INSECT AND DISEASE RESEARCH IN TREE IMPROVEMENT AND SEED PRODUCTION -- PETAWAWA, 1981-1982

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INTRODUCTION

Research on insects and diseases at Petawawa National Forestry Institute for 1981-82 has focused primarily on management and control of insects responsible for seed losses in white spruce, Picea glauca [Moench] Voss. Because of the high priority attached to finding solutions to seed and cone insect problems only a small proportion of time has been devoted to studies on selection and testing for resistance to insects and diseases. This report outlines our activities and progress for the period 1981-82.

SEED AND CONE INSECTS: SPRUCE

Our strategy for finding solutions to seed and cone insect problems is an integrated pest management approach which means: assessing and evaluating damage and losses; monitoring populations and predicting outbreaks which cause unacceptable levels of damage; using cost-effective and environmentally acceptable chemical and biological controls; prescribing stand establishment and management practices which will reduce outbreaks and damage.

Evaluating losses and monitoring insects

Management techniques to minimize seed losses to cone insects in white spruce are being evaluated by comparing seed yields, insect attack and cone crops in a variety of stands ranging from unmanaged seed collection areas with varying tree densities to intensively managed clonal seed orchards. Most losses are attributed to the following insects: spruce budworm, Choristoneura fumiferana Clem., coneworm, Dioryctria reniculleloides Mutuura and Munroe, seed moth, Laspeyresia youngana (Kearfott), cone maggot, Hylemya anthracina (Czerny). Surveys conducted since 1979 in three stand types varying in seed tree density

are providing information about when and where to collect cones and possible effect of stand structure on seed yields and losses to insects. A cooperative study with Dr. G.G. Grant of Forest Pest Management Institute at Sault Ste. Marie was initiated in 1980 to evaluate sex-attractant pheromones for use as a monitoring tool for the spruce seed moth. Effective lures have been identified and flight monitoring since 1980 is providing needed information on relationships among flowering, insect flight activity and weather factors.

Chemical control

Data and advice were provided to Dr. D. Barnes, Manager, Regulatory and Environmental Affairs, Cyanamid Canada Inc. to support 'Minor Use Registration' of dimethoate for cone and seed insect control by means of foliar-spray applications. Our data also suggest that the systemic insecticides lannate and orthene might be useful for control of white spruce seed and cone insects. More data on the effectiveness of these two insecticides is needed.

Application of carbofuran insecticide to soil provides foliage protection from budworm feeding on white spruce seed trees (Fogal et al. 1981). Granular carbofuran should be worked into the soil to prevent bird mortality and application should be timed to precede a rainfall to enhance uptake by the trees. Applying carbofuran as a liquid soil drench to black spruce, Picea mariana (Mill.) B.S.P., trees provides better foliage protection than granules in the year of treatment. Both granular and liquid applications provide protection in the year following treatment. More data on efficacy for cone and seed protection, potential phytotoxic effects and on environmental hazards are required before the registration of this insecticide for use on white and black spruce seed trees can be considered.

Experiments were initiated in 1981 to determine if the injection of systemic insecticides into the stems of white spruce trees would control seed and cone insects. Dicrotophos at doses of .56 and 1.12 gAI/cm DBH and oxydemetonmethyl at .36 and .72 gAI/cm DBH provided increases in numbers of sound seeds per cone of 80 percent or more in the year of treatment. The effect persisted into the second year with increases of 60 percent or more. Phytotoxic stress due to treatment was negligible. Experiments are underway to test effectiveness of these chemicals over a wide geographic range within the province of Ontario and to evaluate effect of treatments on seed germinability.

Information activities resulted in publication of two reports on chemical control. One was a state of the art account of methods for control of budworm on seed trees (Fogal, 1982a) the other a literature review covering all aspects of control of seed and cone insects on white and black spruce (Fogal 1982b).

Biological control

Initial investigations with fungal diseases of insects revealed that several seed and cone insects of white spruce were susceptible to

Beauveria bassiana (Fogal 1981a). This fungus might have potential as a biological control agent. A method and facilities for producing conidiospores of B. bassiana were developed at PNFI. With contract funds from PNFI and a grant from the Ontario Pesticides Advisory Committee, laboratory and field tests explored possibilities for use of this fungus for control of seed and cone insects. A soil bioassay system was developed for testing B. bassiana conidiospores on the spruce cone maggot which pupates in the duff beneath the trees. Tests suggest that treatments of soil with B. bassiana conidiospores can reduce by as much as 34 percent the numbers of cone maggot puparia containing living larvae or pupae. A field study to investigate the possibility of protecting seeds of white spruce from several cone-feeding insects by treating flowers and conelets with conidiospores was completed. Treatment of recently-closed flowers enhanced seed yield by as much as 55 percent without causing damage to developing cones.

SELECTION AND TESTING FOR RESISTANCE TO INSECTS AND DISEASES

Activities have been confined largely to information exchange. A report on the relevance of tree improvement to forest pest management was presented at the Canadian Forest Pest Control Forum (Fogal 1981b) and contributions were submitted to the Newfoundland Royal Commission on management and control of the spruce budworm (Fogal and Strunz 1981, Strunz and Fogal 1981). In addition a review on variations in susceptibility of native and introduced conifers was published (Fogal et al. 1982).

In cooperation with Dr. M. Carson and Mrs. S. Carson from the Forest Research Institute, Rotorua, New Zealand, Dr. C.W. Yeatman and I began analysis of progeny tests established by Mr. M. Holst in 1968 to test heritabilities of winter dessication and susceptibility of Scots pine, Pinus sylvestris L. to gall rust, Endocronartium harknessii (J.P. Moore) V. Hiratsuka and to the leader weevil, Pissodes strobi Peck. Analyses of variance of winter dessication established that seedlot differences were highly significant. Parent-offspring regression was highly significant and narrow sense heritability was estimated to be 0.66. Differences in weevil damage among seedlots were also highly significant, the parent-offspring regression was significant and heritability was estimated to be 0.44. Strong evidence of qualitative resistance to gall rust was observed and it may be controlled by only a few genes. Added to this, there is additional evidence of quantitative variation in resistance underlying the major gene effects. A manuscript is in preparation.

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