Control of Spruce Cone Rust (Chrysomyxa pirolata Wint.) with ferbam: Skimikin Seed Orchard 1985

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Ferbam has been shown to control spruce cone rust (Chrysomyxa pirolata Wint.) when one or two sprays are applied to cones during the pollination period (Summers, et al., 1986). The purpose of this trial was to confirm those results on an additional cone crop.

Materials and Methods

During May, 1985, 30 cone bearing trees in the Central Plateau high elevation seed orchard at Skimikin were treated randomly (n = 6 trees each):
- sprayed May 14, when most conelets in the orchard were elongating,
- sprayed May 18, as close to pollination as operationally practical,
- sprayed May 30, after pollination,
- sprayed on all three dates,
- not sprayed.

All sprays contained ferbam (Ferbam 76W, 2 g/L and were applied to run-off to the cone bearing portions of the trees using a 15L backpack sprayer.

Basidiospores were collected from nearby alternate host plants (Pyrola sp.) between May 1 and May 30 using the carousel sampler described by Powell and Morf (1967).
During July and August, 1985, the numbers of infected and uninfected cones on each tree were assessed. After cone collection in August and air drying for two months, the seed from healthy cones was extracted and bulked by treatment. For each bulked seedlot, 16 random samples of seed were x-rayed. The percentage filled seed was determined by comparing the total filled seed to the total of filled and empty seed in the 16 samples\(^1\). The filled seed was then separated and germination tests (ISTA, 1976) were done on four random samples per seedlot.

The data collected was analyzed using chi-square analysis for both the numbers of infected and uninfected cones and the numbers of filled and empty seeds in each treatment. Pairwise comparisons were made using the degrees of freedom for the overall chi-square to determine significance. Analysis of variance and Duncan's multiple range test were used for seed germination data analysis (Ministry of Forests, Research Branch germination analysis program).

Results and Discussion

The sprays prior to and at the time of pollination reduced the incidence of cone rust with the spray on May 18 being the most critical (Fig. 1a). The spray prior to pollination (May 14) reduced the amount of rust from 26% in the check group (not sprayed) to 14%, however, the spray May 18 reduced the rust to less than 10% in both the single and multiple spray treatments. The May 30 spray had little effect. This is probably because of a lack of inoculum.

\[\text{% filled seed} = \frac{\text{filled seed in 16 samples} \times 100}{\text{total seed in 16 samples}}\]
FIG. 1 Percent cones infected by spruce cone rust (A) percent germination (B) and percent filled seed (C) for various treatments at Skimikin Seed Orchard in 1985. Bars with the same letter are not significantly different (Chi-Square $P:0.05$ for A and C; Duncan's multiple range test $P:0.05$ for C).
Peaks of basidiospore production occurred at intervals between May 14 and May 22 (Fig. 2). The sprays on May 14 and/or May 18 protected the cones during this period. Basidiospore production virtually ceased after May 22, accounting at least in part, for the lack of protection by the spray after pollination (May 30), i.e., the infection period was over. The study cited previously also found that spore production and the pollination period coincided closely, indicating that infection is associated with the pollination period.

There were no significant differences in germination between treatments (Fig. 1b). Germination percentages were all 95% or greater. There were differences between treatments in the amount of filled seed, however, these differences were inconsistent and probably not treatment related (compare the 3 spray treatment, the 1 spray May 17 at pollination and the spray May 30, Fig. 1c).

There was a lot of variation in the amount of rust infection between trees in some treatments (Fig. 3). This can be explained at least in part by differences in cone phenology and the fact that there seems to be a relatively short "window" during which protection can be achieved. Cone development in an orchard is not synchronous. A single spray on a tree may be at the right time to protect those cones which are susceptible to infection, but it may be too early or too late to protect the cones on another tree or cones on the same tree which have developed more slowly or more quickly. Combinations of "early" and "late" trees within a treatment would contribute significantly to
Fig. 3 Schematic plots showing the distribution of data collected on diseased cones in each treatment at Skimikin in 1985. Box represents location of 50% of observations; end of whiskers, "O" or "*" represent extremes; middle bar and "+" locate median and mean respectively (generated by S.A.S. Proc Splot). Longer boxes and associated whiskers indicate more tree to tree variation.
variation found in the degree of protection afforded by a treatment. Evidence for this is that the amount of variation was lowest in the multiple spray treatment where there was a 10\% variation in the level of infection between trees. In this treatment two of the 3 sprays would have provided protection over a significant period of early conelet development. The amount of variation increases to 30\%-40\% for single sprays applied at or before pollination. Here, the period of possible protection was much shorter. Variation increases again to about 60\%-70\% for those trees sprayed after pollination and in the check group. A large amount of variation in these latter two groups is not unexpected because of the many environmental and biological factors involved in the host plant relationship and because neither group had protection during the critical pollination/infection period.

The above discussion indicates that while ferbam can reduce spruce cone rust if applied as a single spray at pollination, 2 or 3 sprays would provide more consistent control operationally because of the differences in cone phenology found in a seed orchard. This fact would be significant operationally in a seed orchard because all trees are expected to contribute equally to the genetic makeup of the seedlot (Crown 1985). High losses in "early" or "late" clones would reduce their contribution overall.

It is suggested that recommendations for the use of ferbam in seed orchards to control spruce cone rust should call for one to three sprays during the elongation/pollination period depending on the synchrony of the crop in a given year. Spraying should take place at approximately weekly
intervals and start when conelets are elongating. Sprays should end once the conelets have reached the horizontal to pendant position. Monitoring basidiospore release from *Pyrola* sp. may offer further guidelines as to when to initiate or terminate control measures.

References Cited


Acknowledgements

The authors wish to than J.R. Sutherland, T.A.D. Woods, and J. Dennis for their assistance collecting the basidiospore data.