BLACK SPRUCE CONE INSECT CONTROL TRIALS, LONGLAC, ONTARIO 1967-68

by

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TABLE OF CONTENTS

ABSTRACT

The effect of cone insects on the yield of black spruce seed was assessed in a seed production area near Longlac, Ontario. From 1965 to 1968 the percentage of untreated cones attacked by insects ranged from 22 to 57, and the degree of infestation and reduction in seed yield were inversely proportional to the size of the current cone crop. In 1967 and 1968, small scale trials were carried out in the same area to determine the effectiveness of several chemical treatments in protecting black spruce seed crops from insect attack. Dimethoate, applied to the cone-bearing portion of the tree crowns at the time the young cones were opening, provided complete protection from insect attack. However, because of the difficulty of treatment and the rather small resulting increase in seed yield, chemical control of black spruce cone insects is not recommended as a general practice.

INTRODUCTION

In 1966 the Kimberly-Clark Pulp and Paper Company began development of a 20-acre seed production area in a vigorous 40- to 55-foot stand of black spruce located on an upland site near Longlac, Ontario. Observations of insect-damaged cones prompted a request for information on the effect of cone and seed insects on the yield of black spruce seed and recommendations on the control of these insects in the seed production area. A search of the literature revealed little information on either subject, although a 2-year study near Lake Nipigon by Fye and Wylie (1968) indicated that, on the average, less than 10 per cent of black spruce cones were attacked by insects. However, with the growing emphasis on the use of genetically superior planting stock, seed production areas and seed orchards are expected to become a major source of seed for reforestation. These stands are managed with the objective of maximizing the yield of genetically valuable seed, and losses caused by insects may not be acceptable. With these considerations in mind, a study was undertaken to provide answers to the specific questions raised by the Company.

On the basis of cone samples obtained from the seed production area in January 1967, the level of insect infestation in the 1965 and 1966 cone crops was assessed, and the reduction in seed yield owing to insect damage was estimated. In 1967 and 1968, trials were undertaken to test the feasibility of protecting black spruce seed crops by chemical means, and further assessments of insect infestation and seed losses were made in conjunction with these trials. This report summarizes the results of both the assessments and control trials.

DEGREE OF INFESTATION

Representative samples of the 1965 and 1966 cone crops were collected by Company personnel in January 1967, and submitted to Sault Ste. Marie for examination. Similar samples of the 1967 and 1968 cone crops were collected during the course of the control trials. Part of

each sample was dissected to assess the degree of insect infestation, and seed was extracted from the remaining cones to determine the yield per cone. The results of these examinations are given in Table 1.

Table 1 Insect infestation and seed yield, black spruce seed production area, Longlac, Ontario

Year	Cone crop rating	No. of cones sampled	% infested[a]	No. of sound[b] seeds per cone
1965	medium	265	28	3.6[c]
1966	light	192	57	12.0
1967	heavy	738	22	24.4
1968	very light	891	56	6.6

[a] Includes cones showing evidence of insect damage as well as those still containing insects.

[b] "Sound" seed determined by float test in methyl alcohol.

[c] These cones were over 1 year old when examined and had likely shed some of their seed.

The data in Table 1 suggest that the degree of insect infestation was inversely proportional to the size of the cone crop. In 1966 and 1968 when the crops were rated as light and very light, respectively, over half the cones were attacked, whereas in the heavy crop year of 1967 only 22 per cent of the cones were infested. The seed yield per cone was two to four times as high in 1967 as in the other two years. However, this difference cannot be attributed directly to the effect of insects, as it is generally recognized that in light cone crops, the seed yield per cone is correspondingly low (Anon. 1948).

Separate seed extractions were made from two groups of cones from the 1967 crop, one group that was infested and the other that was free of insect attack. The relatively small seed loss due to insects is indicated by the fact that the average yield of sound seed from the undamaged cones was 27.4, whereas that from the insect-infested cones was 22.7.

A bulk sample of cones from the 1967 crop (with no separation of infested and undamaged cones) produced a yield equivalent to 8 ounces of sound seed per bushel of cones. This compares favourably with the long term average yield of 6.4 ounces per bushel (Anon. 1958) and provides further evidence that in the heavy crop year of 1967, insects did not have a serious effect on seed production.

Insect samples were reared from typically infested material and the adults were identified by the Insect and Disease Survey Unit, Ontario Region. In every crop the predominant insect was a cecidomyiid, *Dasyneura rachiphaga* Tripp, and the only other species found was a chalcid that occurred less frequently. In describing the habits of *D. rachiphaga*, Tripp (1955) noted that "The larvae make small gall-pockets in the rachis of white spruce cones. As they do not come in contact with the seeds they cause them no direct injury. However, in some cones the rachis may be almost completely filled, and possibly some injury may result to the seeds from the destruction of the conductive tissue." The results of this study suggest that the behaviour of the insect and its effect on seed production may be similar for black spruce.

