Inoculation and nodulation of subterranean clover on acid soils

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On strongly acid soils in North East Victoria, subterranean clover is failing to establish, grow and persist after cropping. On these soils (pH <5.5 in 1:5 H20), soil Rhizobium populations are very low and nodulation of subterranean clover is reduced (1). Rhizobium numbers can be increased by the application of lime, or more slowly by sowing high rates of inoculated seed, with corresponding improvements in nodulation (1). In this paper, the effects of no inoculum and the lack of clover host plants on Rhizobium numbers and on subsequent nodulation and growth of subterranean clover is discussed.

Methods

A factorial experiment combining lime and seed inoculum treatments was sown to subterranean clover (cv. Woogenellup) in May 1982 on a strongly acid soil (Rutherglen site; pH 4.9). Soil Rhizobium populations were counted, using the plant infection technique, and the nodulation and growth of regenerating subterranean clover measured in the following year. Soil Rhizobium numbers and the nodulation and growth of volunteer subterranean clover were measured at another acid field site (Lilliput; pH 5.O) 6 months after lime had been applied, but before the site was sown with inoculated subterranean clover seed.

Results and Discussion

Initial soil Rhizobium populations at both sites were below detectable levels. At the Rutherglen site. sowing uninoculated seed into unlimed soil did not increase Rhizobium numbers, despite a satisfactory density of host clover plants over the 1982 growing season (Table 1).

Table 1 Effect of inoculation and lime on Rhizobium and regenerating clover, 1983. Rutherglen site.

Lime	Inoc.	Rhizobium log (no/g soil) June	Nodulation (no/plant) April	Growth (t/ha DM) October
0	-	nd	0.7	2.26
	+	1.47	2.1	3.48
2.5	-	1.81	3.1	4.50
	+	2.21	3.9	5.87

nd = not detected (<10/g soil)

Without lime and inoculum, Rhizobium numbers did not increase despite satisfactory subterranean clover growth, suggesting that the strongly acid soil conditions adversely affected Rhizobium growth and nodule formation. With lime, Rhizobium populations increased in the absence of inoculum. Seed inoculation also improved Rhizobium numbers. The benefit of sowing inoculated seed, even into strongly acid soil, is clearly illustrated by the improved growth of subterranean clover regenerating in the following year.

At the Lilliput site, Rhizobium numbers remained undetectable on 3 of the 4 unlimed plots, in contrast to increases of 10^2 to 10^3 Rhizobium/g soil on plots limed 6 months previously. No host clover plants were present for most of this period (September to March), apart from subterranean clover volunteering on late summer rains 4 to 5 weeks before sampling. Of the plants germinating on the unlimed plots, 90% were not nodulated. The strongly acid soil conditions have adversely affected multiplication of Rhizobium in the absence of host subterranean clover plants.

1. Coventry, D.H., Hirth, J.R., Reeves, T.C. and Jones, H.R. (1984). Soil Biol. Biochem. (in press).