

# PREVENTION OF INSECT-CAUSED SEED LOSS IN DOUGLAS-FIR WITH SYSTEMIC INSECTICIDES

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## ABSTRACT

*Cone-bearing Douglas-fir trees in three localities on Vancouver Island were sprayed with the systemic insecticides Bidrin (0.35 and 0.75%), dimethoate, Sumithion, Meta-Systox-R, and SD 9129 (1.0 and 2.0%) when cones had reached the pendent stage of development. With the exception of Sumithion, all materials gave varying degrees of control over important insect pests of cones in this area, i.e. the gall midge, *Contarinia oregonensis* Foote, the cone moth, *Barbara colfaxiana* (Kft.), the seed chalcid, *Megastigmus spermotrophus* Wachtl, and the scale midge, *C. washingtonensis* Johnson.*

## INTRODUCTION

Although cone and seed insects have been recognized for many years as a limiting factor in the production of Douglas-fir seed, only recently have they been considered a serious problem. Protection against insect-caused losses has become increasingly important with the current trend towards production of seed in orchards.

Johnson (1962, 1963) prevented damage by the gall midge, *Contarinia oregonensis* Foote with the contact insecticide Guthion applied at the time of oviposition. The disadvantages of contact insecticides are that application requires precise timing and the results can be seriously affected by unfavourable weather. Systemic insecticides would remove or reduce these difficulties.

Hedlin (1962) showed that systemic insecticides would kill larvae of the gall midge in Douglas-fir cones. In 1963, Bidrin and dimethoate gave good results and were most effective when applied at or near the pendent stage of cone development (Hedlin, 1964). Johnson and Rediske (1964) found that several systemic insecticides gave control of the gall midge, and the seed chalcid, *Megastigmus spermotrophus* Wachtl when injected in twigs or sprayed on cones and foliage. Buffam and Johnson (1965) had good results with dimethoate against the midge and seed chalcid in Washington in 1964.

This paper reports the results of experiments conducted in 1964 to prevent damage by the gall midge, *C. oregonensis*, the scale midge, *C. washingtonensis* Johnson, the cone moth, *Barbara colfaxiana* (Kft.) and the seed chalcid, *M. spermotrophus*. The life histories and habits of the insects important in this region have been reported by Hussey (1955); Hedlin (1960, 1961); Hedlin and Johnson (1963); Johnson and Winjum (1960).

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## MATERIALS AND METHODS

The cone crop was relatively light throughout the region. Trees from 20 to 30 feet in height were selected in each of the four areas, Goldstream, Mt. Prevost, Nitinat River Valley, and Robertson River Valley on Vancouver Island.

Treatments were as follows:

1. Trees in Goldstream, Mt. Prevost and Nitinat River Valley plots were sprayed with materials as shown in Table 1. A one-gallon compression type sprayer was used from a ladder to spray cones and foliage thoroughly. The entire cone-bearing area of trees bearing few cones was sprayed; trees with larger numbers of cones were sprayed only in the intermediate portion of the crown, leaving untreated portions above and below the treated area.
2. To compare effectiveness of different methods of application some trees in the Goldstream plot were treated with a portable mist blower. Insecticides Bidrin, Sumithion and dimethoate were used. The concentrations were double those used in the garden sprayer to compensate for lower volumes.
3. Trunk applications of undiluted insecticides were made in the Robertson River Valley. Bidrin, Sumithion and dimethoate were each applied to the trunks of six trees with a paint brush at three ml. active material per inch dbh.
4. To compare the absorptive capacities of foliage and cones, Bidrin (0.75%) and dimethoate (2.0%) were applied as sprays to (a) foliage only, (b) cones only, and (c) foliage and cones.

TABLE 1  
INSECTICIDES, CONCENTRATIONS, AND NUMBERS OF TREES TREATED IN EACH  
OF THREE AREAS ON VANCOUVER ISLAND

Insecticide	Concentration %	No. of trees sprayed and date		
		Nitinat 29 May	Goldstream 9 June	Mt. Prevost 10 June
Bidrin—(emulsifiable con- centrate—Shell Oil Co.)	0.35	4	4	4
	0.75	4	4	4
Dimethoate—(spray concentrate —American Cyanamid Co.)	1.00	4	4	4
	2.00	4	4	4
Sumithion—(emulsifiable con- centrate—Sumitoma Chem. Co.)	1.00	4	4	4
	2.00	4	4	4
Meta-Systox-R (spray con- centrate—Chemagro Corp.)	1.00	4	4	0
	2.00	4	4	0
SD9129 (spray concentrate— Shell Oil Co.)	1.00	0	4	2
	2.00	0	4	2

As shown in Table 1 the Nitinat treatment was made earlier than the other two. Cone development at Goldstream and Mt. Prevost was about

one week later than at Nitinat. Treatments were delayed beyond the planned date because of unfavourable weather.

