THE EFFECT OF COBALT ON THE GROWTH OF YOUNG LUCERNE ON A SILICEOUS SAND

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1. INTRODUCTION

The establishment of lucerne on areas of siliceous sand in south-eastern South Australia has frequently been hindered by difficulty in ensuring adequate symbiotic nitrogen nutrition. Earlier investigations have shown that impaired nitrogen fixation on these soils has been variously caused by the absence of a suitable strain of Rhizobium meliloti in the soil; by the failure of a large proportion of plants to nodulate when inoculated seed had been sown on sands having a pH below 6; and by molybdenum deficiency. Tiver 14 has reviewed these problems and related aspects of legume establishment on acid soils in southern Australia.

Field work has shown that the poor nodulation rate on acid sands can be greatly improved by drilling inoculated seed with 200 lbs per acre of lime concentrated in the drill rows 7 13, and molybdenum deficiency can be corrected by use of molybdenum fertilizer. Response to these treatments has proved somewhat erratic and while this is probably due in part to seasonal climatic variation the possibility that other factors are involved has been considered.

Cobalt deficiency in plants became of agronomic interest with the discovery that three legumes, Glycine max 1 2 3 Medicago sativa 5 12 and Trifolium subterraneum 6, suitably inoculated, required a cobalt supplement when grown in nutrient solutions free of cobalt and low in nitrogen. Field responses to cobalt by subterranean clover have subsequently been reported in Australia 10 11.

The cobalt requirement of lucerne in the field is of interest as this species is commonly used on the type of deep sand in south-eastern...
South Australia on which a response had previously been found in subterranean clover \(^{11}\). In the experiments here presented, the relationships between cobalt response and factors which may be important in determining the ability of lucerne to nodulate and fix nitrogen on acid soils (liming, inoculation, and molybdenum treatments) have been studied.

2. EXPERIMENTAL SITE

The experimental site lies 25 miles south of Bordertown, South Australia, in an area of podsolized sand of very low fertility. The average annual rainfall at the nearby town of Frances is 19.5" and is estimated to be close to this at the experimental site. Although the rainfall distribution shows a winter maximum, lucerne can grow for much of the year provided nutrients are not limiting.

The top six inches of soil is a grey siliceous sand (pH 5.6–5.8) underlain by four to five feet of pale yellow sand over a layer of sandy clay which is mottled reddish brown and capped by a layer of ferruginous concretion. Similar soils occur extensively in the eastern part of the Upper South East region in South Australia and contiguous areas in the state of Victoria.

The site was adjacent to the experiment in which a response to cobalt had been obtained in subterranean clover in the previous year. \(^{11}\) It had been partly cleared of natural vegetation by ploughing four years previously. Shortly before the experiments commenced, the regrowth was cleared and the area cultivated and harrowed to produce a seedbed.

3. EXPERIMENTAL METHODS

(a) Experiment A

A replicated factorial design with split plots was used. The main plot treatments were in three blocks, each containing all combinations of the following liming and inoculum treatments:

<table>
<thead>
<tr>
<th>Lime</th>
<th>Inoculum rate or Nitrogen</th>
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<tr>
<td>Nil</td>
<td>Nil</td>
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<tr>
<td>Calcium carbonate, 1,257 kg per hectare (1,120 pounds per acre)</td>
<td>Nil + 112 kg per hectare (100 pounds per acre) of nitrogen as urea.</td>
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<td></td>
<td>Standard commercial inoculation.</td>
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<td>Heavy inoculum rate (approx. 1000 ( \times ) commercial rate)</td>
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The sub-plot treatments were:

Nil, and cobaltous sulphate (\( \text{CoSO}_4 \cdot 7\text{H}_2\text{O} \)), 280 g per hectare (4 ounces per acre).