

INCIDENCE AND SUSCEPTIBILITY OF LODGEPOLE PINE TO A NEEDLE DISEASE AND TWO RUST DISEASES IN A PROVENANCE TRIAL PLANTATION AT THE B.C. MINISTRY OF FORESTS SEED ORCHARD AT RED ROCK, PRINCE GEORGE FOREST REGION

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Summary

A 1.5 man-day survey of over 12 000, 15-year old lodgepole pine from 53 different provenances within B.C., the Yukon and Western Alberta in July found that most two- and three-year old needles on 93% of the trees were infected by a pine needle cast, Dothistroma (Scirrhia) pini. Western gall rust, Endocronartium harknessii and stalactiforme blister rust, Cronartium coleosporioides infected up to 25% of the 90 trees per replication.

Yukon provenances were among the most severely infected by needle cast and blister rust and were uniformly among the least vigorous. Most other provenances that were severely infected by the needle cast were of low vigor and probably bioclimatically unsuited to the Prince George environment. It was not clear whether severe infections in particular provenances were due largely to stresses in the Prince George environment or a lack of evolved resistance to a disease not commonly encountered in the native environment.

Lodgepole pine Provenances

The Red Rock Seed Orchard near Prince George is the site of one of the largest lodgepole pine provenance trials in B.C. The plantation was established from seed originating from 53 locations within B.C., western Alberta and the Yukon. The seed was germinated in 1969 and seedlings were outplanted in their present location in 1973. All 53 provenances are represented in each of four adjacent blocks, and each provenance replication contains a total of 90 trees from 6 families. Trees of the same family arose from the seed of a single parent tree.

Diseases

In the past two years the pine needle cast Dothistroma (Scirrhia) pini has caused increasingly severe needle losses within the provenance plantation. Spores mature in June and July and are transmitted by rain splash from dead needles to adjacent healthy ones. The ability of this disease to infect needles of all ages renders it particularly damaging. An ideal environment was provided for infection by the young, evenly spaced, single species plantation. The only factors limiting disease proliferation were the availability of inoculum, weather conditions and host resistance. Mature spores from prolific 1983 infections satisfied the first requirement, and cool moist early summer weather the second. Host susceptibility within the provenances was evidently variable.

1984 Survey

In July more than 12 000 trees were examined to determine whether some provenances were more susceptible to the disease than others. During the 1.5 man-day survey, trees were also examined for the presence of western gall rust, Endocronartium harknessii, which causes frequent branch mortality and occasional tree mortality, and stalactiforme blister rust, Cronartium coleosporioides. Both diseases were rated on the frequency of their occurrence within a provenance, on a five point scale from very low (less than 3 infected trees per provenance replication) to very high (more than 15 infected trees per provenance replication). Each provenance replication was further subjectively rated in terms of vigor (see Table).

Results

D. pini had proliferated to infect 93% of the 12 000 trees examined and affected virtually every provenance. The two rusts were present in most of the provenances, though their occurrence varied greatly and independently. The stalactiforme rust particularly, and its alternate host, indian paintbrush, had proliferated in the past few years.

Two provenances from the Yukon (No's 32+33) were among the most severely infected by the needle disease and the stalactiform rust. These provenances were also uniformly among the least vigorous within the plantation. Other provenances which exhibited particularly low resistance to the needle cast included some from the Chilcotin (15, 16 and 18), Rock Creek in the west Kootenay (41) and Sawdust Creek near Kimberley (47). Conversely, six provenances from the vicinity of Prince George (24, 40, 61, 62, 63, 65) were among the least infected by all three diseases, and were among the most vigorous. All other provenances displayed moderate or variable levels of infection.

Discussion and Conclusions

With few exceptions, those provenances most severely infected by needle cast and the two rust diseases were those which appeared the least vigorous. Low vigor is probably both a cause and an effect of the diseased condition. The least vigorous trees were usually the farthest removed from their native environment. Yukon provenances, for example, evolved for optimal growth within a short growing season in the summer, when the photoperiod approaches 24 hours. The Rock Creek and Chilcotin provenances are adapted to a much drier climate than is found in Prince George¹. The severely infected Sawdust Creek provenance originated from an elevation of over 1 800 m, the highest

¹Monthly meteorological summaries for B.C. 1970-1983

elevation in the trial. These least vigorous provenances were all subject to stresses in the Red Rock plantation not found in their native environment. In addition, in their native environment they were less exposed to diseases such as D. pini that rely on certain fairly specific moisture conditions to proliferate. Trees that have not been pressured to select for resistance to the disease will likely be less resistant.

In the Prince George environment, it is not possible to isolate the factors influencing susceptibility of the various provenances to needle cast. Followup surveys of these same provenances in their native habitat coupled with experimental selected inoculations would be more informative.

TABLE - Incidence of needle and stem districts in lodgepole pine provenance trials at Red Rock Seed Orchard, Prince George Region, 1984.

