The performance of lupins on the alkaline grey clays of the Wimmera region of Victoria

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The trend towards more intensive cropping and the ability of legumes to boost soil fertility have prompted many wheat farmers to include lupins in their cropping systems. Disappointing yields of lupins, however, were generally obtained from crops grown on self-mulching calcareous grey clays. The low yields were usually associated with areas of poorly growing plants widely scattered throughout the crops.

Self-mulching calcareous grey clays are common in the Victorian cereal belt; they support about 25% of the State's cereal production and comprise nearly half of the Wimmera region. They have uniform fine-textured profiles, which crack significantly upon drying and are calcareous throughout. Gilgai formation is an important characteristic of these soils causing localised redistribution of lime and salt contents of the profile.

It was considered important to investigate the failure of these soils to support uniform crops of lupins, thus enabling the potential of lupins within a continuous cropping system to be assessed.

Methods

In a two-year study, 20 pairs of adjacent areas of "healthy" and poorly growing plants were pegged out (using 3 m^2 quadrats) in four commercial crops of *Lupinus angustifolius* cv. Uniharvest, located in the Wimmera region of Victoria. The soils beneath these crops were self-mulching calcareous cracking clays (Ug 5.24) and consisted of gilgai elements (mounds and depressions) for which the surface manifestation of microtopography had been obliterated by levelling and cultivation. At maturity, the quadrats were hand-harvested and grain yield and protein contents were measured. Immediately after harvest, two soil cores (70 cm deep) were taken from each quadrat area and divided at 10, 30 and 50 cm prior to being analysed for pH, exchangeable cations, total soluble salts, chloride and calcium carbonate contents.

Results and Discussion

The district's seasonal conditions during the two years of the experiment (1979 & 1980) were well within the normal range; the rainfall was 109% and 93% of the long-term average (423 mm) for the two years respectively.

At all sites, about 70% of the crop area was chlorotic, stunted and yielded significantly less grain than the "healthy" areas (0.47 vs 2.10 t ha^{1}); grain protein levels, however, were similar (28.1 + 2.2%). The root systems of the "unhealthy" lupins were ill developed and poorly nodulated.

All soil profiles were morphologically similar, except that those under the poorly growing plants had shallower topsoils (10 vs. 25 cm) and more obvious accumulations of carbonates. Analyses showed that all the soils were at least two pH units above the optimum pH for growth of *Lupinus angustifolius (l).* Compared with the productive areas, soil profiles (0-70 cm) supporting the "unhealthy" lupins had higher levels of pH (0-10 cm: 8.6 vs. 8.2; 10-70 cm: 9.8 vs. 9.3), calcium carbonate (8.3 vs. l.2%), exchangeable sodium percentage (22 vs. 15%), total soluble salts (l,362 vs. 793 ppm) and chloride (467 vs. 287 ppm). The recurrence of this pattern of soil differences was consistent with the land having previously been subjected to the gilgai process. The "healthy" and "unhealthy" areas of lupins corresponded to the gilgai depressions and mounds, respectively.

The results indicate that the gilgai formation oft these self-mulching calcareous cracking grey clays exacerbates the adverse effect of high alkalinity, rendering them incapable of supporting successful crops of lupins.

1. Bachevskii, S. 1977. Cited in Field Crop Abstr. 30 (10), 6249.