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Environment Canada / Environnement Canada

Forestry Service / Service des Forêts

1976

SOME PRELIMINARY OBSERVATIONS ON THE UPTAKE AND TRANSLOCATION OF BENOMYL BY MAPLE (*ACER SACCHARUM*) MARSH. FOLLOWING TRUNK - INJECTIONS

by

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File Report No. 65 November, 1976.

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INTRODUCTION

Because of decimation of the American elms (*Ulmus americana* L.) in many metropolitan cities, government agencies and the private sector are replacing dead elm trees with other species of ornamental trees such as maple, oak, birch, ash etc. Clearly, planting of trees is important in urban environments and should become more important in the near future as rapid urbanization continues with the development of large cities, greenbelts, arboretums and recreation parks. With newer plantings, the management of pest problems also assumes importance.

Lately this danger was recognized in stands of maple trees (*Acer saccharum* Marsh. where high incidence of maple wilt (*Verticillium albo-atrum*) (V. dahliae) has been reported (Gregory & McWain, 1973). Many of the maples suffering from "maple decline" show considerable infection by the verticillium wilt.

There is no cure for the maple wilt, but it is known that the fungicide benomyl, especially its salt, MBC-PO4, (Lignasan® phosphate) which is used to combat the Dutch elm disease, *Ceratocystis ulmi* (Buism) is also effective against the maple wilt pathogen (Sinclair et al, 1976). To investigate the uptake and distribution of this compound, a co-operative project with the Department of Agriculture was initiated by using a stand of nursery size maple seedlings which were inoculated with *Verticillium albo-atrum*. Subsequently, a collaborative project was developed with the City of Ottawa, for further testing of a modified trunk-injection apparatus on large street trees in the urban environs of Ottawa.

MATERIALS AND METHODS

(i) Culture of Seedlings: During August, 1976, twenty-four sugar maple seedlings (*Acer saccharum*) Marsh., 1.22 m (4 ft.) high and 2.54 cm (1 in.) d.b.h. were selected at the Agriculture Canada Experimental Farm, Ottawa nursery, and separated into four groups of six trees each:-

Group A - consisted of trees treated with Lignasan-P and inoculated with maple wilt.

Group B - consisted of trees inoculated with maple wilt alone, to be treated with benomyl later, after the disease symptoms had expressed.

Group C - consisted of trees inoculated with maple wilt alone, but not treated with any fungicide - these served as controls.

Group D - consisted of trees treated with benomyl and then inoculated with maple wilt.

Groups A and D were treated in the summer of 1976.

(ii) Treatment of Large Trees: Five street trees, 7.62 m (25 ft.) high, 20 - 25 cm (8 - 10 in.) d.b.h. were injected with soluble benomyl (Lignasan-P) and five were left as controls. Bioassays were performed on tree samples according to the procedure of Prasad and Travnick (1973).

(iii) Preparation of Chemicals: Lignasan phosphate, a soluble salt of benomyl, which is experimentally used for the treatment of Dutch elm disease and has shown promise against the maple wilt (McWain and Gregory, 1973) was used for the treatment. Concentration was adjusted to 1000 ppm and 100 ml of solution was injected into the trunk of each seedling. For large trees, 3.8 - 11.4 ℓ (1 - 3 gallons) of the same solution was used for injection into their trunks.

(iv) Development of Apparatus: The modified trunk-injection apparatus developed at the Chemical Control Research Institute (Prasad, 1975) and used for treatment of elm trees was employed for treatment of mature maple trees. To treat nursery seedling trees, 2.5 - 5.0 cm (1 - 2 in.) d.b.h. the one quart size plastic apparatus had to be further modified. For this purpose only one injector, made of a plastic tube connector of 0.32 - 0.64 cm (1/8 to 1/4 inch) tapered size was used. One hole in the trunk was drilled with a 0.32 cm (1/8 inch) drill, not deeper than 1.27 cm (1/2 inch) and after all air bubbles were removed from the hose, the injector was inserted into the stem of the seedling tree and a 100 ml volume was injected into each tree. Similarly for the large street trees, the low pressure trunk-injection technique was used. Depending upon the size of the tree and the prevailing environmental conditions the injection was complete in 1 to 3 hours. The pressure during injection varied from 68.9 - 20.7 kPa (10 - 30 p.s.i.).

RESULTS

A. Seedling Trees: The trunk-injection method used to treat small maple seedlings worked very well (Fig. 1). The uptake of 100 ml of fungicide took about two hours, even when the humidity was very high due to rainy weather.

