Effect of Selected Insecticides and Fungicides on Germination of Douglas Fir and White Spruce Pollen

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Germination of two lots each of Douglas-fir and white spruce pollen was determined in vitro on a pesticide-amended medium. In general, all the pesticides (two insecticides and two fungicides) reduced pollen germination of both tree species; an exception was ferbam which sometimes increased Douglas-fir pollen germination slightly. Additional tests are needed to determine if pesticides affect pollen germination in vivo.

Various seed and cone insects and inland spruce cone rust (*Chrysomyxa pirolata* Wint.) are major impediments to seed production in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and spruce (e.g., white spruce (*Picea glauca* (Moench) Voss.)) seed orchards in British Columbia (5, 6). Until alternative strategies or integrated approaches are developed, orchard managers must rely solely upon pesticides for controlling these pests. The efficacy and possible phytotoxicity to trees and cones of several pesticides have been (or are being) determined, but information is also needed on their possible detrimental effects on pollen germination.

Methods

The pesticides tested were the insecticides dimethoate 25 EC (at 10,000, 1,000, and 100 p/m a.i.) and oxdemeton-methyl 25 EC (at 10,000, 1,000, and 100 p/m a.i.) and the fungicides ferbam 76 WP (at 1,520, 821, and 152 p/m a.i.) and potassium coconate 11-percent (at 20,000, 10,000, and 5,000 p/m a.i.). The highest of these concentrations corresponds to the manufacturers' recommended field application. The pollen germination medium (3), with 2-percent agar added, was autoclaved and cooled to 50° C. The pesticides were added before it was poured into petri dishes. A pH meter was used to determine the pH of the medium for each treatment. Two lots each of Douglas-fir (34-percent and 31-percent germination capacity) and white spruce (18-percent and 50-percent germination capacity) pollen were dusted with a dry paint brush onto the various media. After incubation in the dark at 26° C for 24 hours and 48 hours, the percentage of germination (8, p. 74-75) was determined. The data were subjected to analysis of variance and the significance of mean differences determined using the Student- Newman-Keuls' test (9). Each treatment and the control were replicated three times and the number of pollen grains (200300) counted per replicate was based on the germination capacity of each lot at the 0.95 confidence level (8, p. 76).

Results and Discussion

Table 1 show that, at the recommended label concentrations, dimethoate, oxydemeton-methyl, and potassium coconate prevented germination of Douglas-fir and white spruce pollen, as did ferbam for white spruce. In general, even lower concentrations of these materials lowered germination, especially of spruce pollen. These reductions in germination occurred regardless of the initial germination capacity of the pollen. One anomaly was the increased germination of both lots of Douglas-fir pollen at the intermediate levels (821 and 1 52 p/m) of ferbam. Matthews and McLintock (4) found that ferbam could increase germination of slash (*Pinus elliotti* Engelm. var. *elliottii*) and longleaf (*P. palustris* Mill.) pine pollen. Observations made both before and after the 48 hours for Douglas-fir and 24 hours for the white spruce (table 1) confirmed that the chemicals affected germination capacity rather than rate.

The pollen lots of each species responded similarly. Overall, reduced germination, particularly of white spruce pollen, appeared to be related to changes in acidity of the medium (table 1) resulting from the added pesticides (e.g., the lower pH of the oxydemeton-methyl-amended medium and the higher pH values when potassium coconate was added). Correlation coefficient or *r* values (9)

Table 1—*Effect of dimethoate and oxydemeton-methyl insecticides and ferbam and potassium coconate fungicides on germination* in vitro *of Douglas-fir and white spruce pollen*

Pesticides and concentration (p/m)	Medium pH	Kind of pollen and percentage of germination			
		Douglas-fir		White spruce	
		Lot 1	Lot 2	Lot 1	Lot 2
Dimethoate					
10,000	5.3	0a[1]	0a	0a	0a
1,000	5.7	3.4ab	3.7b	0a	0a
100	5.7	5.4b	9.1c	2a	4.8a
0 (control)	5.9	9.0c	11.2c	24.1b	56.5b
Oxydemeton-methyl					
10,000	4.2	0a	0a	0a	0a
1,000	5.2	7.5b	9.5b	0a	0a
100	5.7	9.0c	9.9b	14.0b	42.7b
0 (control)	5.9	9.0c	11.2b	24.1c	56.5c
Ferbam					
1,520	6.0	11.3a	12.1a	0a	0a
821	6.3	14.7b	16.8b	0a	0a
152	5.9	14.7b	10.3a	0a	0a
0 (control)	5.9	9.0a	11.2a	24.1b	56.5b
Potassium coconate					
20,000	9.6	0a	0a	0a	0a
10,000	9.3	0a	0a	0a	0a
5,000	8.4	0a	0a	0a	0a
0 (control)	5.9	9.0b	11.2b	24.1b	56.5b

[1]The four treatment means for each pollen lot and pesticide are significantly different ($p = 0.05$) if followed by a different letter. Germination after 48 hours for Douglas-fir and 24 hours for white spruce.

of 0.59, 0.61 (significant at p = 0.05), and 0.11 (nonsignificant) were obtained when germination percentages of both Douglas-fir and spruce pollen were regressed against the pH of the media containing dimethoate, oxydemeton-methyl, and ferbam, respectively. No such analysis was possible for the potassium coconate data because no pollen germination occurred at any dosage rate. Stanley (7) lists pH as one of the principal exogenous factors affecting *in vitro* germination of conifer pollen. However, it is not possible to state whether the pesticide effects were caused by changes in pH or by the pesticides themselves because these two factors are very closely connected. Moreover, pollen germination varied among chemicals at the same pH, which suggests a true pesticide effect.

The results of this study suggest a potential harmful effect of pesticides on pollen germination and subsequent seed yield. Additional research is planned to determine if these harmful effects also occur *in vivo*. Other studies (1, 2) suggest that this seldom occurs or that the harmful *in vitro* effects may be nullified by using other formulations of the pesticide or by varying application timing or equipment.

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