and 11).
- There was no effect of any S source on protein concentration in canola seed.
- Response trends of total N uptake, total S uptake, PFP, SUE and % recovery of applied S were usually similar to seed yield (data not shown).

### ***Conclusions***

- Our findings indicated optimum/high consistent seed yield of canola with sulphate-S, applied as broadcast-incorporated into soil in spring prior to seeding.
- Findings also suggested potential of fall broadcast RRES/Vitasul or spring broadcast pre-emergence RRES/Vitasul in preventing S deficiency in hybrid canola, but seed yield was still slightly lower (although not significant) than the highest seed yield obtained with spring broadcast/incorporated sulphate-S treatment.
- As far as I know, itasul is probably the first granular ES fertilizer, which has shown potential to prevent S deficiency in hybrid canola in the first year of application, even when applied in spring, producing 3-year average seed yield 94-95% of the best/highest seed yield obtained with sulphate-S.
- ES fertilizers are usually less expensive and are expected to cost less per unit of S compared to sulphate-S. So, it is possible that RRES/Vitasul may result in better economic returns/farm income, plus any environmental benefits (by minimizing leaching of sulphate-

S, which may occur on coarse-textured/sandy soils under wet soil conditions after sporadic heavy rains in spring or early growing season).

- However, our results/findings are based on one site/soil, so there is a need of further future research to test this ES product for its efficacy under varied soil types, climatic and crop growing conditions.
- For producers – who are planning to use this ES fertilizer/Vitasul on their farms, they should try it on a small scale (for their own satisfaction) and find out if Vitasul is working/effective under their particular soil, crop and farm/climatic situations/conditions.

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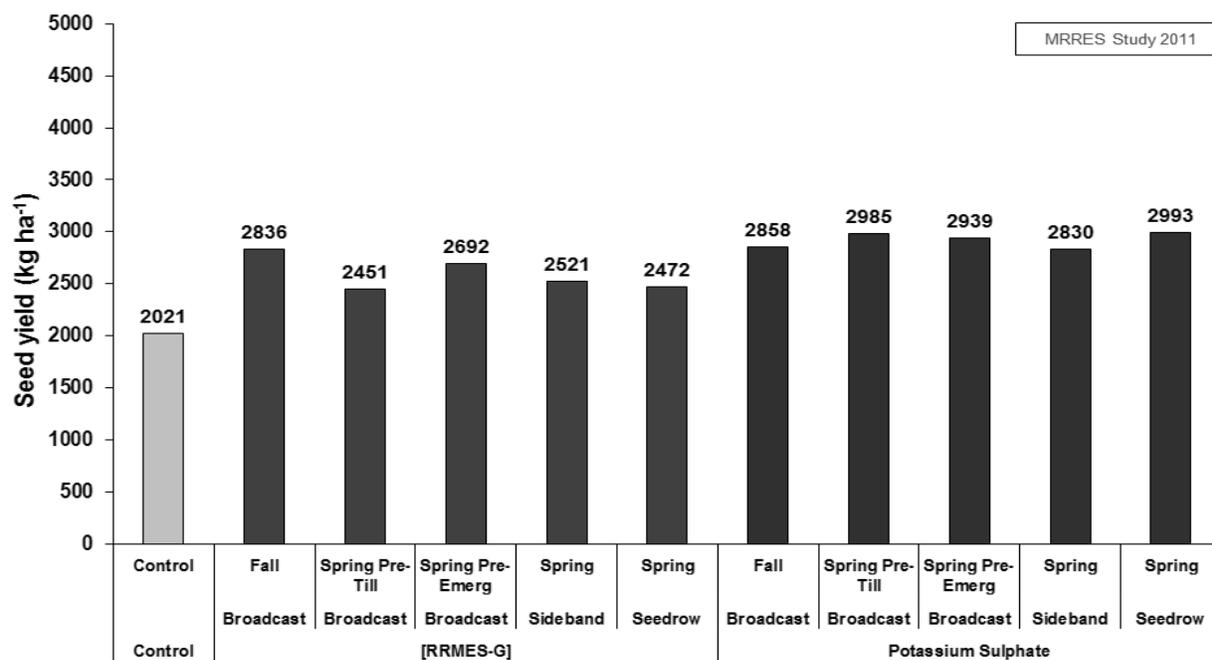


Figure 5. Seed yield of canola with rapid release elemental S (RRES) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2011 on a S-deficient soil at Star City, Saskatchewan (LSD<sub>0.05</sub> = 425).

