CLUBROOT RESISTANCE IN TURNIP
II. THE 'SLURRY' SCREENING METHOD AND
CLUBROOT RACES IN THE NETHERLANDS

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SUMMARY

In the Netherlands four clubroot races in stubble turnips are recognised and are coded a, b, c and x. The first three used to be designated respectively as Waaslander, Gelria A and Mommersteeg, the original differentials. So far no resistance to the x-race has been found. The ‘slurry’ screening method is described and its results compared with the ‘root-dip’ method. A new set of differentials has been created using inbred lines homozygous for specific combinations of resistance and susceptibility.

INTRODUCTION

Towards the end of the 1960’s some 80000 ha of stubble turnips were annually grown in the Netherlands. Clubroot was the only serious disease problem. Several clubroot races were recognised and several sources of resistance were known. Resistance was found in varieties as Mommersteeg, Gelria, Novitas, Waaslander, with white fleshed roots, and in the yellow fleshed green top group (LAMBERTS, 1958; WIT & VAN DE WEG, 1964; TJALLINGII, 1965). In 1974 the stubble turnip area is estimated to have declined to 40,000 ha because of a major change to maize and grass as fodder crops.

Turnips are a typical cross fertilising plant species. The varieties and landraces mentioned were selected by mass selection and bulked in isolation. This implies a considerable degree of heterozygosity and therefore these varieties were suspect as differentials. Since the late 1950’s clubroot research at the SVP has been aimed at obtaining a set of homozygous turnip differentials.

A selection and inbreeding program was carried out to reach the necessary stage of homozygosity. Prerequisite was the availability of an effective glasshouse screening method. What has been described below is the ‘slurry’ method, which emerged from a series of experiments during the early 1960’s.

THE SLURRY METHOD

Clubbed tissue is stored in deep freeze (–15 to –20°C) where it will keep its infective power for at least five years.

The ‘basic suspension’ and the ‘slurry’ are prepared as follows. Depending on the desired test, for example a quantity of 12 g of deep frozen clubbed roots is brought to normal temperature in about 3 hours. The material is macerated in a household mixer with 25 ml water added, a quantity roughly twice the weight of the clubbed tissue. The mixer is cleaned out with a similar volume of water which is then added
Table 1. Resting spore counts calculated per ml of basic suspension.

<table>
<thead>
<tr>
<th>Suspension</th>
<th>Spore concentr.</th>
<th>Suspension</th>
<th>Spore concentr.</th>
<th>Suspension</th>
<th>Spore concentr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$0.8 \times 10^8$</td>
<td>6</td>
<td>$1.3 \times 10^8$</td>
<td>11</td>
<td>$1.9 \times 10^8$</td>
</tr>
<tr>
<td>2</td>
<td>$0.8 \times 10^8$</td>
<td>7</td>
<td>$0.7 \times 10^8$</td>
<td>12</td>
<td>$1.2 \times 10^8$</td>
</tr>
<tr>
<td>3</td>
<td>$2.2 \times 10^8$</td>
<td>8</td>
<td>$0.5 \times 10^8$</td>
<td>13</td>
<td>$0.7 \times 10^8$</td>
</tr>
<tr>
<td>4</td>
<td>$0.8 \times 10^8$</td>
<td>9</td>
<td>$0.2 \times 10^8$</td>
<td>14</td>
<td>$1.0 \times 10^8$</td>
</tr>
<tr>
<td>5</td>
<td>$1.0 \times 10^8$</td>
<td>10</td>
<td>$1.0 \times 10^8$</td>
<td>15</td>
<td>$0.5 \times 10^8$</td>
</tr>
</tbody>
</table>

To the macerated lot. There is now about 60 ml of basic suspension. The density of resting spores can be counted with a haemacytometer (Table 1).

The basic suspension is further diluted with tap water to 600 ml. With a mixture of steamed soil and garden peat it is made into about 1200 cc of a viscous mud that will pour easily. This is the slurry.

For testing during winter a 40 cm deep bench in a glasshouse is fitted out with a heating cable on the bottom attached to a thermostat. The first 10 cm are filled with steamed soil so as to distribute the heat more generally. The bench is filled with a 2:1 mixture of steamed soil and garden peat. In this soil 4 cm deep holes are made with a small stick of about 3 cm diameter and with a rounded off end. In a 1 m broad bench nine holes (10 cm apart) are made across in a row, rows being 15 cm apart. Four rows (36 holes) are filled with the quantity of 1200 cc mud. This is left to dry out and shrink for two days. The hard mud surface is now broken and sown with 10–20 seeds per hole of the plant material to be tested. The stand per hole is subsequently thinned to about 8 plants. One row of 9 holes is normally used to test one progeny.

To get good growth in winter, one 400 W Philips H.P.L. lamp per m$^2$ of bench 16 hours a day is essential. For good infection the heating cable should keep soil temperature at about 24°C.

During late spring and summer, testing can be done very well in a cold frame. A heating cable is not required. When a longer growth period of 10–13 weeks is allowed the plants will become larger and rows should be spaced out 20 or 25 cm.

Scoring is done on uprooted plants 6–13 weeks after sowing, depending on the bench. Any plant with a visible clubbed root is scored susceptible, no grading was done so far. Glasshouse trials showing 60% or more diseased seedlings in the susceptible differential are considered successful. From 48 such trials since 1968 five failed on this criteria. Cold frame trials normally have a disease incidence of 80% in the susceptible differentials. Out of 12 cold frame trials done so far one has failed.

Basic suspensions contain roughly $10^8$ resting spores per ml (Table 1). Working down to dilutions as outlined above the slurry contains about $5 \times 10^6$ resting spores per ml. A hole will contain about 33 ml of slurry with upwards of $10^8$ spores. In this medium about 8 plants will grow through whatever may be their most susceptible stages.

THE SLURRY METHOD COMPARED WITH THE ROOT DIP METHOD

The root dip method is characterised by the transfer of plants about 10 days old. During the transfer the roots are put into a basic spore suspension for a period of