Following treatments outlined in (1) above, cones were collected at intervals for a month and examined for data on the effectiveness of insecticides on the gall midge and the cone moth. The other insects which attacked later were not considered in these examinations.

When cones became mature in September, one 20-cone sample was collected from each treated and each control tree for examination. In addition, if possible, 10 cones were taken from above and 10 from below the treated portion of each tree. In the laboratory, cones were sliced longitudinally and damage assessed.

#### RESULTS

Insects occurred in varying numbers in all experimental areas. The gall midge was plentiful in all areas; the cone moth was plentiful in the Nitinat and scarce in other areas; the seed chalcid and scale midge were present in moderate numbers in all areas. Oviposition periods of the insects are shown in Fig. 1.

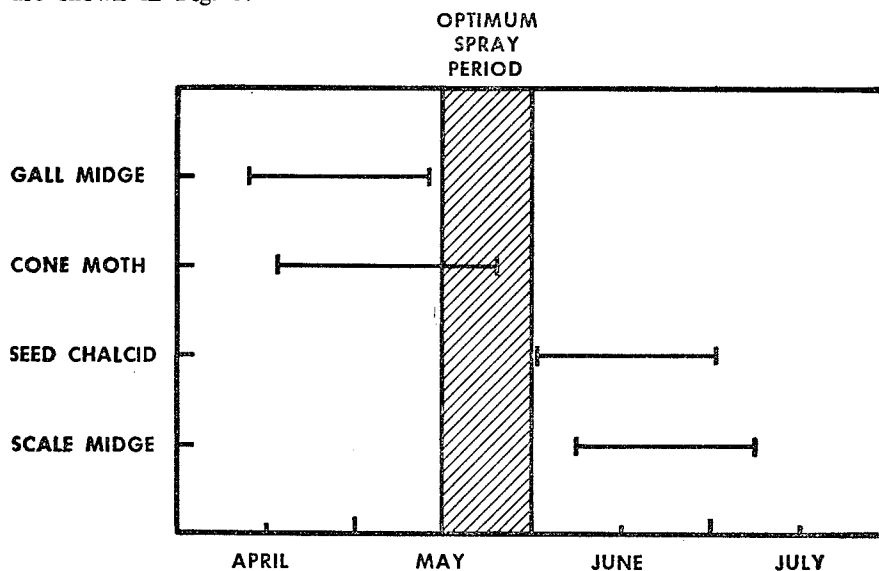


FIGURE 1. Oviposition periods of Douglas-fir cone insects in relation to optimum time of spraying.

Table 1 shows the number of trees treated and application dates for the insecticides used in each of the three spray plots.

Cone examinations made following spray applications showed varying effectiveness against the gall midge in early stages. Meta-Systox-R (2%) killed larvae six days after spraying. Bidrin (0.35% and 0.75%) and dimethoate (1%) killed some larvae while dimethoate (2%) and Meta-Systox-R

TABLE 2  
A COMPARISON OF PERCENTAGES OF SEED DESTROYED BY INSECTS FROM TREATED AND UNTREATED DOUGLAS-FIR TREES

Insect	Plot	Untreated	Percentage of Seed Destroyed											
			Bidrin		Dimethoate		Treated with Sumithion		Meta-Systox		SD9129			
			0.35	0.75	1.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0		
	Nitinat	21	4	0	2	0	21	37	0	0	0	0	a	a
Gall midge	Goldstream	20	b	b	3	0	18	15	0	0	0	0	0	0
	Mt. Prevost	15	1	1	0	2	15	29	a	a	2	0	0	0
	Nitinat	24	2	0	0	0	0	1	0	0	0	a	a	a
Cone moth	Goldstream	0	b	b	0	0	3	0	0	0	0	0	0	0
	Mt. Prevost	1	1	0	0	0	0	0	a	a	0	0	0	0
	Nitinat	10	7	2	0	1	21	14	2	3	a	a	a	a
Seed chalcid	Goldstream	15	b	b	2	0	5	2	3	0	0	0	0	0
	Mt. Prevost	4	0	0	0	0	0	0	a	a	0	0	0	0
	Nitinat	8	1	1	1	0	11	10	0	0	a	a	a	a
Scale midge	Goldstream	15	b	b	2	1	3	6	0	2	0	0	0	0
	Mt. Prevost	6	4	0	0	0	1	4	a	a	0	0	0	0

a. No treatment.

