NOTE

INVESTIGATIONS INTO THE FUNGICIDAL EFFECT OF CUPROUS OXIDE AGAINST *PHAEOCRYPTOPUS GAEUMANNII* ON DOUGLAS FIR SEEDLINGS

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Abstract

Two experiments were carried out in successive years to investigate control of infection of Douglas fir (Pseudotsuga menziesii) *by the needle parasite* Phaeocryptopus gaeumannii. *Newly flushed seedlings were sprayed past the point of run-off at different intervals after bud-burst, using cuprous oxide fungicide at concentrations between 0.025% and 0.2%, combined with 0.08% Surfac 717 as surfactant. With one exception all concentrations reduced infection on current foliage when sprayed once between 9 and 41 days after flush. Two sprays, the first within 27 days of bud-burst and the second 26 to 57 days later, gave a better level of control in one of the experiments than any single-spray treatment.*

INTRODUCTION

There have been few attempts to test the effect of fungicides against the Douglas fir (*Pseudotsuga menziesii*) needle parasite *Phaeocryptopus gaeumannii* (Rohde) Petrak. Merkle (1951) recorded an experiment using Bordeaux mixture in which one application made during the sporulation period of the fungus failed to give control. More recent work has indicated that two copper fungicides, copper oxychloride and cuprous oxide, each required an added surfactant for effective control (Hood, 1973; Vanner and Hood, 1974). The following note describes two experiments carried out with cuprous oxide combined with a surfactant, to investigate the level of control obtained by spraying at different times and concentrations, and with a varying number of applications during the growing season. Infection of current foliage of Douglas fir with *P. gaeumannii* takes place in spring on needles newly emerged from the terminal bud.

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TABLE 1: EFFECT OF SPRAY TIMING ON INFECTION BY *PHAEOCRYPTOPUS GAEUMANNII*
(Includes all copper concentrations)

No. Sprays per Season	*1970-1* Spray Timing *Time**	*Date*	*No. Seedlings*	*Mean % Foliage Infected Sep. 1971*	*Standard Deviation*	*1971-2* Spray Timing *Time**	*Date*	*No. Seedlings*	*Mean % Foliage Infected Aug. 1972*	*Standard Deviation*
Unsprayed	—	—	8	36	± 12	—	—	16	75	± 15
One	2	23 Nov.	5	35	± 9	9	19 Nov.	8	11	± 9
	11	4 Dec.	5	31	± 12	15	25 Nov	4	9	± 4
	25	18 Dec.	5	7	± 6	21	19 Nov.	8	17	± 9
	35	23 Dec.	5	2	± 1	29	19 Nov.	8	18	± 12
	41	12 Jan.	5	6	± 4	35	19 Nov.	8	19	± 9
	—	—	—	—	—	41	21 Dec.	8	14	± 9
Two	2, 30	23 Nov. 23 Dec.	5	3	± 3	2, 33	19 Nov. 21 Dec.	7	2	± 2
	6, 69	23 Nov. 26 Jan.	10	13	± 10	9, 41	19 Nov. 21 Dec.	7	2	± 2
	11, 50	4 Dec. 12 Jan.	5	5	± 5	9, 57	19 Nov. 6 Jan.	8	3	± 3
	11, 77	4 Dec. 8 Feb.	5	12	± 9	27, 53	25 Nov. 21 Dec.	4	4	± 1
	30, 69	18 Dec. 26 Jan.	5	2	± 1	27, 69	25 Nov. 6 Jan.	4	9	± 5
	—	—	—	—	—	27, 84	25 Nov. 21 Jan.	4	6	± 4
Three	6, 35, 82	23 Nov. 23 Dec. 8 Feb.	5	0.4	± 0.6	—	—	—	—	—

*Days after bud-burst when sprayed.

METHOD

Two similar trials were carried out over a period of 2 years, as follows:

Experiment 1

Between November 1970 and February 1971 (inclusive), newly flushed Douglas fir seedlings in pots were hand-sprayed up to three times with suspensions of a New Zealand-made cuprous oxide fungicide (wettable powder, 50% Cu)* at different intervals after bud-burst. Seedlings were 1½ to 2 years old, approximately 30 cm tall, and had been stored for 1 month at 4° C prior to potting up. This cool storage treatment slightly delayed bud-burst and most seedlings flushed during the second half of November. (Douglas fir in the Rotorua area normally flushes somewhere between late September and mid-November, depending on age and origin.) Those experimental seedlings that flushed at approximately the same time (within, at most, 9 days of each other) were arranged into groups of five. Each group was sprayed either once, twice, or thrice, different groups being sprayed at different times as outlined in Table 1. Within each group of five seedlings, two were sprayed with a concentration of 0.025% fungicide, while the other three were sprayed at concentrations of 0.05, 0.1 and 0.2%, respectively. Volumes of 0.5 or 1.0 litres per seedling were used for each application, an amount sufficient to pass runoff point; and in all cases 0.08% Surfac 717 was added as surfactant. Rainfall during the 24-hour period after spray applications did not exceed 3 mm, and after most applications there was no rain. Eight seedlings that flushed over the same period as treated seedlings were left unsprayed as controls, and all seedlings, control and treated, were sited beneath infected trees from October until April to subject them to a source of inoculum.

The percentage of the current year's needles from the main growth flush that were infected was determined by one person who counted, out of 50 to 200 needles per seedling, the number that bore pseudothecia. This evaluation was done in September (1971) when pseudothecia were large enough to be visible through a hand lens.

Experiment 2

Another experiment was undertaken during the 1971-2 growing season. In this experiment seedlings were not subjected to cool storage so flushing occurred earlier, between mid-October

*Manufactured by Copper Refining Company, Auckland.

and mid-November. The seedlings were divided into groups of eight as they flushed, two seedlings within each group being sprayed with 0.025% fungicide, two with 0.5%, two with 0.1% and two with 0.2%. Surfac 717, at a concentration of 0.08%, was used with all applications. (Details of the spray timing are outlined in Table 1.) Most treated seedlings were protected from rainfall during the first 24 hours after spraying. Sixteen seedlings that flushed over the same period as treated seedlings were used as controls and all seedlings, control and treated, were placed beneath infected trees from October until March. The seedlings were sprayed during November with 0.05% DDT.

Some seedling mortality occurred. Those that survived were evaluated in August 1972. A total of 400 current needles per seedling were counted, three assessors counting different seedlings.

RESULTS AND DISCUSSION

Variation in fungicidal concentration had no obvious effect on infection levels, except on seedlings sprayed once in 1971-2 where applications at 0.025% may have been slightly less effective than those at higher concentrations. For this reason the data from the different concentrations have been combined in the Table.

From Table 1 it can be seen that all spray treatments reduced infection, except for the 1970-1 one-spray treatments applied 2 and 11 days after bud-burst. In that experiment, new shoots 11 days after bud-burst were no longer than 5 cm and needles were only partially unfolded: thus insufficient foliage may have received fungicidal protection at that time. In 1971-2 many new shoots at 9 days after bud-burst were already 5 to 10 cm long and had more fully opened foliage.

Control seedlings were not as heavily infected in 1970-1 as in 1971-2, possibly because they flushed later in the season than usual and were therefore exposed to less inoculum. This may also explain why, with the above-mentioned exception, mean infection levels of seedlings sprayed once only were lower in the first experiment than in the second.

Spraying twice in 1970-1 was only marginally more effective than spraying once, whereas spraying twice in the 1971-2 series did give a higher level of control.

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