Samples of leaves were collected one and four weeks after the treatment. Three leaves from each seedling were collected, one each from bottom, middle and top and were bioassayed in the laboratory for presence of fungicide (Table I).

Table I

Uptake and Distribution of Lignasan-P in Sugar Maple Seedlings Inoculated with Maple Wilt Following Trunk Injection

Leaves	Zone of Inhibition (mm) After: 1 week	4 weeks
Bottom	17.9	13.6
Middle	10.1	25.2
Top	9.0	4.9

The above results clearly demonstrate a good distribution throughout the whole seedling. The data also show that movement takes place from the site of application to apical parts in one week while by the fourth week the fungi-toxicant has migrated and concentrated in the middle leaves. It seems there is some dilution or metabolic factor in the younger and top leaves as very little material remained there.

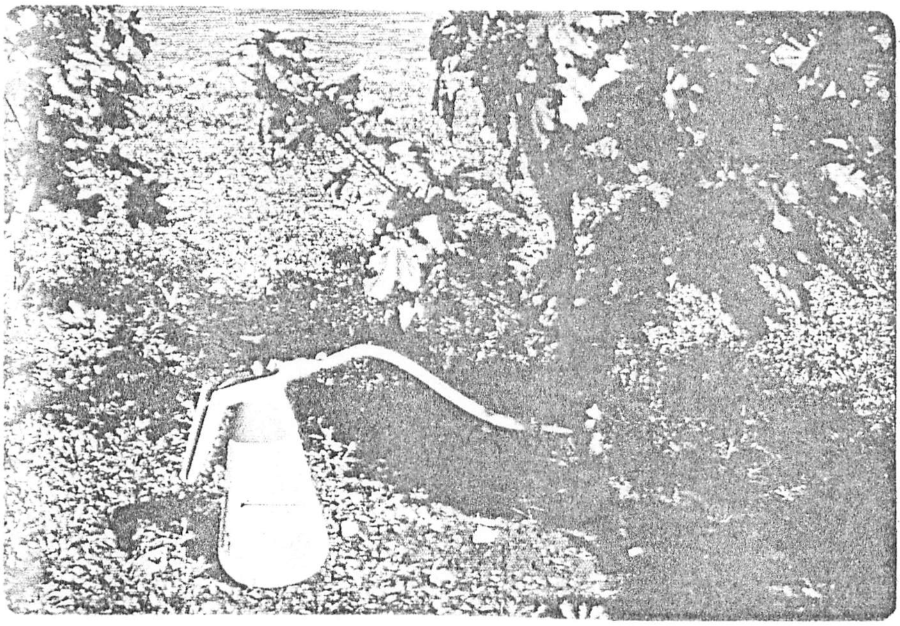

Fig. 1. Introduction of benomyl into a maple seedling with a modified trunk-injection apparatus.

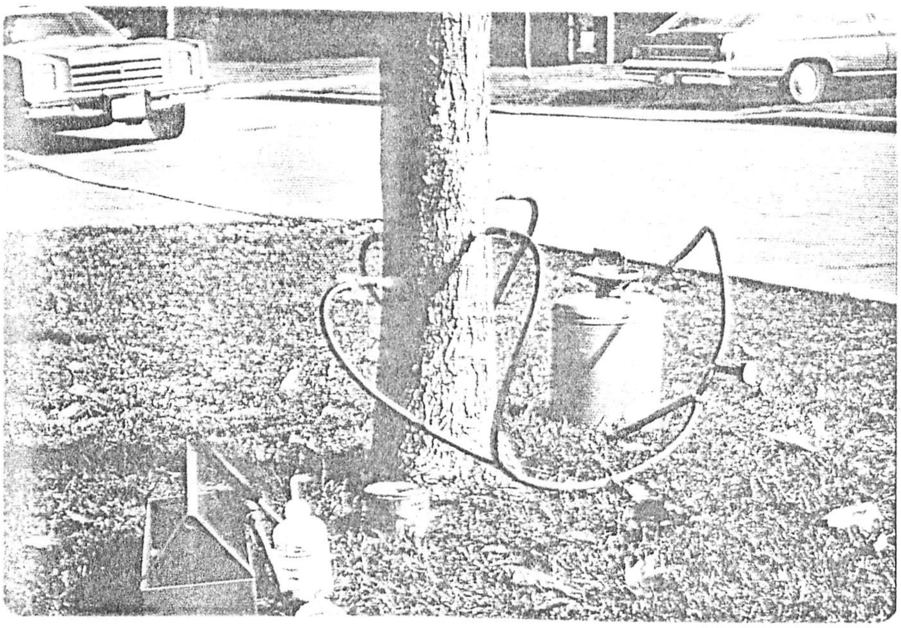

Fig. 2. Injection of a street maple tree with soluble benomyl (Lignasan-phosphate) using the pressurized trunk-injection apparatus.