INSECT CONTROL TRIALS

Although the initial assessment did not suggest that cone insects seriously limited black spruce seed production, it was decided that trials should be undertaken to determine whether chemical treatment could provide complete protection.

For the control of Douglas-fir cone insects, Hedlin (1966) found that systemic insecticides were most effective and that treatment should be applied to the whole cone-bearing portion of the crown. The first trials, in the spring of 1967, involved two dates of treatment, three insecticides, five concentrations, and two methods of application. On white spruce, oviposition by adult cecidomyiids and chalcids occurs in early spring shortly after the young cones open (Tripp and Hedlin 1956). It was anticipated that the timing would be similar for these insects on black spruce, and the first group of treatments was scheduled to coincide as closely as possible with flowering. The series was repeated on a similar group of trees 2 weeks later.

The spray equipment for the hydraulic treatments consisted of a hand-pumped garden sprayer with a capacity of about 3 gallons. An attempt was made to spray all cones and foliage in the cone-bearing portion of each tree crown to the dripping point. Mist blowing was carried out with a gasoline-powered, back-pack mist blower, and treatment was continued only to the glistening point. For both methods of application, a scaffold ladder 30 feet in height was used to put the operator within effective range of the target area. This proved satisfactory for trees up to 40 feet high, but for taller trees, a bamboo pole was affixed to the spray wand of the hydraulic sprayer in order to reach the cone-bearing part of the crown. The addition of a red dye, Rhodamine B, to the spray solution provided visual evidence of the degree of coverage obtained. Four trees were treated with each insecticide, each concentration, and each method of application; 60 trees were treated at each date. The trees to be sprayed were selected at random, but those receiving the same treatment were grouped to reduce the necessity of moving the ladder, and those receiving different treatments were separated by at least 1 chain to minimize the possible effect of spray drift. The series of treatments required one

full day in each case, June 13 and June 27. Both days were sunny and warm with light winds, and there is no reason to believe that results were affected by weather conditions.

Cone samples were collected in September. A hooked knife attached to a 16-foot bamboo pole was used in conjunction with a 30-foot aluminium ladder to obtain samples from most trees, but it was necessary to fell a number of the taller trees in order to obtain adequate samples. Cones were taken from 10 untreated trees as a check on the general level of infestation in the stand. The difficulty of collecting cone samples had no significant effect on these trials, but it pointed up the serious, practical problem of harvesting the cone crop from a seed production area without damaging the trees.

After collection, cones were stored at 32°F until dissection was carried out in January 1968. A minimum of 25 cones from each tree was examined; this made at least 100 cones for each treatment. Cones were examined under a microscope after being quartered longitudinally with a scalpel; those containing one or more larvae or pupae, or showing any damage from larval feeding, were classified as infested. Table 2 shows the percentage of infested cones for each treatment.

The high level of insect infestation in material treated June 27 suggests that these treatments were too late to be effective, probably because insect attack had already taken place. Thus, the following assessment of the effectiveness of the various chemicals and concentrations is based on the results of the treatments carried out June 13.

With an average infestation level of only 3.6 per cent for all concentrations and both methods of application, Dimethoate appeared to be the most effective insecticide. Average infestation levels for the other chemicals were 5.9 per cent for Meta-Systox R, and 10.4 per cent for D.D.T., and the average for unsprayed trees was 21.8 per cent. There was no significant difference between average infestation levels for all mist blower treatments (6.4 per cent) and all hydraulic treatments (6.8 per cent).

The encouraging results achieved with Dimethoate prompted a further trial with this insecticide in 1968. Examination of black spruce trees in the spring of 1968 indicated that the cone crop would be extremely light. Consequently, trees in the 12- to 14-foot height class[1] were selected for this trial, since the crowns could readily be examined to determine the presence of female flowers. Two groups of 15 trees were treated, one with the mist blower which contained Dimethoate at a 5 per cent concentration, the other with a hydraulic sprayer containing the same insecticide at a 1 per cent concentration. The only change in technique and equipment was the substitution of a gasoline-powered hydraulic sprayer for the hand sprayer used in the previous year. Spraying was carried out June 11, under favourable weather conditions similar to those prevailing in 1967.

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[1] In a young stand adjacent to the seed production area.

Table 2 Treatments and percentages of cones infested, black spruce cone insect control trials. Longlac, 1967

Treatment					Percentage cones infested	
Insecticide	Method of application	Concentration (% act. ingredient)	Approx. vol./tree (gal.)	Approx. amt. act. ingredient/tree (oz.)	Spray June 13	Spray June 27
Meta-Systox R[a]	Hydraulic sprayer	0.1	3/4	.02	1.0	19.0
" "	" "	0.5	"	.12	0.0	9.3
" "	" "	1.0	"	.24	9.0	18.9
" "	Mist blower	2.0	1/4	.16	13.3	19.0
" "	" "	5.0	"	.40	6.0	13.3
Dimethoate[b] (Cygon 4E)	Hydraulic sprayer	0.1	3/4	.04	11.0	34.0
"	" "	0.5	"	.24	4.0	16.0
"	" "	1.0	"	.48	0.0	20.0
"	Mist blower	2.0	1/4	.32	3.0	39.3
"	" "	5.0	"	.80	0.0	20.8

[a] Emulsifiable concentrate, 2 lb. active per U.S. gallon, 25% concentration. (Chemagro Corp.)