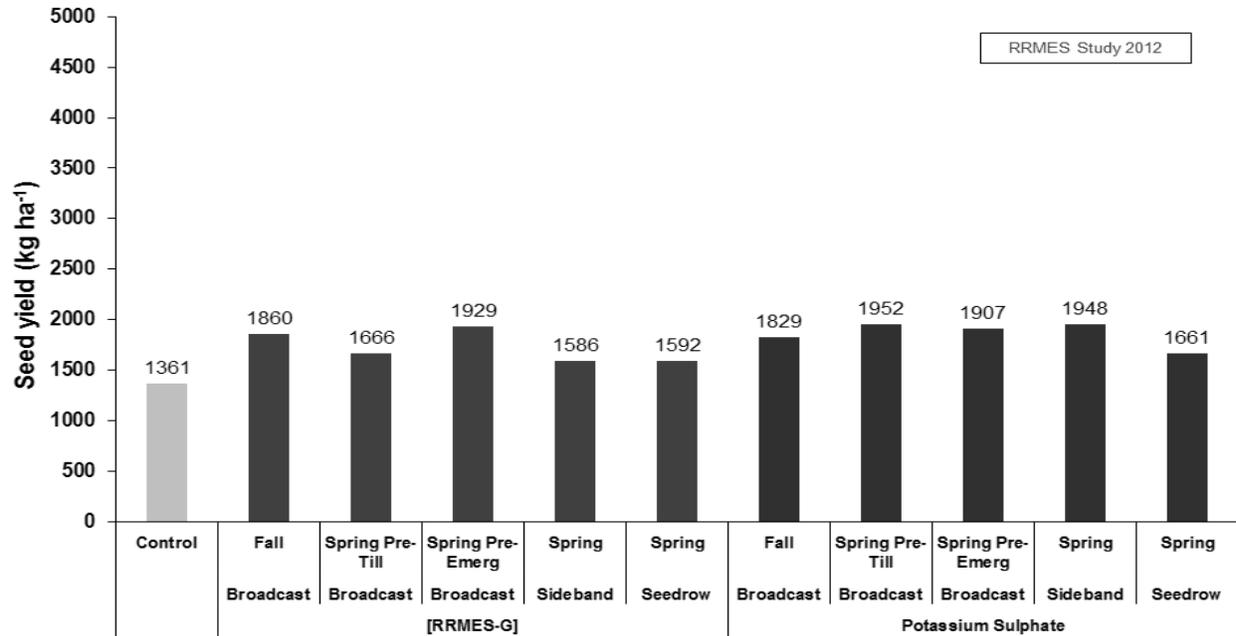


Figure 6. Seed yield of canola with rapid release elemental S (RRS) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2012 on a S-deficient soil at Star City, Saskatchewan (LSD<sub>0.05</sub> = 228).

