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THE EFFECTS OF NITRATE NITROGEN  
AND PHOSPHATE ON THE  
NODULATION AND NITROGEN FIXATION  
OF WHITE CLOVER (TRIFOLIUM REPENS L.)

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### SUMMARY

The effect of nitrate nitrogen and phosphate on nodulation, nitrogen fixation and growth of white clover (Trifolium repens L.) plants was evaluated in a series of 'growth cabinet' and glasshouse experiments. Plants of a different age and nodulation status were used.

Nodule dry weight, nodule number and the average nodule weight declined on plants grown in solution cultures containing low concentrations of nitrate nitrogen (0.25 - 0.5mM). The nitrogen fixing activity of plants was also depressed by low concentrations of nitrate nitrogen, in experiments conducted during the winter and spring, but a stimulation in activity was observed in plants grown during the summer. The nature of the response was dependent on the growth response of the host plant to nitrate nitrogen. High concentrations of nitrate nitrogen (4mM) markedly reduced nodulation and nitrogen fixation in all experiments.

Phosphate increased the total nodule weight, nodule number and the nitrogen fixing activity of white clover plants, and several interactions between nitrate nitrogen and phosphate for nodulation and nitrogen fixation were obtained:

- (a) Nodule weight, nodule number and the nitrogen fixing activity were more severely reduced by low concentrations of nitrate nitrogen at low phosphate levels than at higher levels.
- (b) In one experiment a stimulation in nitrogen fixing activity occurred at the low nitrate nitrogen concentration and the highest phosphate level.
- (c) At high levels of nitrate nitrogen no increase in nitrogen fixing activity was observed when higher rates of phosphate were applied.

The effect of nitrate nitrogen and phosphate on the soluble and reserve carbohydrate content, and percent total nitrogen and phosphate in the host plant and nodule material was evaluated and the relationship of the carbohydrate to nitrogen ratio with nitrogen fixing activity determined. The ability of this ratio to explain changes in nitrogen fixing activity is discussed.

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### INTRODUCTION

It is a well established fact that the presence of nitrate ions can depress nodule development on legume roots, but recent studies in Queensland (Gates, 1970) have shown that this sensitivity can be ameliorated if phosphate levels are maintained at a high rate. Gates studies involved tropical legumes and their appropriate rhizobial symbionts, and this study was conducted to ascertain whether a similar situation obtains with a temperate species like Trifolium repens (White Clover).

Quantitative information on the effect of nitrate nitrogen and phosphate on nitrogen fixing activity in white clover was also lacking, and an attempt was made to rectify this deficiency by examining the changes in rate of ethylene production per plant or mg nodule (dry weight) with the application of nitrate nitrogen and higher rates of phosphate.