REPLANT DISEASE IN APPLE ORCHARD SOIL'

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Abstract

In a pot biossay for the presence of replant disease, Beautiful Arcade apple seedlings grew significantly better in most apple orchard soils fumigated with chloropicrin than in untreated soil. The cause of the poor growth of apple trees in replant orchards in Nova Scotia is not known.

Introduction

In Nova Scotia several apple growers have experienced difficulty in obtaining satisfactory growth of apple trees when replanting apple orchards. The problem did not appear to be associated with poor orchard management. Replant diseases of apple have been reviewed by Hoestra **(1)** and Savory *(3)*. Hoestra **(1)** distinguished two types of replant problems: that caused by nematodes, and that due to specific apple replant disease **(SARD)** of which the cause is unknown. A pot test, comparing the growth of apple seedlings in non-fumigated soil and in soil fumigated with chloropicrin, has been developed to assay for the presence of **SARD** (4). The results of using this assay on apple orchard soils are reported in this paper.

Materials and methods

The pot bioassay test for **SARD** was essentially that outlined in a personal communication from D. M. Way, East Malling Research Station, Maidstone, Kent, England. The orchards were all on sandy loam soil and samples from each orchard site consisted of bulked subsamples of the top **22–25** cm of soil. The soil samples were sieved and 3 liters of each placed in each of two 3.6-liter, wide-mouth, screw-cap, glass jars. Chloropicrin, *0.6* ml, was added to each filled jar and the screw cap sealed with Strip Seal weather strip (Tremco Manufacturing Co. of Canada Ltd.). After **7** days the soil was removed and exposed to the air for a least a week during which it was turned twice. A Beautiful Arcade apple seedling at the cotyledon stage of growth was set into each of **10**, **11.5–cm** clay pots each containing **500** cc of fumigated soil, and **10** pots of non-fumigated soil from each site. The pots of soil from each site were randomized in **10** blocks on the greenhouse bench, hand watered daily, and fed nutrient solution at weekly intervals. When well established the height of the seedlings was measured every **2** weeks.

Results

In **1970**, the SARD test was carried out on two soil samples from each of five apple orchards designated A,B,C,D, and E. One sample in each orchard was from a site where young apple trees were growing poorly (poor growth soil) and the other was from a site where growth was satisfactory (good growth soil). The Beautiful Arcade seedlings were transferred to pots of fumigated and non-fumigated soil from each site on April **9** and

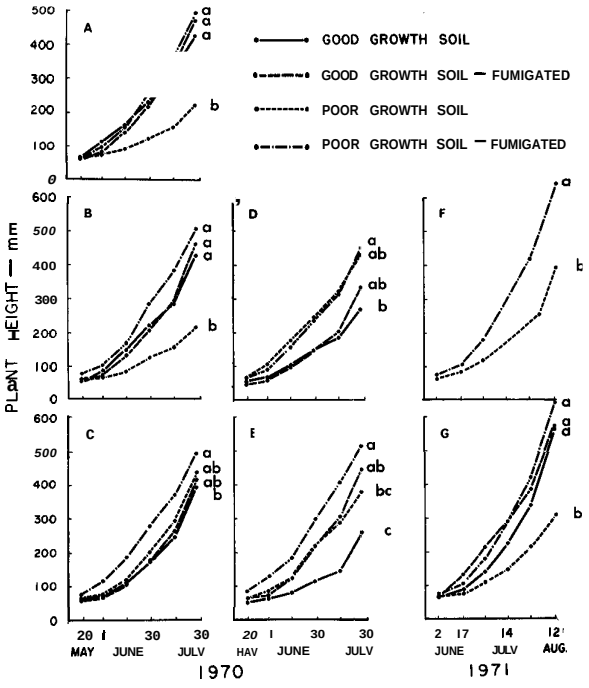

Figure 1. Growth of Beautiful Arcade apple seedlings in chloropicrin fumigated soil and in non-fumigated soil from Orchards A to G. The small letters indicate Duncan's Multiple Range groupings of treatments which do not differ significantly at the 0.01 level.

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the height of the seedlings was measured on the dates shown in Fig. 1.

The growth of the seedlings (Fig. 1) was significantly (P.01) increased by fumigation with chloropicrin in the poor growth soils from orchards A, B, and E, but not in those from orchards C and D. In the good growth soils fumigation had no significant effect on the growth of seedlings from orchards A, B, C, and D, but in orchard E it resulted in a significant (P.01) increase in growth. orchards A and B were the only ones in which there were significant differences between the growth of apple seedlings in non-fumigated poor and good soils.

In 1971, the SARD test was done on soil from two orchards (F and G). In orchard G, separate soil samples were tested as in 1970 from a site where trees were growing poorly and a site where growth was satisfactory. Orchard F did not have a site where growth was considered satisfactory so the test was done on a single sample from this orchard. The apple seedlings were transferred on May 12 and measured on the dates shown in Fig. 1. Fumigation with chloropicrin significantly (P.01) increased the growth of the apple seedlings in the poor growth soil from both orchards but had no effect on growth in the good growth soil from orchard G.

