THE EFFECTS OF PHOSPHORUS SUPPLY
ON COMPETITION BETWEEN
HARD BROME GRASS AND SUBTERRANEAN CLOVER

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SUMMARY

The influence of the nutrient status of the soil on competition between an annual grass and clover was examined in a series of glasshouse experiments. The experiments were designed as a replacement series, in which mixtures and monocultures of *Bromus rigidus* Roth. and *Trifolium subterraneum* L. cv. Mount Barker were grown at a constant plant density. Competitive ability of each component was measured by the crowding coefficient calculated from shoot dry weight. The two species concerned commonly grow in association in annual, sown pastures in the winter rainfall area of southern Australia.

In Experiment I the two species were grown over a range of frequencies at a plant density of 0.3 cm\(^{-2}\) on an acid siliceous sandy soil taken from under an established pasture that had been fertilized with superphosphate. The addition of phosphorus increased the competitive ability of the grass. The addition of potassium or sulphur produced a frequency dependant competitive response. The frequency dependence was attributed to a response of the grass in mixture to nitrogen fixed by Rhizobium growing in symbiosis with the legume.

The effect of phosphorus supply on the competitive ability of the two species was studied further in Experiments II, III, and
IV. A virgin siliceous sandy soil of low fertility was used in these and subsequent experiments. The effect of phosphate on competitive ability observed in Experiment I was repeated although the grass became less competitive with time. Variation of plant density (0.08 and 0.29 cm⁻²) did not alter the effect of phosphorus on competition. Root lengths were measured in this and subsequent experiments, using C¹⁴ labelling, to identify each component in a mixture.

Experiment III showed that the soil temperature markedly affected growth and competitive ability, favouring the clover at the higher soil temperatures. The effect of phosphorus showed no interaction with that of soil temperature.

In Experiment IV barriers were arranged below ground to allow or to prevent inter-specific mixing of root systems. Canopies were allowed to mix. The grass became more competitive when its roots were mixed with clover roots. Although this indicated that the grass derived some advantage from having its roots mixed with clover roots, there was little other evidence that the plants competed directly for scarce supplies of phosphorus. At the highest phosphate rate the mixtures overyielded at the final harvest, when the clover dominated the grass.

The relative importance of direct competition for scarce
supplies of phosphorus, and of indirect effects of the level of phosphate supply on competition for factors other than phosphorus is discussed in relation to the data from the four experiments. The agronomic implications, including the feasibility of manipulating pasture composition by fertilizer management, are also considered briefly.
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