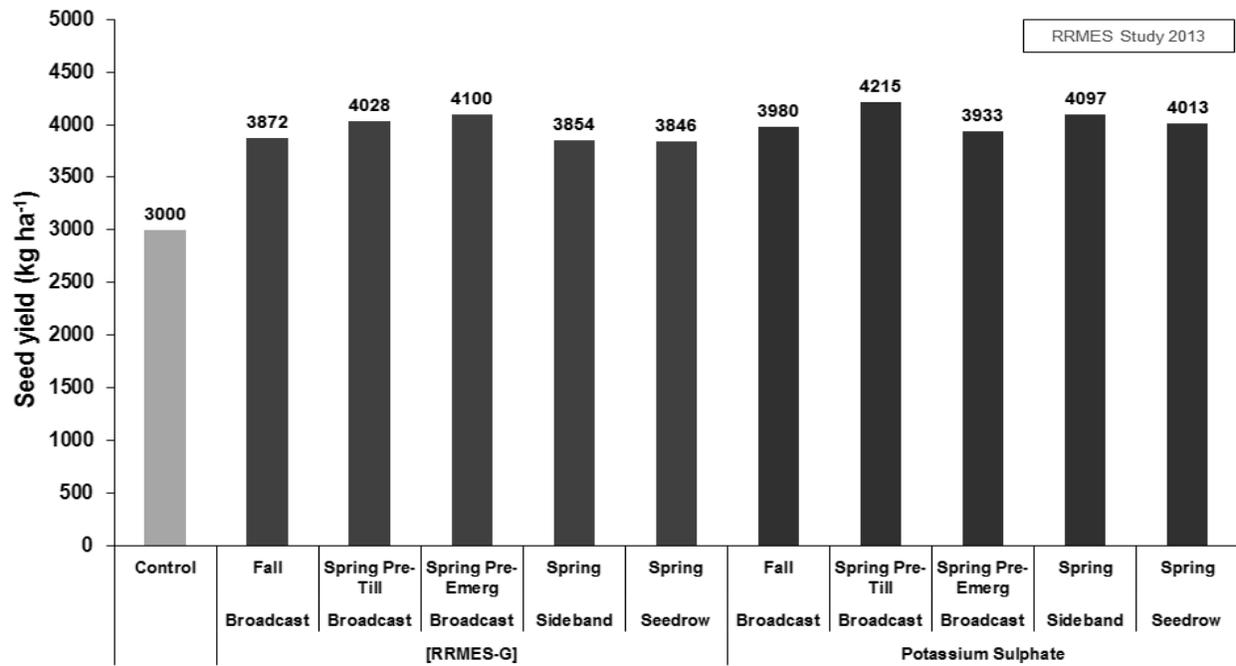


Figure 7. Seed yield of canola with rapid release elemental S (RRS) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2013 on a S-deficient soil at Star City, Saskatchewan (LSD<sub>0.05</sub> = 337).

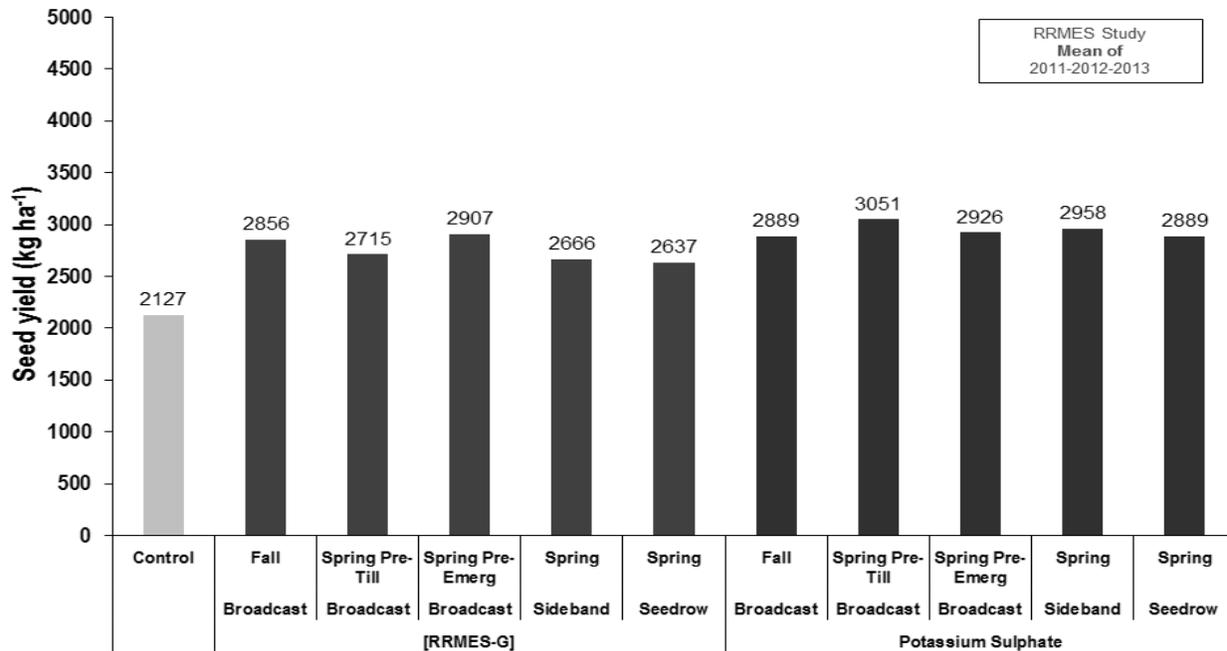


Figure 8. Mean seed yield of canola (average of 3 years) with rapid release elemental S (RRES) and sulphate-S fertilizers applied with various combinations of application time and placement method on a S-deficient soil at Star City, SK, (LSD<sub>0.05</sub> = 207).

