

THE EFFECT OF AGE ON THE SUSCEPTIBILITY TO BLISTER RUST OF WESTERN WHITE PINE SEEDLINGS

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INTRODUCTION

In British Columbia we have initiated a program to select western white pines (*Pinus monticola* D. Don.) that are resistant to white pine blister rust (*Cronartium ribicola* J.C. Fischer) (Meagher and Hunt 1986). Our program screens seedlings; it is similar to the programs in the U.S. Forest Service (Bingham 1983; Hunt 1988). Seedlings are 2 years old when inoculated, because younger *P. strobus* L. seedlings are highly susceptible (Clinton and McCormick 1919; York and Snell 1922) and it is believed that *P. monticola* behaves similarly (Bingham 1983). Likewise, if *P. strobus* is old when tested, it appears highly resistant compared to seedlings (Patton 1961, 1967). It is then possible that scions from highly resistant older *P. monticola* trees may produce very susceptible offspring. The objective in this study was to determine if *P. monticola* seedlings become more resistant with age and whether highly resistant older trees (screened as clones) produce susceptible offspring.

METHODS

In the first test, three seedlots from three different geographic areas (Sooke, Vancouver Island--1 tree; Barrière, Kamloops Forest Region--5 trees (pooled); and Kaslo, Nelson Forest Region--5 trees (pooled)) were grown for 4 successive years and then inoculated (Hunt 1988) at the same time. In the second test, open-pollinated seed was gathered from two highly resistant clones and a susceptible clone (Hunt and Meagher 1989). Infection incidence (needle spots and stem cankers) in offspring (average 51 individuals per seedlot) from these clones were compared to incidence in offspring from candidate trees, including a highly cankered control, and resistant Idaho F₂ (Bingham 1983), all inoculated at the same time.

RESULTS

Older seedlings averaged fewer spots per tree (Table 1) and had fewer trees with many spots compared to younger seedlings of the same seedlots. The 1-year-old seedlings had the fewest spots, because they were small targets, but on a per-metre basis they had 15-70 times as many spots as the older seedlings (Table 1). Spots were more frequent on the current foliage than on older foliage, and stem cankers originated only from spots on current foliage. Cankers were less frequent on 4-year-old seedlings than on younger seedlings.

The susceptible clone (A1) produced more cankered offspring than all other seedlots tested (Table 2). One of the resistant clones (G8) produced about as many spotted and cankered offspring as a control (C) candidate, while the other was about as resistant as Idaho F₂ stock (Table 2).

Table 1. Blister rust spot and canker incidence in three seedlots (pooled) inoculated in 1987 at different ages

Age (yr)	Sample size	Mean spots/tree	Mean ^a spots/m	Trees spotted (%)	Trees cankered (%)
1	113	8.7	11.70	100	100 ^b
2	215	30.2	0.67	100	98
3	229	23.8	0.55	99	98
4	179	11.1	0.16	92	88

^a Crown sizes of all trees were recorded, and two representative seedlings of ages 2, 3, and 4 years had the needles counted and measured to obtain a summed needle length representative for the age class. Needles were counted on all 1-year-old seedlings and summed for the seedlot, then seedlots were averaged.

^b Most trees cankered about 5 months sooner than older seedlings.

Table 2. Blister-rust incidence in offspring from resistant (r) and susceptible (s) clones, candidate trees, and Idaho F₂ orchard seed

Seed parent	Spots/seedling (mean)	Trees cankered after 2 years (%)
s-A1	8.7	97
48	7.4	93
49	6.7	90
60	13.9	89
65	8.7	87
62	6.5	85
r-G8	8.5	83
C	8.7	81
48	8.7	79
65	9.4	79
r-B640	6.9	74
F2	4.3	73

DISCUSSION

Four-year-old seedlings become resistant to blister rust, showing fewer spots and cankers than their younger siblings. Cankering of 2- and 3-year-old seedlings was similar, although the latter had fewer spots (Table 1). One-year-old seedlings were very small targets, but developed relatively many more spots and cankers earlier than older seedlings. Like eastern white pine (Clinton and McCormick 1919; York and Snell 1922), 1-year-old seedlings are highly susceptible. The optimal age for rigorously screening seedlings is 2-3 years. For use in field sites of low-inoculum-density, perhaps older seedlings could be screened.

Since cankers were associated only with spots on current foliage, it must be concluded that under our inoculation conditions, all foliage except the current foliage is resistant to blister rust. This is contrary to observations of western white pine by Lachmund (1933) and eastern white pine by Hirt (1936, 1938) and to previous inoculation results of western white pine (Pierson and Buchanan 1938) where current needles are considered the most resistant. Only Snell (1936) and Patton (1961) report that current needles are most susceptible. More field inoculations are needed to confirm the high susceptibility of current needles and that cankers predominately originate from these needles; otherwise, results from screening seedlings may be an artifact of test conditions and not accurately reflect the field situation.

Resistant clones derived from screening old material as clones may produce susceptible offspring (Table 2); thus, this material is not suitable for seed orchards unless their offspring also indicate resistance.

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