Ameliorating alkaline soils with deep ripping and gypsum

The aim of this replicated trial was to investigate the effect of deep ripping and gypsum on root and plant growth of wheat, canola and lentils.

Summary
Gypsum applications and deep ripping are two possible methods of ameliorating sodic soils. In this trial applying gypsum as a soil ameliorant had a significant effect on wheat yields, but not canola. In wheat, gypsum applied at 5.0 t/ha (average yield 2.1 t/ha) yielded significantly higher than gypsum at 2.5 t/ha (average yield 1.9 t/ha) and no gypsum (average yield 1.9 t/ha) (LSD = 0.1).

Ripping had a negative and significant effect on yield – the deeper the ripping the lower the yield (wheat - unripped 2.3 t/ha, shallow ripped 2.1 t/ha and deep ripped 1.6 t/ha; canola – unripped 0.6 t/ha, shallow ripped 0.5 t/ha and deep ripped 0.2 t/ha).

Further investigation is required to ascertain the long-term effect of deep ripping and gypsum application.

Background
Much of the Wimmera/Mallee has sodic soil. The excess sodium disperse the clay particles leading to soil structure decline resulting in poor air and water movement through the soil and causing poor physical properties. Such soil can be ameliorated with the application of gypsum (calcium sulphate), which leads to the replacement of sodium attached to the soil particles, with calcium. Calcium has a stronger bond with clay particle surfaces and prevents dispersion. Deep ripping can physically alter the structure of the soil improving aeration and water movement through the profile.

This trial investigated the benefits of gypsum and deep ripping in ameliorating sodic soil.

Methods
Deep and shallow ripping took place in October 2000 Ripping depths were 0, 35 and 70 cm. In March 2001 gypsum was applied over the top of the ripping treatments at 0, 2.5 and 5 t/ha. The paddock was mechanically fallowed.

Yitpi wheat (90 kg/ha), Mystic canola (5 kg/ha) and Digger lentils (50 kg/ha) were dry sown in May with 80 kg/ha Mallee Mix 1. Weed and disease control was conducted during the season with normal applications of registered products.

Plant counts were conducted for all treatments and plots were harvested to gain grain yield, protein and screening results.

All trials were conducted using a fully replicated randomised block design.

Results
Ripping had a significant and negative effect on wheat and canola yields in 2001 (refer Table 1). In wheat, unripped treatments averaged 2.3 t/ha, shallow ripped treatments averaged 2.1 t/ha and deep ripped treatments averaged 1.6 t/ha. (LSD = 0.1). In canola, ripping had the same impact on yield with unripped, shallow ripped and deep ripped averaging 0.6, 0.5 and 0.2 t/ha respectively.

Gypsum application rate had no significant effect on grain yield in either the canola or wheat crops.

There was no significant interaction between the ripping depth and the gypsum rate applied.

Lentils failed due to moisture stress and two severe frost events.

Table 1: The effect of 3 gypsum rates and 3 ripping depths on wheat and canola at the Birchip site in 2001.

	Wheat			**Canola**		
Gypsum rate	**Deep**	**Shallow**	**Unripped**	**Deep**	**Shallow**	**Unripped**
0	1.5	1.9	2.2	0.2	0.5	0.6
2.5	1.5	2.1	2.2	0.3	0.5	0.7
5	1.7	2.1	2.3	0.3	0.4	0.5
Significant difference Gypsum Ripping	NS P<0.001, LSD 5% = 0.1			NS P<0.05, LSD 5% = 0.2		

Interpretation
Ripping had a negative and significant effect on yield – the deeper the ripping the greater the yield penalty (wheat - unripped 2.3 t/ha, shallow ripped 2.1 t/ha and deep ripped 1.6 t/ha; canola – unripped 0.6 t/ha, shallow ripped 0.5 t/ha and deep ripped 0.2 t/ha). The objective of deep ripping is to fracture the poorly structured sodic subsoil and in doing so create pathways for water and air movement through the profile. During the ripping operation movement of the hostile subsoil (sodium, boron, high pH) into the topsoil may occur, impacting on the chemical composition of the topsoil. Deep ripping also opens up the soil and increases evaporation from deeper down the profile – this was more than likely the cause of the lower yields in this dry year. Deep ripping also creates an upheaval in the soil profile upsetting many of the normal soil processes – this would take time to settle out. Often positive responses to deep ripping are not seen until the year after ripping has taken place.

Applying gypsum, as a soil ameliorant did not have a significant effect on wheat or canola yields - even at the highest rate of gypsum (5 t/ha). Gypsum is also a source of elemental sulphur, and although the soil was marginal in sulphur – 2ppm, it had no effect on canola which is highly responsive to S.

There was no evidence of gypsum application and deep ripping interacting to improve overall soil structure and crop growth.

Commercial Practice

On the sodic soils of the Wimmera and Mallee region applying gypsum will aid in ameliorating topsoils, however to impact on the subsoil very high rates of gypsum and time (3 or more years) will be required to allow the gypsum to move down the profile. The rate of gypsum to apply will be dependent on application intervals and the exchangeable sodium percentage of the soil.

Applying gypsum is also a cost-effective method of applying elemental sulphur, which is important, as high analysis fertilisers generally contain low levels.

Deep ripping can cause yield penalties in the year of ripping, and this trial work indicates that the deeper the ripping the more detrimental it is to yield. The BCG shall monitor this site to ascertain the long-term effect of deep ripping and gypsum application.