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CONTROL AND MONITORING OF SEED AND CONE INSECTS OF WHITE AND BLACK SPRUCE -- PETAWAWA 1983-84

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INTRODUCTION

All activities for 1983-84 were concentrated on studies relating to the control and monitoring of seed and cone insects of white spruce, Picea glauca (Moench) Voss, and black spruce, Picea mariana (Mill.) BSP. A study on selection and testing for resistance to insects and diseases was terminated in 1983.

Most data from experiments and surveys that began in 1979 have been summarized and analyzed. In addition, data collection involving yearly assessments on long-term experiments and surveys was continued. Several reports have been written, some are published and others are under review. Findings and conclusions are summarized below.

CHEMICAL CONTROL

a. Foliar application of systemic insecticides

Cone-bearing portions of white spruce trees were sprayed by means of hydraulic sprayers with 1.0 and 1.5 per cent solutions of dimethoate, methomyl, and acephate in a 12-year-old and a 25-year-old plantation. Each insecticide provided highly significant reductions in the incidence of cone damage by coneworm, Dioryctria reniculelloides Mutuura and Munroe, cone maggot, Lasiomma anthracina (Czerny), and cone-axis midge, Dasineura rachiphaga Tripp, and no difference among insecticides was evident. Treatments had no effect on budworm, Choristoneura fumiferana (Clemens) damage.

Dimethoate has been registered for use against seed and cone insects of spruces by Agriculture Canada under the "Minor Use" registration process. Methomyl and acephate should also be considered for registration as foliar sprays against these insects. However data on cone yields, seed yields, seed quality and possible phytotoxic effects are needed.

b. Stem injection or implants of systemic insecticides

Injections of liquid formulations of dicrotophos and oxydemeton-methyl at 1 g AI/cm DBH by means of Mauget® injectors were tested for control of defoliation by spruce budworm, and spruce coneworm, cone damage by insects and for increase of sound seeds in cones of white spruce trees. Implantation of powdered acephate at 0.5 and 1.0 g AI/cm DBH by means of Medicap® capsules was tested for control of cone damage by insects and for increase of sound seeds. Effect of time of injections of liquid dicro-tophos at 0.5 g AI/cm DBH on cone damage was also tested.

Dicrotophos and oxydemetonmethyl effectively reduced defoliation by budworm at upper, middle and lower crown levels for two seasons following injection; dicrotophos was more effective than oxydemetonmethyl. Cone damage attributed to budworm was not reduced in the year of treatment unless treatments were made shortly after the peak of flowering; however damage was controlled the year after treatment. Acephate did not control budworm damage to cones. Coneworm damage was not controlled by dicro-tophos or oxydemetonmethyl but was controlled by acephate the year after treatment, but not in the treatment year. Spruce seedmoth damage was reduced by dicrotophos and oxydemetonmethyl in the year of treatment but not the year after; acephate was effective both years. Spruce cone maggot and seed-inhabiting insect damage was reduced by dicrotophos and oxydemetonmethyl in the first but not the second year whereas acephate was again effective in both years. Spruce cone axis midge damage was controlled by dicrotophos and oxydemetonmethyl in the first year but not the second, and acephate was not effective in either year. Number of seeds was increased by dicrotophos and oxydemetonmethyl in both assessment years, but in spite of control of insect damage, seed counts were not increased by acephate implants. Treatments did not appear to cause severe toxic stress.

