Some Effects of Mycorrhizae on the Phosphorus Nutrition of Monterey Pine Seedlings

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The role of mycorrhizae in the growth of coniferous trees is of interest not only as an uncommon ecological relationship and a matter of concern in afforestation but also as a problem to be solved before the mineral nutrition of such species can be satisfactorily related to the chemical properties of soils. The marked effects of mycorrhizal inoculation on the growth of coniferous seedlings are well known (3, 7, 10, 12) but the mechanism of mycorrhizal benefit is still obscure. The investigations of McComb (6, 7), in particular, have singled out phosphorus nutrition as a probable major factor in the response of coniferous seedlings to mycorrhizal infection on certain soils. The experiments reported here were designed to test the effect of mycorrhizae on the phosphorus nutrition of Monterey pine, *Pinus radiata*, D., Don., seedlings under various conditions.

**PROCEDURE**

**GENERAL METHODS**

For Experiment 1 a synthetic soil was prepared from quartz sand, bentonite, and difficultly available phosphatic minerals. Two prairie soils, an O'Neill sandy loam from near Ames, Iowa, and a Carrington silt loam from near Token Creek, Wisconsin, were used for Experiments 2 and 3. Previous studies of mycorrhizal response and analytical data concerning these latter soils have been reported by McComb (78), and Rosendahl (12), respectively. The test organism was Monterey pine. In Experiments 1 and 2, germinating seeds of known weight classes were sown, whereas 10-week old seedlings, grown in 1/10 Hoagland's solution, were used for Experiment 3. *Boletus luteus*, wheat, was introduced as the inoculating fungus but, as noted, no certain success was obtained. Where inoculum was added the noninoculated treatments received an equal amount of sterile substrate.

The culture vessels in Experiments 1 and 2 were No. 1 cannery tins which held 575 grams of the synthetic soil, 454 grams of Carrington soil, or 500 grams of the O'Neill soil. Glass cylinders of about 200 ml volume were used in Experiment 3. Since the plants were grown in the greenhouse, the vessels were placed in trays of water during the summer to reduce soil temperatures. Moisture was maintained close to weight. At harvest the plants were separated into tops and roots. In cases of doubt, the mycorrhizal nature of the roots was determined by examination of sections stained with cotton blue in lactophenol. For analysis the tissue was dried at 70° C and ashed with Mg(NO₃)₂ at 550–600° C. Phosphorus was determined by the molybdivanadophosphoric acid method (4). Following harvest, soil nitrate and ammonia, and phosphorus soluble in Morgan's extracting solution were determined (11).