AVAILABILITY OF ELEMENTAL S FERTILISER TO CROPS GROWN IN NEW ZEALAND

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Mixtures of molten sulphur (S) and bentonite cooled to form prills and finely divided sulphur combined together with bentonite to form prills, offer a high analysis form of S fertiliser which is safe to handle and apply. On wetting, finely divided S particles are dispersed. Thus they provide the advantages of rapid oxidation of finely divided S to plant available sulphate, without the hazards associated with application of fine dry S powder.

The effectiveness of the prills as a fertiliser depends especially on the ratio of S to bentonite (Fig.1), the form of bentonite used, the temperature and moisture conditions in the environment (Fig.2) and the sulphur particle size (Fig. 3). At the minimum bentonite content recommended for use in New Zealand (10%) there is likely to be variability between different batches of these products. At higher bentonite concentrations, this variability declines.

The elemental S is a slow release form of fertiliser compared with the sulphate form of superphosphate or ammonium sulphate (Sinclair et al. 1985). Sulphur from s/bentonite prills is more slowly available to plants than dry powdered elemental S of similar partlicle size range. However, prills generally release sulphate to plants within the season of application and have proven to be an effective form of pasture fertiliser for biennial applications. This was especially evident on a rendzina soil (limestone) where sulphate leaching limits the effectiveness of traditional superphosphate fertilisers.

Elemental S fertiliser has not been recommended for use in annual crop production, unless applied a year in advance of seeding (current recommendation in Saskatchewan). Recent experiments in north-eastern Saskatchewan have shown that elemental S (Degra Sul) will increase annual crop yields when applied in the spring of the planting year (Nuttall 1986). The elemental S was surface broadcast and incorportated to a shallow depth by the seeding implement. Usually, fertilisers when broadcast are incorporated by disc or cultivator to depth of 5 cm or more.

Preliminary glasshouse trials in New Zealand showed that neither temperature, soil moisture or placement of the elemental S fertiliser had little effect on yield response of rape to S. The position of the prills on the surface of the soil made them vulnerable to breakage and dispersion by wind and water erosion as observed in a field experiment at Middlemarch, N.Z. In a glasshouse experiment the dispersion of one half the elemental S prills with a spatula resulted in a much higher yield than deep placement where physical dispersion of the prills was not possible (Table 1).

A field experiment was conducted on Clutha soil (Recent soil) to measure the effect of placement of S fertiliser and S fertiliser source (elemental S and ammonium sulphate) on herbage and seed yield of oilseed rape. The placement treatments were: (1) shallow incorporated, N-S fertiliser incorporated by the seeding implement, (2) deep incorporated, N-S fertiliser incorporated to a depth of 7.5 cm by a heavy duty cultivator (3) banded N, nitrogen fertiliser banded in a row to a depth of 2.5 cm, S fertiliser broadcast before seeding (4) banded N and S, N-S fertiliser banded together to a depth of 2.5 cm (5) surface applied, N-S fertiliser applied on the surface of the soil after seeding. The sulphur fertiliser was applied at 50 kg^{-1} with with 65 kg N and 20 kg P ha^{-1} as basal treatments.

Yields of six plants per plot harvested at the rosette stage (Table 2) show a similar pattern of results to final seed yields obtained in Canada (Nuttall 1987). Shallow incorporation of prilled S by the seeding implements was shown to produce the highest herbage yields, whereas, deep incorporation of ammonium sulphate with a heavy duty cultivator to 7.5 cm produced the lowest yield.

Banded N and S elemental S fertiliser produced the highest yield of oilseed rape (Table 3). Shallow incorporation of the NS fertiliser did not match results obtained in Canada or the earlier rosette stage yield. In Canada the N fertiliser source was ammonium nitrate, which may have been more efficient with surface application than urea. Because of higher rainfall, warm temperatures and a longer growing season resulting in yields of at least two tonnes per hectare higher than in Canada, loss of urea N fertiliser because of denitrification or volatilization could have reduced the yield of the shallow treatment relative to deep banding. Banding of N fertiliser has been shown to be the most efficient method of applying N fertiliser in cropping. Banding N and S fertiliser to a depth of 5 cm with the plot seeder and then seeding the rapeseed in the same band helped to disperse the elemental S. This approach may not be suitable for farm field conditions because the hoe openers of the seeding implement may not follow in the same track of the banded row. In western Canada, to aid in leveling of fields, the fertiliser banding equipment is run perpendicular or diagonal to the direction of seeding. Therefore, larger field or plot trials would have to be established to determine if diagonal band placement would be an effective method of applying elemental S fertiliser.