b. Cones lost to squirrels.

(1% and 2%) gave complete kill of gall midge larvae after 13 days. Sumithion (1% and 2%) and SD 9129 (1%) gave no kill at this time. The time required for SD 9129 (2%) to take effect was not determined.

Results of examinations of mature cones from treated and untreated trees in the spray plots are shown in Table 2.

Bidrin gave effective protection against insects in all areas except in the Nitinat plot at the lower concentration.

Dimethoate was effective in all areas at both concentrations.

Sumithion was effective only against the cone moth in the Nitinat plot and seed chalcid and scale midge in Goldstream and Mt. Prevost plots. It was ineffective against the gall midge.

Meta-Systox-R and SD9129 were effective against all insects in the areas in which they were applied.

Insecticides applied with the mist blower were more effective at lower than at higher levels on the tree indicating inadequate coverage throughout the crown.

Applications of Bidrin, Sumithion and dimethoate to tree trunks gave poor results. There was a slight but ineffective reduction in seed loss when compared with controls.

Results of applications of Bidrin and dimethoate for comparison of absorptive capacities of foliage and cones are shown in Table 3. Materials applied to foliage only, and to foliage and cones killed all larvae of gall midge and cone moth, the only insect species present. Materials, applied to cones only, were slightly less effective.

TABLE 3  
EFFECTIVENESS OF INSECTICIDES AGAINST DOUGLAS-FIR CONE INSECTS WHEN APPLIED TO FOLIAGE ONLY, CONES ONLY, OR BOTH

Treatment	No. cones examined	Gall midges		No. cone moth larvae	Condition of insects (footnote)
		No. cones infested	No. cone scales infested		
<b>Bidrin 0.75%</b>					
Foliage only	10	8	89	3	a
Cones only	10	10	89	0	c
Foliage and cones	10	9	44	0	a
Untreated	20	14	52	3	b
<b>Dimethoate 2.0%</b>					
Foliage only	10	6	22	3	a
Cones only	10	6	28	0	c
Foliage and cones	10	8	55	6	a
Untreated	20	11	29	5	b

a. all insects dead.

b. all insects living.

c. a few retarded gall midge larvae living — others dead.

Examination of cones from the untreated portions of treated trees showed that there was no effective translocation of insecticide from treated to untreated portions of the tree. Seed losses were comparable to those in cones from untreated trees.

Phytoxicity resulted from application of some insecticides. This appeared in the form of needle and cone bract burn. All materials except Sumithion caused slight damage to some trees.

#### DISCUSSION AND CONCLUSIONS

The systemic insecticides Meta-Systox-R, dimethoate, Bidrin, and SD 9129 gave good protection against insect caused losses in Douglas-fir when applied as sprays to cones and foliage. In planning a control program I would rate them in the above order. Meta-Systox-R killed gall midge larvae more rapidly than other materials, it was generally effective and is only moderately toxic to mammals. Dimethoate was effective, but slower than Meta-Systox. Bidrin was effective but is highly toxic to mammals. SD 9129 requires further testing, and Sumithion was ineffective against the gall midge.

Insecticides should be applied to give complete coverage of cones and foliage, when cones are near the pendent stage of development. At this time the gall midge and cone moth have already attacked, but are killed before damage occurs to developing seeds; the scale midge and seed chalcid attack later but damage is reduced by the residual effect of the insecticides.

Although the effective insecticides had slight phytotoxic effects on some trees, this does not appear to be important.

Based on the precautionary measures recommended by distributors, dimethoate is the least toxic to humans of the effective materials dimethoate, Meta-Systox-R, and Bidrin. The oral LD50 to rats for each is 215, 65 and 22 mg. per kg. respectively.

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