Injection or implantation appear to have merit for eventual use against insects that attack cones and defoliate white spruce plus trees. Protection of white spruce plus trees by this method should facilitate collection of large quantities of seed and healthy scion material for establishment and development of seed orchards. However more work is required to determine how factors such as pollination, size of the cone crop, and stand quality influence the outcome of treatments in terms of seed yields and to determine if treatments have any adverse effects on seed yields and quality or on long term health of the tree. The chemicals tested are not registered for use against seed and cone insects but they should be considered for "Minor Use" labelling.

c. Soil incorporation of carbofuran

Carbofuran was applied to black spruce seed trees by soil incorporation of granular and liquid formulations at rates of 5 or 10 g AI/cm DBH (equivalent to rates of 32 or 64 kg AI/ha of soil surface) on May 14, 1980. Numbers of spruce budworm, spruce coneworm, degree of

defoliation, cone production, percentage of cones damaged by seed and cone insects, numbers of sound seeds per cone slice, numbers of female buds on a sample branch from the cone-bearing portion of the tree, and phytotoxicity were assessed in 1980 and 1981 on all experimental trees.

Treatments provided moderate to excellent protection of black spruce from spruce budworm defoliation. The liquid formulation was effective for budworm control in the year of treatment and persisted the year after treatment; granular carbofuran was not effective in the year of treatment, but it was effective the following year. Rapid and efficient uptake by the tree, to ensure control, is enhanced by use of a liquid formulation applied as a drench rather than incorporation of granules into soil. The toxicant appears to be equally effective at upper, middle and lower crown levels. Treatments did not provide increases in cone or seed yields nor did they protect cones from cone insect damage. A slight phytotoxic effect was evident 2 years after treatment with the liquid formulation at 10 g AI/cm DBH.

There is very little information available about the fate or environmental impacts of carbofuran used on forest soils but evidence suggests that it is persistent, hazardous and should be used cautiously and sparingly. The application rates used in this experiment were similar to those used in seed orchards of southern pines for control of seedbug. However, control of budworm defoliation on black spruce trees requires relatively large quantities of soil-applied carbofuran by comparison with mist blower-applied acephate for example. In addition, it does not appear to provide cone or seed protection of black spruce. Soil-applied carbofuran may not be economically or environmentally acceptable for use on black spruce seed orchards.

BIOLOGICAL CONTROL

All data relating to work on Beauveria bassiana (Bals.) Vuill., has been analyzed. Investigations and findings are summarized below.

Soil around the base of white spruce trees was sampled to determine the vertical and horizontal distribution of cone maggot puparia in a 12-year-old and a 22-year-old plantation. Most of the puparia were found within a 1 m radius of stems in the upper organic soil layers, but some also penetrated to the mineral horizon.

Small samples (25 g fresh weight) of organic soil were inoculated with conidia of B. bassiana to test efficacy of the fungus for control of cone maggots added to soil at two moisture levels (72 or 122 g water per 100 g oven-dry soil). Conidia were formulated with flour or talc carrier (5 g conidia per kg carrier) and mixed with soil at a rate of 25.1 mg conidia per 100 g oven dry soil. After incubation in

closed containers in the laboratory, average mortality of 42 per cent was observed with both formulations in drier soil; there were no differences between formulations. The fungus was not effective in the wetter soil. When larvae were added to reconstituted plantation soil treated with the equivalent of 3.56 kg conidia per ha and incubated under field conditions, mortality averaged 21 per cent for both formulations and again, there was no difference between formulations.

A report outlining a method for producing conidia on solid medium has been prepared. Large quantities of conidia can be obtained commercially, however, their effectiveness against seed and cone insects is unknown. The quality of such preparations can be determined by following the procedures and guidelines presented in the report; rates of application can then be adjusted by comparison with conidia of known quality produced by the method outlined.

EVALUATING LOSSES AND MONITORING INSECTS

Surveys of cone crop size and cone damage by insects in three habitat types of white spruce, were continued. This work will be terminated in 1985 and data will be summarized and analyzed for publication. Evaluation of sex-attractants for use as a monitoring tool for spruce seedmoth was also continued. Results to date are being analyzed for publication.

REPORTS

Fogal, W.H. and S.M. Lopushanski. 1983. Stem injection of insecticides for control of white spruce seed and cone insects. IUFRO, Cone & Seed Insects Working Party Conference, Athens, Georgia. Pp. 157-167.

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