References:

[1] Nuttall, W.F. 1987. A comparison of sulphur fertiliser sources applied on wheat and canola - update 1986. Proceedings of the Soils and Crops Workshop, February 19-20 1987. University of Saskatchewan, Div. of Extension, Saskatoon, Saskatchewan.

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Table 1. Effect of elemental S (Degra Sul) placement and batch (dispersion) on rape herbage yield harvested at 92 days in the glasshouse.

Batch	Dispersion tests+	Placement*		Mean
		Shallow, 0-1 cm	Deep, 5 cm	
	% S < 0.5 mm	Yield in t ha^{-1}		
1.	52.8	3.27	1.82	2.55
2.	5.4	2.75	1.60	2.18
	Mean	3.01	1.71	
	Control, ammonium sulphate	4.48		

* F test significant for placement effect, $P < 0.05$, prills on surface were dispersed physically at 49 days.
+ Percentage elemental S passing through 0.5 mm mesh sieve after 48 hour dispersion in water.

Table 2. Effect of sulphur fertiliser source and placement on yield of rape herbage at rosette stage of growth at Middlemarch on Clutha soil.

Sulphur fertiliser placement		S fertiliser source*		
		1. Elemental (Degra Sul)	2. Ammonium sulphate	Mean
		yield of six plants in g's per plot		
1. Shallow incorporated		51	39	45
2. Deep incorporated		38	31	35
3. Banded N and S shallow incorporated		45	39	42
4. Banded N and S		41	39	40
5. Surface applied after seeding		38	35	37
Mean		43	27	
Control, without S fertiliser	34			
Control, without N, P and S	21			

* F test significant for S fertiliser source was significant at $P < 0.05$.

Standard error of sulphur fertiliser source sulphur x fertiliser placement is 4.2.

Table 3. Effect of sulphur fertiliser source and placement on yield of rapeseed at Middlemarch in 1988, Clutha soil.

Sulphur fertiliser placement		S fertiliser source*		
		1. Elemental (Degra Sul)	2. Ammonium sulphate	Mean
		------ grain yield in t ha^{-1}		------
1. Shallow incorporated		4.53	4.82	4.68
2. Deep incorporated		4.82	4.70	4.76
3. Banded N and S shallow incorporated		4.47	4.81	4.64
4. Banded N and S		5.20*	4.98	5.09
5. Surface applied after seeding		4.52	4.17	4.35
Mean		4.71	4.70	
Control, without S fertiliser	4.47			
Control, without N, P and S	3.86			

* Significantly higher yield than controls P < 0.05.

