WATER-TABLE DEPTH AND OXYGEN CONTENT OF DEEP PEAT IN RELATION TO ROOT GROWTH OF PINUS CONTORTA

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SUMMARY

Oxygen concentrations were measured at monthly intervals in deep peat in plots in which the water-tables are maintained artificially at levels ranging in depth from 11 cm to 33 cm below the surface. Good correlation was observed between weight of roots of 11 year old Pinus contorta in these plots and oxygen concentrations in different horizons at all times of the year, although strongest correlations coincided with the winter months when oxygen concentrations are lowest, indicating that the root pattern is determined more by adverse rather than optimum seasonal conditions.

INTRODUCTION

The anaerobic conditions obtaining in undrained peatland limit vegetational development to a relatively small number of species which can survive in a largely oxygen-deficient habitat. Some indigenous species achieve this by having root systems confined to the surface horizon while other are anatomically or physiologically adapted to root in such water-logged conditions. However, if crop plants such as herbage or trees are to be grown, considerable improvement in the physical conditions obtaining in the peat must be achieved. This inevitably involves drainage, to lower the water-table and improve the aeration of the upper soil horizons.

This paper examines the effect of the depth of the water-table on the oxygen concentrations in different horizons in deep blanket peat and the relationship between these and the root development of Pinus contorta.
EXPERIMENTAL

The experimental site is located within an area of blanket bog 209 m above sea level at Inchnacardoch Forest, Inverness-shire, Scotland, and comprises 4 plots, each 30 m x 3 m, in which water-tables are maintained at different levels by impounding water in perimeter ditches (Table 1). One third of each was planted with *Pinus contorta* (North Coastal origin – Skagway, Alaska) in 1963 the establishment and development of which have already been studied² ⁴ ⁵. Measurements of oxygen concentrations in the peat were made monthly at duplicate sites within the planted areas of the plots.

**TABLE 1**

Mean water-table levels in experimental plots
(measurements are from the surface)

<table>
<thead>
<tr>
<th>Plot</th>
<th>Nominal water levels in surrounding ditches, cm</th>
<th>Mean water-table levels in plots, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>11.0 ± 0.5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>18.8 ± 0.6</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>24.8 ± 0.8</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>33.2 ± 1.0</td>
</tr>
</tbody>
</table>

METHODS

Small plastic cells were constructed, each incorporating a window covered by a thin membrane permeable to molecules of oxygen but impermeable to water (Fig. 1). A cell consists of a 40 ml polypropylene test tube, 2.5 cm diameter, (A), with two rows of five 4 mm diameter holes drilled in a 2 cm band round the middle (B). These holes are covered with a 4 cm wide strip of silicone rubber membrane (C) which encircles the tube and is secured to it with Araldite in such a way that no leakage occurs. The membrane found most satisfactory is silicone rubber of 0.001"/0.002" thickness reinforced with polyester net, although polyethylene (polythene) or polytetrafluoroethylene (PTFE) could also have been used⁹ ¹¹. Before attaching the membrane, a hoop-shaped handle of polypropylene rod (D), of dimensions appropriate to the depth to which the cell is to be inserted, is welded on the sides of each tube near the top. Each cell is fitted with a rubber stopper with a hole (E), through which excess water can flow when the stopper is inserted into the water-filled tube thus avoiding pressure on the delicate membrane. The hole in the stopper is subsequently closed with a rust-proof, self-tapping screw.

A specially constructed semi-cylindrical auger with an outside diameter the same as that of the polypropylene tubes is used to remove a core of peat to