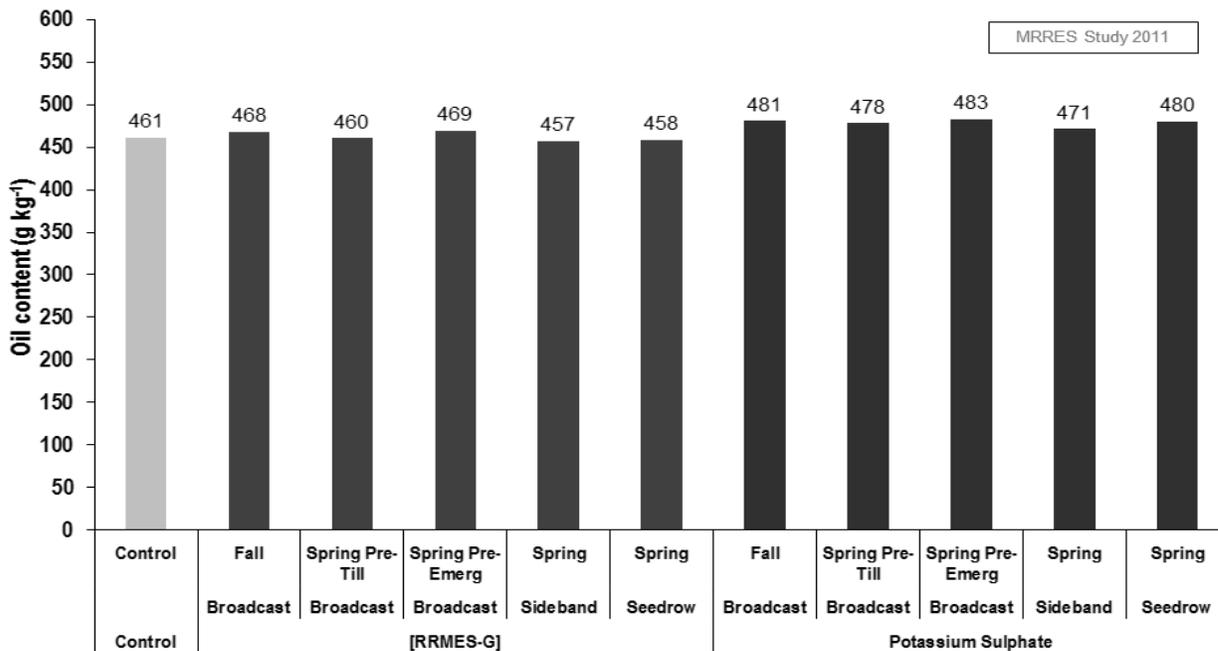


Figure 9. Oil concentration in canola seed with rapid release elemental S (RRES) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2011 on a S-deficient soil at Star City, Saskatchewan (LSD<sub>0.05</sub> = 12).