B. Experiments with Large Trees: The results from injection into large trees (Figs. 2 & 3) were not very convincing. Considerable variation was found in the rate and manner of uptake and translocation of the compound. Some trees took up the material 3.8 - 11.4 ℓ (1 - 3 gallons) quickly, while some took much longer time to empty the container. When bioassays were performed on the branches and leaves very little fungi-toxicant was detected from any part of the tree.

Table II

Uptake and Distribution of Lignasan-P in Large Maple Trees* following Trunk-Injection

Days After Treatment	Zone of inhibition (mm)	
	Leaves	Twigs
15	0.2	0.6
30	0.3	0.4
60	0.0	0.0
90	0.4	0.3

* Average of five trees.

This is somewhat contrary to uptake by elm trees. Perhaps the anatomy and physiology of maple tree is markedly different from that of an elm tree and only more research can elucidate the mechanism of transport of pesticides by large maple trees. According to Sinclair et al (1976) the vessels of maple trees are smaller than those of elm trees and caution should be taken in extrapolating results from one tree species to another. It could be that root injection similar to that developed by Kondo (1972) might be more applicable and useful for maple trees. However, since maple wilt infection spreads largely through the soil, any root injection treatment has to be done with utmost care and caution.

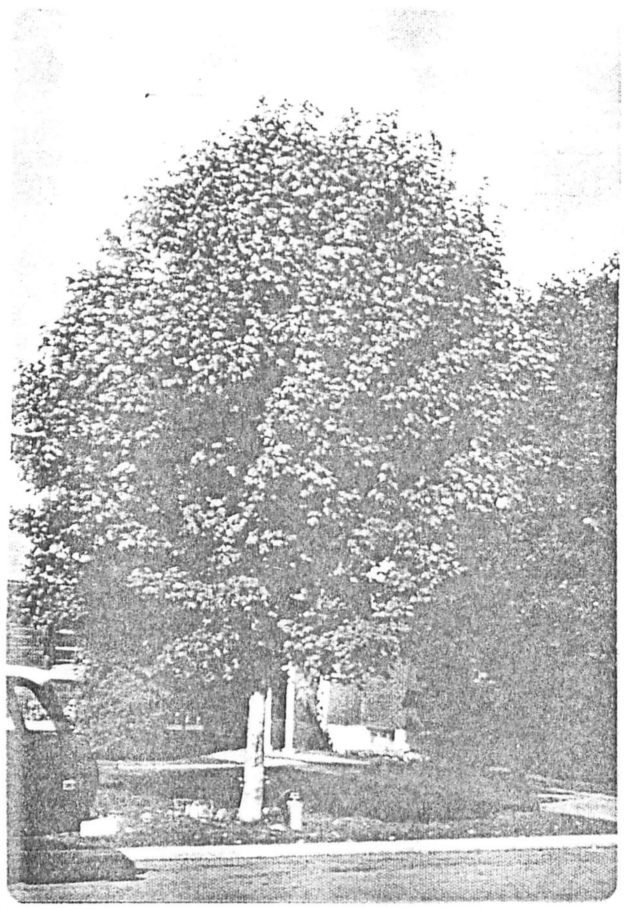

Fig. 3. Trunk-injection treated maple tree on a street in Ottawa.

SUMMARY

Sugar maple seedlings were treated with benomyl (Lignasan phosphate) to test systemic uptake and distribution with a view to treat maple trees against the Maple wilt (*Verticillium albo-atrum*). A small, portable, and inexpensive injection apparatus was designed for injection into seedling trees. For large trees the modified trunk-injection apparatus was employed. The distribution throughout the seedlings was excellent but uptake and translocation by large trees was erratic. Further research is needed to investigate the mechanism of translocation and suppression of the disease in large maple trees.

ACKNOWLEDGEMENTS

The authors thank Messrs. D. Travnick and Gault Donaldson for technical assistance in the field and Mrs. Lorna Potter for laboratory bioassays. They also appreciate the co-operation of the City of Ottawa in carrying out the investigations with street trees.

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