SCREENING PORT-ORFORD-CEDAR FOR RESISTANCE TO PHYTOPHTHORA LATERALIS: RESULTS FROM 7000+ TREES USING A BRANCH LESION TEST

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ABSTRACT

As part the process of developing an operational program breeding for genetic resistance to a root disease of Port-Orford-cedar (*Chamaecyparis lawsoniana*) caused by *Phytophthora lateralis*, an inter-agency effort has been undertaken to select and screen phenotypically resistant trees throughout the range of Port-Orford-cedar. The USDA Forest Service, USDI Bureau of Land Management, and Oregon State University (OSU) have selected over 7000 trees across south-west Oregon and northern California, predominantly on federal lands. Generally, these selections were healthy trees in areas where *P. lateralis* was known to be present. Screening began at OSU in 1989, and different techniques were developed and used through 1996. Operational screening of field selections began in 1997, and through 1998, over 6700 clones were screened using the branch dip method. This method had previously been found to identify at least the most resistant clones. Lesion length was measured on 6 branches per clone, and these measurements were compared with a resistant and a susceptible control tree. Relatively few of the clones screened in 1997 and 1998 had branch lesion means smaller than the resistant control. Approximately the top 10% of each run was selected to be included in the breeding program. Over 1000 clones are currently in the breeding program, for the purposes of retesting, crossing, and archiving these genotypes. The screening effort is continuing in 1999 with many areas of private land within the range of Port-Orford-cedar being targeted for selection and testing, with an ultimate goal of screening a total of 9000 trees.

INTRODUCTION

P. lateralis has been found in pockets across the natural range of Port-Orford-cedar, with young trees being killed in a matter of months, and even large older trees dying within a few years of infection. A small percentage of individuals however have shown marked resistance to the pathogen, and consistently perform well in testing. An operational program to find, breed, and propagate individuals expressing resistance is currently under way cooperatively with the USDA Forest Service, USDI Bureau of Land Management, and Oregon State University (OSU).

Beginning in 1989, healthy trees growing in areas with a known presence of *P. lateralis* were tested for resistance. From 1989 through 1996, approximately 700 individuals were tested, using various methods developed at OSU. A fast and effective method of artificial inoculation with *P. lateralis* was developed, and beginning in 1997, the operational screening program was begun. In 1997 and 1998, nearly 7000 individuals were selected in the field, and screened at OSU. The selection and screening is continuing in 1999, with a goal of screening a total of 9000 individuals.

MATERIALS AND METHODS

- Beginning in early spring, branches from selected trees are sent to OSU and screened in "runs" as they are received from the field.
- The cut ends of 6 branches approximately 1 foot long from each individual, separated into 2 blocks of 3 branches each, are exposed to inoculum for 24 hours.
- After inoculation, the branches are stuck in tubes filled with vermiculite, and watered once a day.
- After 21 days, the bark and cambium are scraped away, revealing any lesion, and the length of the lesion is measured.
- As a basis for comparison, a highly resistant clone (CF1) and a susceptible clone (CON1) are tested in each run.

RESULTS

(results from 1997 and 1998 are similar; only 1998 results are shown)

- In each run, there is a wide range in mean lesion length among clones (figs. 1 and 2).
- CF1 mean is usually the smallest or one of the smallest in the run (fig. 1).
- CON1 mean is usually higher than the run mean (fig. 1).
- Despite a wide range in clonal means in each run, in almost all runs, significant clonal differences were detected.
- The difference between the checklots (CON1 - CF1) also varies by run, but to a lesser degree, and there is no trend with time.
- Less than 5% of the clones screened had mean lesion lengths smaller than CF1.
- Overall mean lesion length of all non-control trees is almost identical between 1997 (32.97 mm) and 1998 (32.89 mm) (table 1).
- Approximately 10% of the clones with the smallest mean lesion scores (table 2) were selected for inclusion in resistance breeding program.

