Enumeration and distribution of Rhizobium Trifolii in an acid soil and implications for nodulation of subterranean clover.

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Increasing acidity of many soils under improved pastures has highlighted the need to fully understand the response of the clover - Rhizobium symbiosis to such conditions. Decline in productivity of subterranean clover has. in some instances, been attributed to failure of symbiotic nitrogen fixation in acidic conditions. This paper reports on an investigation of Rhizobium trifolii in an acid soil (pH 4.1; 0-10 cm; 0.01M $CaC1_2$1:5 w/v) and its implication for nodulation of subterranean clover.

Methods

The experimental site was an old subterranean clover-based pasture located near Stratford, East Gippsland, Victoria. The pasture contained a low proportion (131) of subterranean clover (cv. Mt Barker) and a larger proportion (20%) of less desirable volunteer legumes (e.g. T.glomeratum) in the year prior to the commencement of the experiment. R.trifolii populations were measured throughout the season and within the soil profile (0-4, 4-9. 9-18. 18+ cm) of existing pasture with and without surface-applied lime (10t/ha) and on sown uninoculated subterranean clover plots (cv. Mt Barker) with and without incorporation of lime (10t/ha). R.trifolii were counted by the plant infection test(1) in 4 replicate samples(each a bulk sample from 10 sites). Nodulation was also examined in soil cores (9 x 25 cm) removed intact from the field.

Isolates of R.trifolii from acid soil were compared with standard strains TAI and WU95 for tolerance to acid-aluminium stress (2) and for symbiotic effectiveness in sterile sand culture (pH 6.5) and sterile acid soil (pH 4.1).

Results and discussion

Prior to the commencement of the 1984 season, R.trifolii numbers were greatest in the top of the profile with up to 10/g dry soil in the top 1 cm. but with 10^2-10^3/g dry soil in regions below 4 cm. High numbers at the top of the profile were associated with high organic matter. In those regions of the profile where both soil pH was low (e.g. < 4.2) and R.trifolii numbers were low. nodulation was restricted. Higher pH and/or larger R.trifolii numbers enabled more nodulation to occur. R.trifolii numbers ranged between 10^3 and 10^4/g dry soil when averaged over the top 4 cm.

These numbers increased by more than ten-fold after the break of the season. Numbers in the lower more acid regions also increased. but to a lesser extent. Cultivation reduced the rate of increase in R.trifolii numbers, whereas cultivation with incorporation of lime enabled populations to equal or surpass those in undisturbed soil. In soil cores, the incorporation of lime increased nodulation and the potential for symbiotic nitrogen fixation in all levels of the soil profile.

R.trifolii isolated from the field appeared to be at least as tolerant of acidity and aluminium as the standard strains TA1 and WU95. The symbiotic effectiveness of these strains is presently being determined.

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