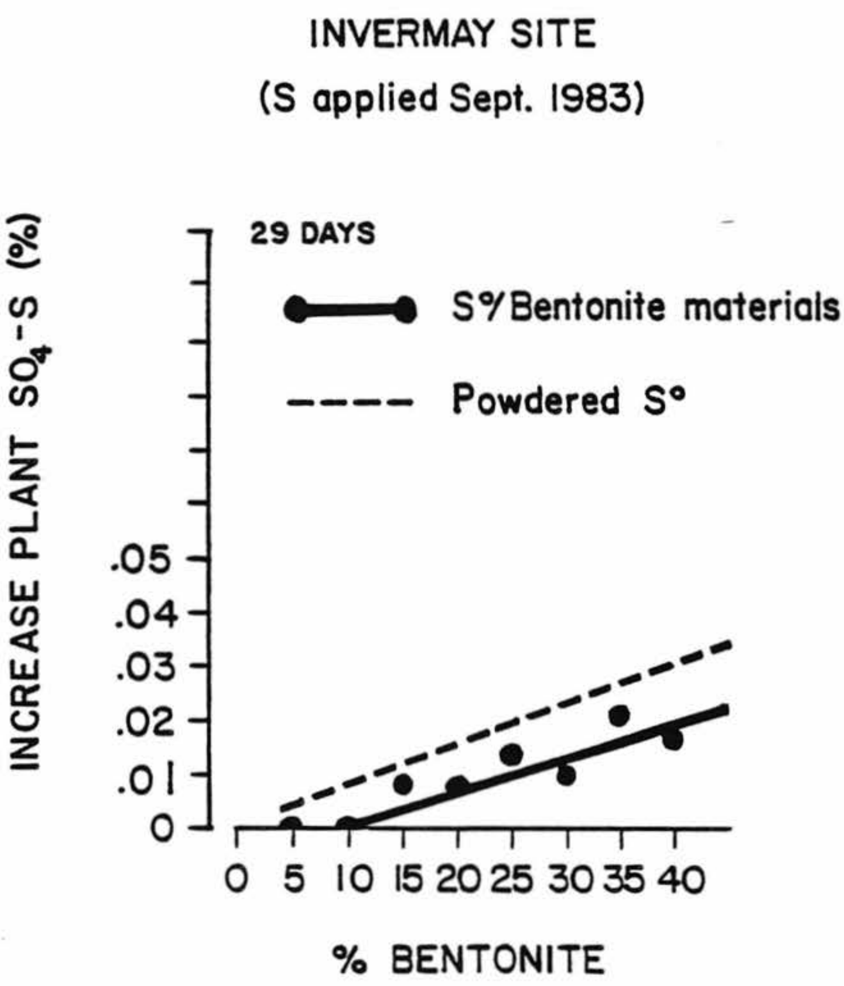

Figure 1. Plant SO_4-S responses to increasing bentonite concentration of elemental S/Na - bentonite prills applied at 50 kg S/ha.

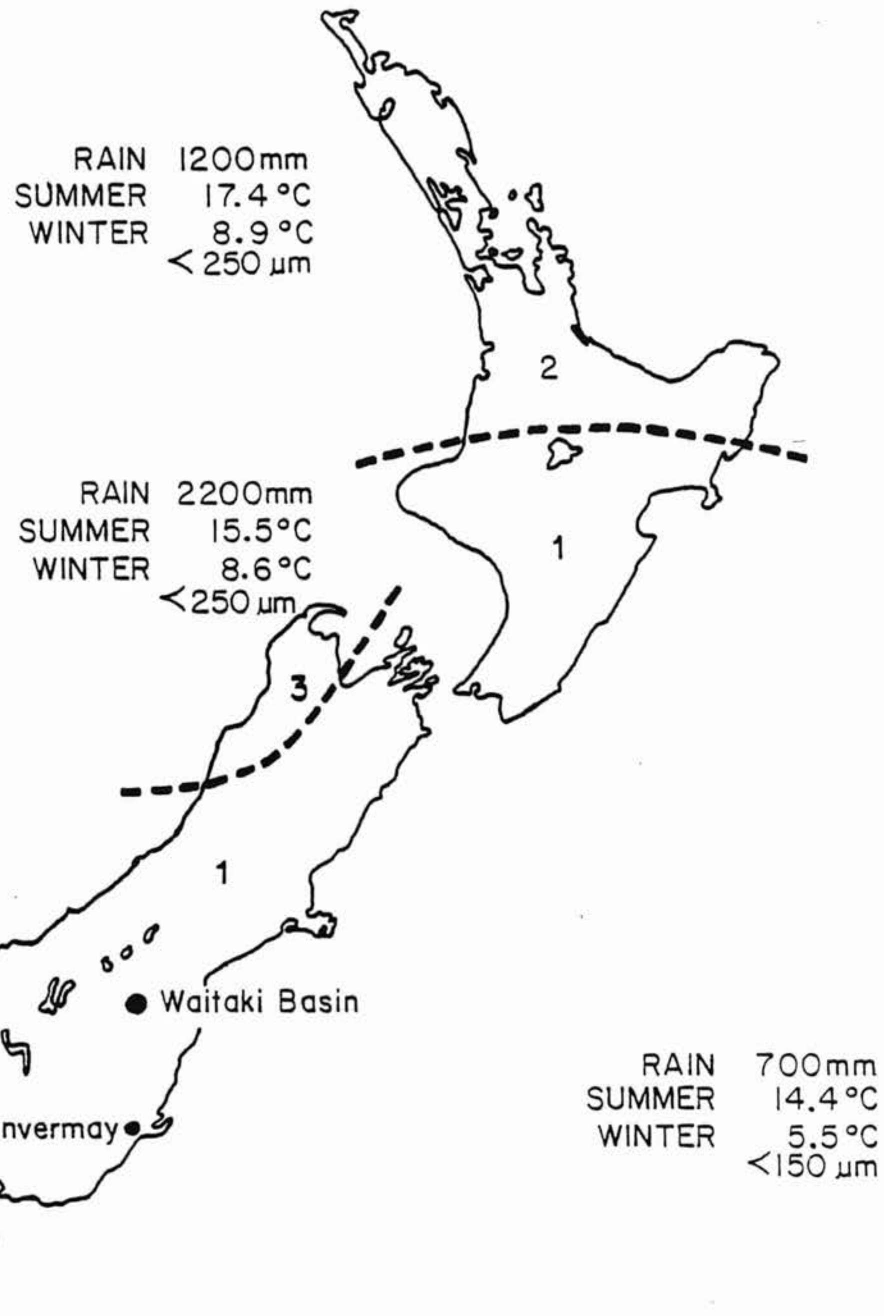

Figure 2. Map of New Zealand showing broad climatic zones which affect recommended S° particle size ranges.

