Effect of gypsum and deep ripping treatments on lucerne productivity under spray and flood irrigation on a red-brown earth

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In Northern Victoria, lucerne is grown under irrigation on shallow red-brown earths having massive B horizons of low permeability. Precision land grading is commonly used to provide adequate slope for surface drainage. However, low infiltration rates and limited soil water storage reduces the yield potential of lucerne. This paper describes two experiments aimed at enhancing water supply for transpiration by overcoming recognised soil physical restrictions.

Methods

In 1979, two field experiments a) spray irrigated and b) flood irrigated (0.13% slope) each 5.5 ha in area were sown to lucerne (cv. Dekalb brand 167). In each experiment, treatments were applied in bays 23x300 m and replicated twice prior to sowing. The soil amelioration treatments were; i) Control - no ripping, no applied gypsum, ii) gypsum, broadcast at 12 t ha^{-1} and mixed into the soil by scarifying to 100 mm depth, iii) soil profile deep ripped to 0.6 m depth at 1 m tine spacings in one direction plus gypsum as above and iv) deep ripped to .6 m depth in two directions plus gypsum as above. In both experiments two irrigations per cut were applied. The depth of water penetration at irrigation way. measured using a cone penetrometer within 24 hrs of irrigation.

Results and Discussion

All soil amelioration treatments out-yielded the control plots each year in both the spray and flood irrigated experiments (Table 1).

Table 1. Lucerne hay yields (t ha^{-1}) for 3 years after establishment 1980/81, 1981/82 and 1982/83.

Treatment	1980/81	1981/82	1982/83
a) Spray irrigation			
Control	11.4a*	14.8a	11.2a
Gypsum	17.1b	19.9b	14.8b
Rip x 1 plus gypsum	17.9b	23.0c	17.3c
Rip x 2 plus gypsum	18.6b	22.5c	17.2c
b) Flood irrigation			
Control	14.0a	15.8a	13.0a
Gypsum	16.4b	19.8b	17.7b
Rip x 1 plus gypsum	15.8ab	19.2b	15.9b
Rip x 2 plus gypsum	16.5b	19.7b	16.9b

*For each trial within columns, values not followed by a common letter differ significantly (P<0.05).

In the spray experiment the ripped and gypsum treatments produced consistently higher yields over three years than gypsum alone. Under flood, however, there was no apparent yield advantage of ripping over gypsum on this site. Lucerne yield increased in direct proportion to the additional water made available for transpiration in the ameliorated soils by deeper wetting of the soil profile at irrigation (r^2 of linear regression equations were 0.81 and 0.78 for spray and flood respectively). In the spray experiment lucerne yield was increased by 60% as the mean depth of water penetration was increased from 41 cm to 73 cm depth as the result of ripping plus gypsum.

The work emphasizes the importance of the subsoil as a source of water for transpiration while the sustained water intake and yield in the ameliorated soils over three years demonstrates their stability over time.