

COMPARATIVE STUDIES OF THE PHOSPHATE ECONOMY OF PLANTS

by

KANTHI FONSEKA ABEYAKOON B.Sc.

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### Summary.

The ability of some plants to grow well at low phosphate concentrations without showing deficiency symptoms is examined. The plant selected for this investigation is Brachypodium sylvaticum. The study is in its nature comparative and the comparison was initially planned with two other grasses Festuca gigantea and Lolium perenne. Since their response to phosphate was not very different from that of Brachypodium, Urtica dioica was selected for comparison. The preliminary investigations are to determine any special ability of Brachypodium to utilize the sparingly soluble inorganic and organic phosphates. Experiments were carried out using rock phosphate which has apatite as its source of phosphate. Brachypodium showed no special ability to utilize this inorganic phosphate. By repeating this experiment with an organic phosphate source, the ability to utilize this source is ruled out. On examination of the morphology of plants in terms of root/shoot ratios, Brachypodium has a significantly higher root/shoot ratio than Urtica. The greater distribution of dry matter for root production in Brachypodium is one contributory factor for the good growth at low phosphate levels. On calculating the root surface area, even though Urtica has a higher root area per unit weight of root, Brachypodium still shows a greater root surface area than Urtica at the same age, especially under low phosphate levels. Rates of uptake of phosphate were compared on a short-term basis and on a long-term basis. Short-term uptake rates were measured for the duration of two hours using  $10^{-5}$  M  $\text{KH}_2^{32}\text{PO}_4$ . These rates obtained for the two species were similar. However, the long-term uptake rates calculated from growth analyses data show that there is no difference in the rates

at low phosphate concentrations, but at high phosphate concentrations Urtica is more efficient than Brachypodium. The effect of mycorrhiza on growth and phosphate uptake is examined. On examination of roots of the two species from their natural habitats, the roots of Brachypodium were always found to be infected, while those of Urtica were free from infection. The experiment carried out with mycorrhiza for Brachypodium gave conclusive evidence for the enhanced growth and increased phosphate uptake in mycorrhizal plants. The possibility that plants have different requirements for phosphate because they differ in their growth rates has been examined a) by growth analyses and b) by measuring photosynthetic rates. No conclusive evidence is obtained for lower growth rates expressed as relative growth rate or net assimilation rate, nor for leaf area ratio of Brachypodium to explain slow growth and hence low phosphate requirements. Both species have photosynthetic rates not significantly different from each other. The phosphate utilization efficiency did not give any conclusive results to show the greater efficiency of one species over the other at utilizing phosphate.

In conclusion, for plants to grow well at low phosphate concentrations the contributory factors are a higher root capacity and an enhanced efficiency due to mycorrhiza.