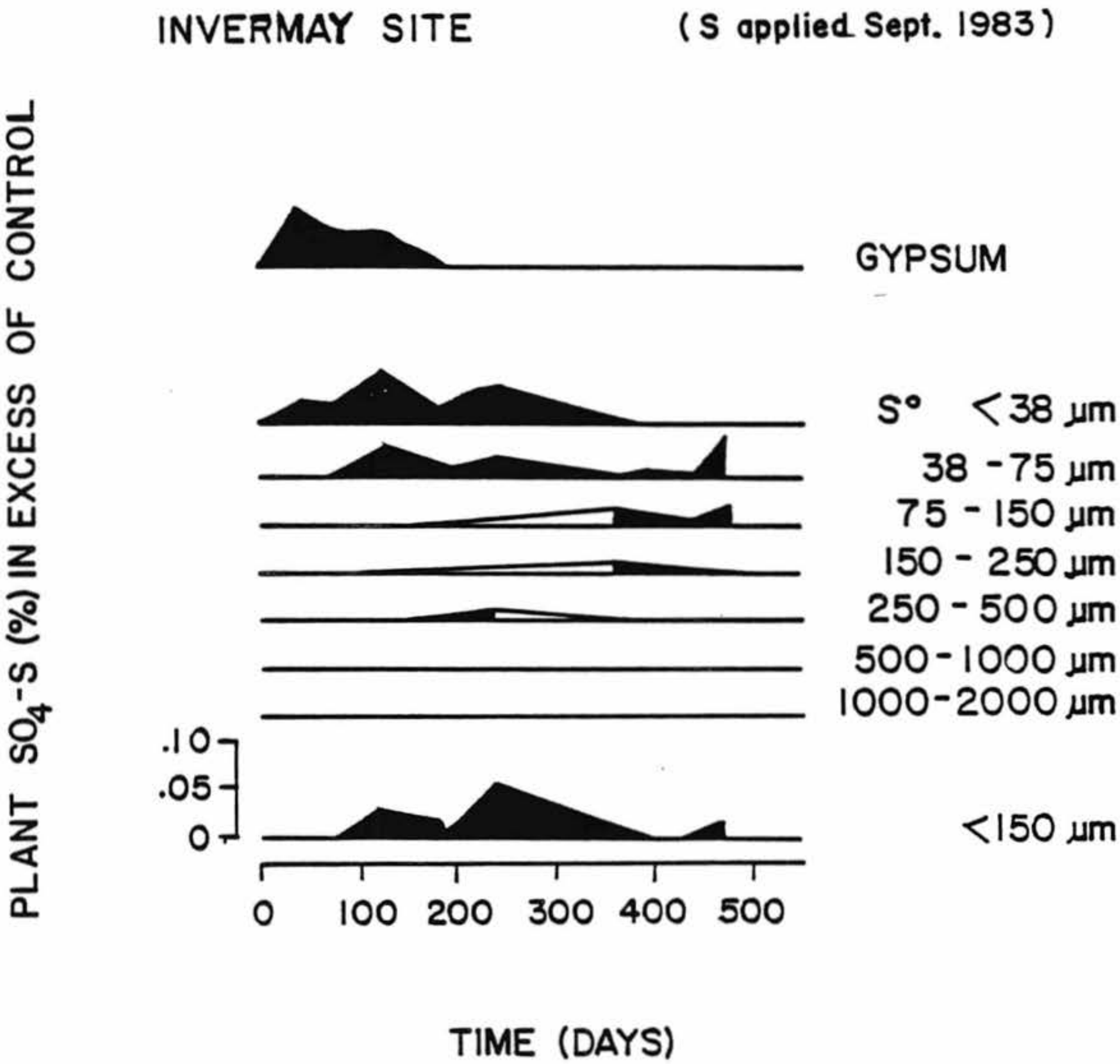

Figure 3. Plant SO_4-S responses to S° particle size ranges and gypsum applied at 50 kg S/ha.