In 1972, the SARD test was done on soil samples from the Canada Department of Agriculture Research Station at Fredericton, N.B. (orchard H) and Kentville, N.S. (orchards I, J, K, L, M, and N). The origin of the samples was as follows:

Orchard	Site	pH	
H	1	4.7	Area formerly in apples
	2	5.4	Area never in apples
I	1	6.2	Area recently cleared of apple seedlings
J	1	4.9	Area recently cleared of apple seedlings
K	1	4.2	Pears removed, tree sites, area formerly in apples.
	2	4.4	Pears removed, between tree sites, area formerly in apples
L	1	4.9	Apples removed, tree sites
	2	4.6	Apples removed, between tree sites
M	1	4.9	Apples removed, tree sites
	2	5.2	Apples removed, between tree sites
N	1	4.4	Area of poor tree growth
	2	4.2	Area of good tree growth

The Beautiful Arcade seedlings were set in pots of fumigated and non-fumigated soil on October 16 and the growth measured on the dates given in Fig. 2.

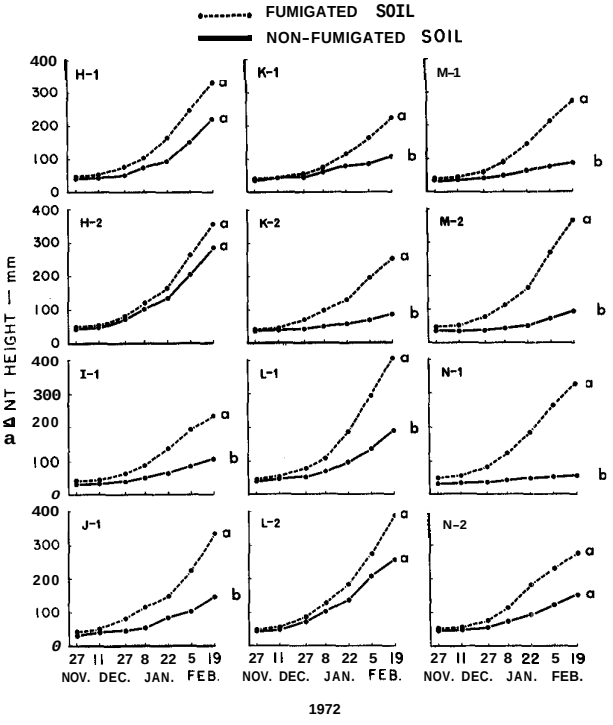

Figure 2. Growth of Beautiful Arcade apple seedlings in chloropicrin fumigated soil and in non-fumigated soil from Orchards H to N. The small letters indicate treatments which do not differ significantly at the 0.01 level.

Fumigation with chloropicrin did not significantly affect the growth of apple seedlings in the apple and non-apple Fredericton soils but, except in soil from the area between tree sites in orchard L and the area of good tree growth in orchard N, it significantly (P.01) increased growth in all Kentville soils. In orchard M the response to fumigation was greater in soil from between tree sites than in soil from the tree sites. Orchard N was replanted in 1968. Its area of poor tree growth included five consecutive trees in the outside row.

Discussion

A response of apple seedlings in soil fumigated with chloropicrin does not necessarily mean that the soil sites are affected by specific apple replant disease (SARD). Several criteria which were discussed by Savory (4) and Hoestra (1) must be established before this can be concluded. However, the results here (Figures 1 and 2) do show that a replant problem exists in Nova

Scotia apple orchards. The cause of SARD is not known but replant problems in the soil may also be caused by such factors as nematodes, high arsenic content, and nutrition (1, 2, 5). Growth may also be better in fresh or non-fruit soil treated with chloropicrin, but Savory (4) points out that the greatest part of the response from fumigation is due to replant effects.

In the 1970 and 1971 tests (Fig. 1) the apple seedling response in the soils from orchards C and D do not indicate that SARD caused the poor tree growth. There was no significant effect from fumigation in soil from either orchard. In orchard E there was a significant response from fumigation in soil from the areas of both good and poor tree growth but there was no significant difference in nonfumigated soil from tne areas of good and poor tree growth. The results from orchards A, B, F, and G suggest that SARD or another replant disorder was present at the sites of poor tree growth. This would also apply to most of the sites sampled in 1972 (Fig. 2).

These tests give no indication that the response was specific for apples. In orchard K the soils were from a pear orchard but the pears were preceded by apples. According to Savory (4) SARD occurs most often in soils with a pH of 6.0 or over. Except for orchard I, which had recently been limed, all the orchards sampled in 1972 had a pH below 6.0.

Because it is not known if the response was specific for apple and the soil sites have not yet been examined for nematodes and other replant disorders, these pot tests do not definitely established the presence of SARD in Nova Scotia apple orchards but they do show that a replant problem exists which can be ameliorated by fumigation with chloropicrin.

Literature cited

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