

PHOSPHATE RESPONSE AND UPTAKE BY
LOTUS PEDUNCULATUS (CV. GRASSLANDS MAKU),
TRIFOLIUM REPENS (CV. GRASSLANDS HUIA)
AND *TRIFOLIUM AMBIGUUM* (CV. PRAIRIE)

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ABSTRACT

Responses of oversown lotus (*Lotus pedunculatus* cv. Grasslands Maku), white clover (*Trifolium repens* cv. Grasslands Huia) and *Trifolium ambiguum* (cv. Prairie) to establishment and maintenance P were investigated in a field trial on a moderately acid (pH 5.25) high country (700 m a.s.l.) Yellow Brown Earth at Mesopotamia Station, South Canterbury. Results showed that lotus consistently outproduced white clover and *T. ambiguum*, especially at low and moderate P applications. Mean total dry matter exceeding 5 t ha⁻¹ yr⁻¹ for the two *Trifolium* species and nearly 6 t ha⁻¹ yr⁻¹ for lotus were recorded in the fourth year after establishment. Poor establishment, low plant population and unresponsiveness to applied P have resulted in *T. ambiguum* giving lowest yields in all P treatments.

The greater productivity of lotus was associated with higher recovery of applied P from the soil. In terms of total and legume dry matter per unit P applied, lotus was the most efficient of the legumes. Critical percentage P for lotus (0.25 - 0.30% P) appeared to be lower than white clover suggesting a lower 'internal functional requirement' for P in lotus.

Lotus appeared to be capable of fixing as much N as white clover,

but N transfer from lotus to the associated grasses was lower than from white clover. Nitrogen transfer from *T. ambiguum* was also inferior to white clover. Thus, grass dry matter yields were always highest when associated with white clover.

In another field trial, the distribution of root activities of the three legumes was investigated by placements of carrier-free ^{32}P in the soil profile around two-year-old spaced planted plants. Results showed that both lotus and white clover root activities (approximately 75% and 64% respectively) were concentrated largely within the top 5 - 7 cm from the soil surface. However, lotus root activities extended over a greater distance laterally (12 cm or more) than white clover, thereby exploring a larger soil volume. Less than 50% of *T. ambiguum* root activity was found in the surface horizon, and much of its root activity (approximately 65 - 70%) was confined to a radius of 5 cm around the plant. Since most of the applied P accumulated in the surface horizon, more than 90% of the total P absorbed by each legume was derived from the surface soil horizon. The contribution of the subsoil to the overall P nutrition of the legumes was negligible.

Phosphate responses and the efficiency of roots in P uptake (P absorbed per unit weight roots) in the legumes were also compared in solution culture experiments. Over a range of P concentrations (1 - 50 μM) lotus yields were significantly higher than the *Trifolium* species. Comparisons of the rate of ^{32}P -labelled phosphate uptake showed lotus roots to be more efficient especially from very dilute external P solutions. Root length per unit root weight and percentage of absorbed P translocated to shoots did not differ significantly between lotus and white clover. Disruption of P supply (distilled water pretreatment) prior to uptake experiment stimulated a greater increase in the proportion of absorbed P transferred to lotus shoots. For

T. ambigua, roots were significantly shorter and root diameter larger per unit weight than in the other legumes. Efficiency of P uptake by *T. ambigua* roots and translocation of absorbed P to the shoot was also inferior.

The possible reasons for the differential growth responses between the three legumes were discussed in terms of:

- a) the efficiency of P recovery (percentage applied P recovered in herbage) which is a function of root architecture, root morphology and root cellular uptake mechanisms;
- b) the transfer of absorbed P to shoots and its subsequent utilization (P utilization quotients) for dry matter production.

The potential for improving the efficiency of fertiliser usage through selection of P-efficient plant characters was briefly discussed. Suggestions were made for further research and assessment of lotus and *T. ambigua* for hill country pasture development.

Lotus cytisoides L.

Cardona, M. A. et Contandriopoulos, J. 1977.
L'endemisme dans les flores insulaires méditerranéennes.
Mediterranea, 2: 49-77

Pour Lotus cytisoides L. (Larsen, 1958; Heyn & Hernstadt, 1967; Cardona, 1973) chez lesquels deux degrés de polyploïdie ont été observés, le diploïde se trouve dans le bassin nord et centre méditerranéen (Espagne, Baléares, Corse, Yougoslavie, Grèce, Chypre, Sicile) alors que le tétraploïde habite les régions plus arides (Tunisie, Liban, Israël). p. 61.