[b] Emulsifiable concentrate, 4 lb. active per U.S. gallon, 45% concentration. (American Cyanamid Co.)

(continued)

Table 2 Treatments and percentages of cones infested, black spruce cone insect control trials. Longlac, 1967 (concluded)

Treatment					Percentage cones infested	
Insecticide	Method of application	Concentration (% act. ingredient)	Approx. vol./tree (gal.)	Approx. amt. act. ingredient/tree (oz.)	Spray June 13	Spray June 27
D.D.T.[c]	Hydraulic sprayer	0.1	3/4	.02	17.0	6.2
"	" "	0.5	"	.12	10.0	46.2
"	" "	1.0	"	.24	9.0	18.4
"	Mist blower	2.0	1/4	.16	8.0	32.1
"	" "	5.0	"	.40	8.0	66.6
Average infestation of treated trees					6.6	25.3
Average infestation of untreated trees					21.8	

[a] Emulsifiable concentrate, 2 lb. active per U.S. gallon, 25% concentration. (Chemagro Corp.)

[b] Emulsifiable concentrate, 4 lb. active per U.S. gallon, 45% concentration. (American Cyanamid Co.)

[c] Emulsifiable concentrate, 25% concentration.

Cone samples were collected, stored, and examined in the same manner as in 1967. Again the predominant insect species in infested cones was *Dasyneura rachiphaga* Tripp. However, Table 3 shows that both treatments provided complete protection against insects, whereas cones from untreated trees were heavily infested.

As in the previous year, seed was extracted from samples of undamaged and infested cones; the average yield of sound seed per cone was 10.3 for the former and 3.8 for the latter. These figures may be compared with those for the 1967 crop, which showed a yield of 27.4 seeds per undamaged cone and 22.7 per infested cone. As suggested earlier, the lower yield per undamaged cone in 1968 is principally due to the light crop, but the level of insect infestation and the reduction in seed yield were both much greater under these conditions.

CONCLUSIONS AND RECOMMENDATIONS

The major conclusions and recommendations drawn from this study may be summarized as follows:

(1) The proportion of black spruce cones attacked by insects ranged from 22 per cent in a heavy crop year, to over 50 per cent in years (1966 and 1968) with light or very light crops. Because of infestation, the yield of seed was reduced about 4 per cent in the former instance and up to 35 per cent in the latter. Thus it would seem that the level of insect infestation is inversely proportional to the size of the cone crop, and that the percentage reduction in seed yield is greater for light than for heavy crops. If you take into consideration the practical difficulty of treating each tree, and the great difficulty of collecting the cones, direct measures to control cone insects in black spruce seed production areas and seed orchards are probably warranted only if the seed is of very high genetic value.

(2) Dimethoate is an effective insecticide for the protection of black spruce cone crops. Treatment should coincide with the opening of the young cones, and it should cover the whole cone-bearing portion of the tree crowns. Application may be made with either a hydraulic sprayer or mist blower, and the recommended concentration is 1 per cent active ingredient for the former, and 5 per cent for the latter.

Table 3 Treatments and percentages of cones infested, black spruce cone insect control trials. Longlac, 1968

Treatment					
Insecticide	Method of application	Concentration (% act. ingredient)	Approx. vol./tree (gal.)	Approx. amt. act. ingredient/tree (oz.)	Percentage cones infested
Dimethoate	Mist blower	5.0	1/6	.53	0.0
"	Hydraulic sprayer	1.0	2/3	.43	0.0
Untreated		-	-	-	56.4

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REFERENCES

Anon. 1948. Woody-Plant Seed Manual. U.S.D.A. For. Serv. Misc. Pub. No. 654.

Anon. 1958. Manual of seed collecting. Ontario Dept. of Lands and Forests. R-13(Rev. 1958).

Fye, R.E. and W.D. Wylie. 1968. Notes on insects attacking spruce and fir cones at Black Sturgeon Lake, Ont., 1963-1964. Canada Dept. of Fisheries and Forestry, Bi-monthly Research Notes Vol. 24 No. 6. Nov.-Dec. 1968.

Hedlin, A.F. 1966. Prevention of insect-caused seed loss in Douglas-fir with systemic insecticides. Forest. Chron. 42(1): 76-82.

Tripp, H.A. 1955. Description and habits of Cecidomyiidae (Diptera) from white spruce cones. Can. Ent. 37(6): 253-263.

Tripp, H.A. and A.F. Hedlin. 1956. An ecological study and damage appraisal of white spruce cone insects. Forest. Chron. 32(4): 400-409.