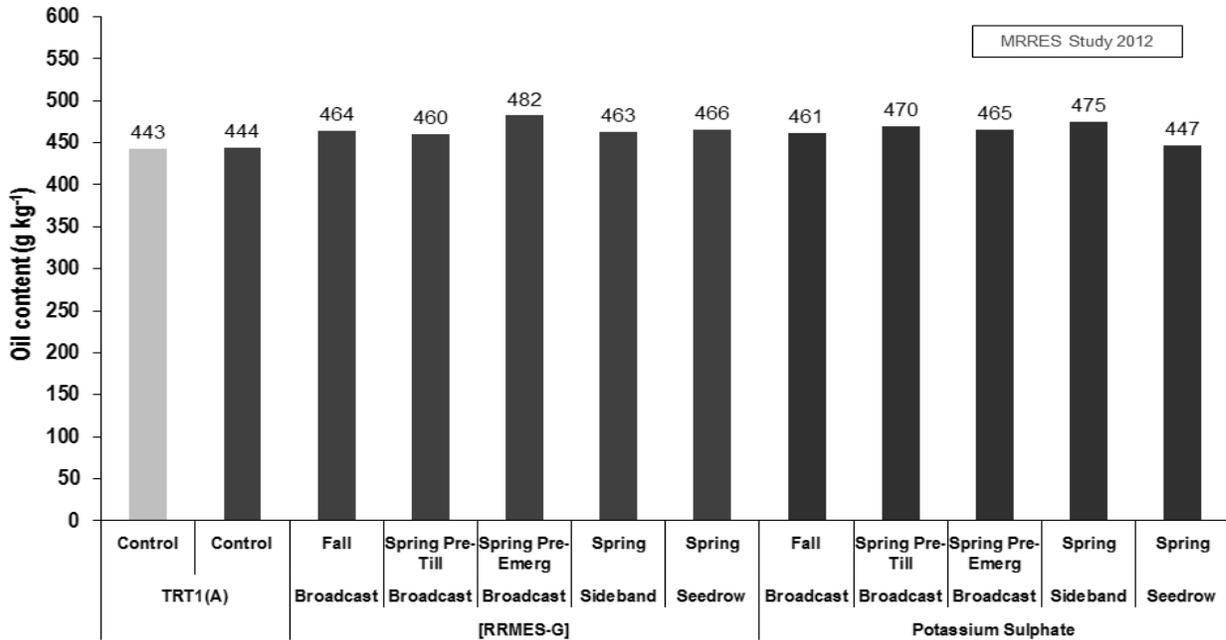


Figure 10. Oil concentration in canola seed with rapid release elemental S (RRES) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2012 on a S-deficient soil at Star City, Saskatchewan (LSD0.05 = 16).

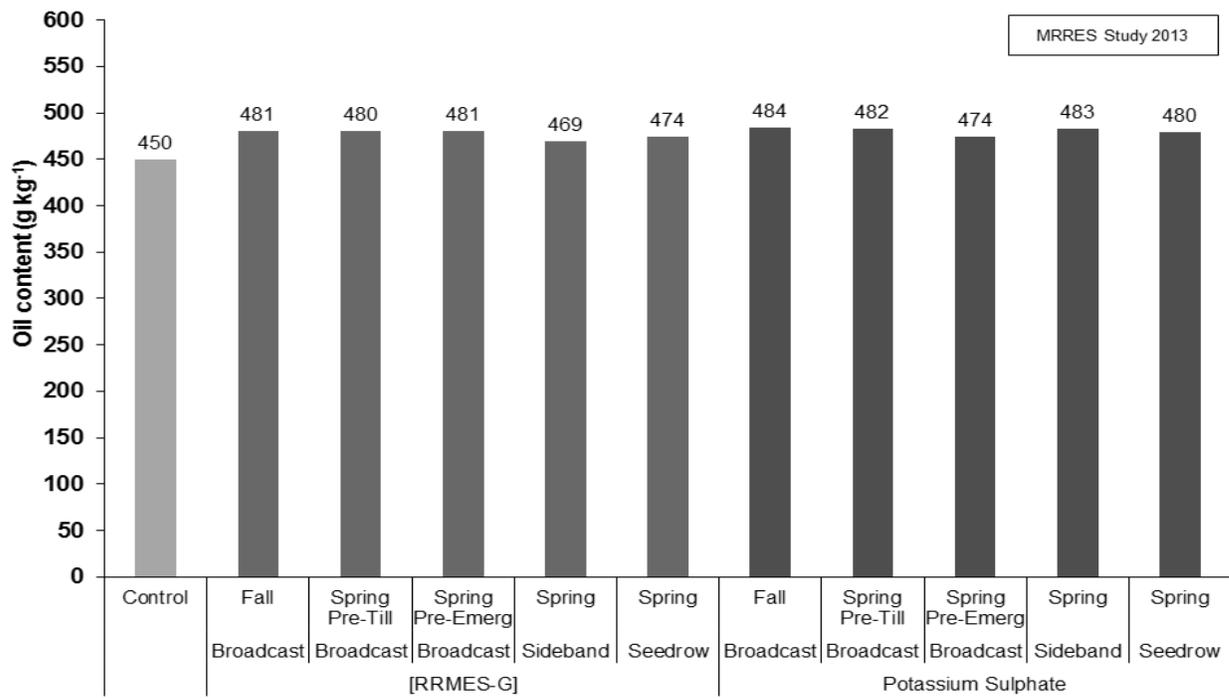


Figure 11. Oil concentration in canola seed with rapid release elemental S (RRES) and sulphate-S fertilizers applied with various combinations of application time and placement method in 2013 on a S-deficient soil at Star City, Saskatchewan (LSD0.05 = 9).