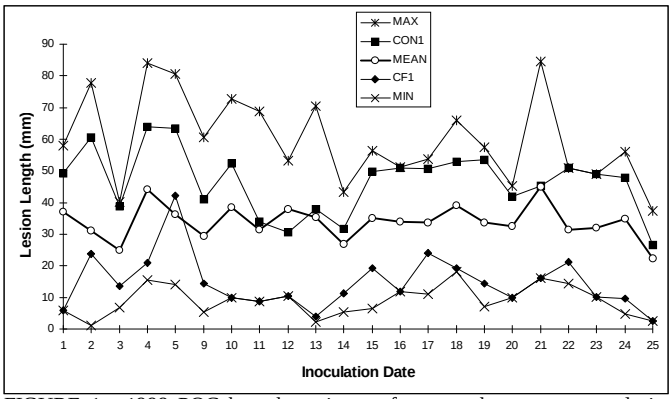

FIGURE 1. 1998 POC branch testing performance by run – mean lesion lengths for top and bottom family per run relative to the two controls and the run mean.

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TABLE 1. Total yearly selections of Port-Orford cedar for disease resistance screening.

	Number of Selections Tested							Number of Trees Selected for Program						
	1989[b]	1990[b]	1995	1996	1997	1998		1989	1990	1995	1996	1997*	1998	
Medford – BLM			190	117	1074	17				20	30	99	3	
Roseburg – BLM					263	187						30	14	
Coos Bay – BLM				15	461	877					10	45	117	
Siskiyou – USFS	24	115[c]		66	2148	1266		24	113		28	203	122	
California – USFS	15	41		112	276	205		15	41		61	20	13	
Private land – OR				10							6	13		
Private land – CA				24										
TOTAL	39	154	190	344[a]	4222	2552		39	154	20	148	397	269	
GRAND TOTAL							**7501**							**1027**

* Includes 17 selections that were dead, cut, or missing when re-visited.
[a] 27 families previously tested in 1989-90.
[b] Original selections from heavily infected areas.
[c] 2 families selected and tested in 1989.

TABLE 2. POC disease resistance screening site mean lesion scores.

		1997			1998		
		n	Lesion Length[a]	CF1 lesion	n	Lesion Length[a]	CF1 lesion
Coos Bay							
	Coos Bay	461	38.95	18.65	885	32.51	11.9
Siskiyou							
	Gold Beach R.D.	511	32.83	24.26	386	33.94	17.08
	Power's R.D.	1517	35.08	15.77	799	37.44	15.77
	Illinois Valley R.D.	120	23.24	10.25	55	32.98	10.17
	Gallice R.D.				26	31.79	10.17
sub-total		2148			1266		
Medford							
	Grants Pass BLM	736	30.81	13.76			
	Medford BLM	338	35.25	19.7	17	28.58	10.17
sub-total		1074					
Roseburg							
	Roseburg BLM	263	31.57	12.01	179	30.88	17.29
California	(watershed)						
	Klamath River	65	34.59	11.55	129	35.03	35.82[b]
	Sacramento River	96	36.21	10.21	38	36.81	11.83
	Smith River – middle	29	33.62	17.17	15	35.62	11.83
	Smith River – north	12	30.06	17.17			
	Smith River	3	26.94	17.17	5	30.02	11.83
	Smith River – south	13	37.98	17.17	18	30.42	11.83
	Trinity River	58	34.49	12.44			
sub-total		276			205		
OVERALL		4222	32.97	15.52	2552	32.89	12.72

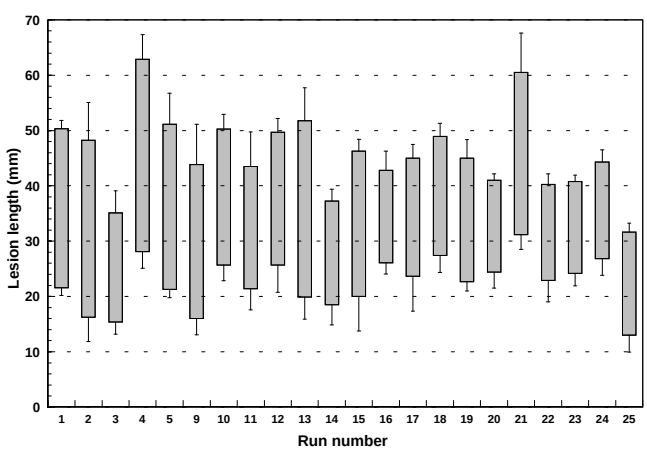

FIGURE 2. Clonal variation in branch lesion length within and between 22 runs in 1998.

The selection of Port-Orford-cedar to date has covered the natural range very well on federal lands. Selection and testing is continuing in 1999, focusing on adjacent private lands, in order to obtain complete sample from across the landscape.

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