Prove- nance #	Origin	Vigor	Dothistroma		Remarks	Cronartium	Endocro- nartium
			% Trees Infected	% Needles Infected			
14	Wentworth Cr. N of Kamloops	mod-good	90	10	low-mod variable from 0-30	high	mod
15	Esperon L.	moderate	100	40	high, up to 70%	high	high
"	"	mod-good	"	20	" " " "	mod-high	mod
"	W of Winfield N of Westbank	" "	"	30	" " " "	high	high
16	Lime L/O (Cariboo)	low	100	60	v. high	low	mod
"		"	"	50	" "	high	mod
17	Oie L.	good	100	20	mod-high	low	mod
"	(between Williams	"	"	"	" "	"	low
"	L. and Wells Grey Park)	mod-good	"	30	"	low-mod	mod
18	Chilco	moderate	100	50	high-v. high	high	high
"	(Chilcotin)	low-mod	"	40	" "	v. high	"
"		moderate	"	20	" "	high	mod
"		low	"	50	" "	low-mod	
19	Nithi R. (Fraser L.)	mod-vig	90	5	v. low	low	high
20	Collins L.	moderate	100	50	variable, from	high	low
"	(just E of	"	80	5	v. low to v.	mod	high
"	Morice L. SW	"	100	10	"	"	"
"	of Houston	"	80	5	variable up to 30	low-mod	mod
21	Doris L.	low-mod	100	10	low-mod	high	high
"	(Babine L. NW	good	90	5	" "	mod-high	"
"	of Granisle)	moderate	100	20	" "	v. high	mod.
22	Telkwa Low.	good	80	5	v. low-mod	low-mod	low
"	(near Smithers)	mod-good	80	5	" " "	low	low
"		good	100	20	" " "	"	mod
23	Udy Cr.	moderate	100	20	mod-high	low	low
"	(Between Quesnel and Nazko)	mod-good	"	"	" "	mod-high	low-mod
24	Findlay Forks	good	100	10	v. low-mod	low	low
"	Williston L.	"	"	5	" " "	"	"
"	(confluence of	"	80	5	" " "	mod	"
"	Drie Peace + Parsnip & Findlay rivers	"	100	10	" " "	"	"

Prove- nance #	Origin	Vigor	Dothistroma		Remarks	Cronartium	Endocro- nartium
			%	%			
			Trees Infected	Needles Infected			
25	Hudson Hope	mod-good	100	10	low-mod	low	low
"		good	"	5	" "	"	"
26	Tower L.	good	50	5	v. low-mod-high	mod	low
"	Between Dawson	mod-good	100	20	" " " "	low	"
"	Cr. and Fort St. John	good	50	5	av. low	mod	low
27	Pink Mt.	moderate	100	30	mod-high	low	low
"	(Alaska Hwy between Fort St. John and Ft. Nelson)	mod-good	"	10	" "	high	"
28	Tetsa L.	low-mod	100	20	mod-high	high	low
"	(Alaska Hwy	moderate	"	30	" "	low-mod	"
"	just E of Stone Mt. Park)	moderate	"	5	up to 20	high	"
29	Muacho L.	low-mod	100	40	v. low-v. high?	low	low
"	(Alaska Hwy)	moderate	70	5	" " " "	"	"
30	Lower Post	moderate	100	15	moderate	high	mod
"		moderate	"	10	"	"	low
"		"	"	"	"	"	"
31	Frances L.	low	100	10	low-mod	low	low
"	(SE Yukon Terr)	"	"	5	" "	high	"
32	Carmacks	low	100	50	high	high	low
"	(southcentral	"	"	40	"	v. high	"
"	Yukon)	"	"	10	"	high	mod
"		"	"	30	"	v. high	"
33	Ethel L.	low	100	40	v. high	low	low
"	(central Yukon near Mayo)	"	"	"	" "	high	high
34	Takhini R.	low	100	20	moderate	v. high	mod
"	(SW Yukon	"	"	"	"	high	"
"	between White- horse and Haines Jct)	"	"	10	"	v. high	low-mod
35	Atlin	low	100	30	moderate	v. high	mod
"	(extreme NW	"	"	5	"	" "	high
"	B.C.)	"	"	20	"	high	mod-high
36	Kinaskan	moderate	70	5	v. low	high	high
	(Stewart-Cassiar Hwy)						

Prove- nance #	Origin	Vigor	Dothistroma		Remarks	Cronartium	Endocro- nartium
			% Trees Infected	% Needles Infected			
37	Cassiar	low	100	10	low	mod	mod
"		moderate	"	5	"	high	high
38	Jackfish Cr.	moderate	50	5	low	low	low
"	S of Ft. Nelson	mod-good	90	10	up to 50	mod	mod
39	Redwillow R.	mod-good	100	10	low-mod	low	low
"	(BC-Alberta	moderate	"	15	" "	low	mod
"	border S of	good	"	20	" "	"	low
"	Dawson Cr)	mod-good	90	5	up to 20	mod	"
40	McLeod Lk. N of Prince George	good	80	5	v. low	low	low
41	Rock Cr.	low	100	30	high	high	mod
"	(West Kootenay)	low-mod	"	"	"	"	"
42	Champion L. (Castlegar)	good	100	10	moderate	mod	low
43	Bisson L.	moderate	100	10	low	low	low
"	(Top of Monashee Hwy)	good	80	5	up to 30 (variable)	low	low
44	Marl Cr.	good	100	20	low-mod	high	low
"	(Donald Station	"	90	5	low-mod	"	low-mod
"	N of Golden	"	100	20	up to 50	mod	low
45	Settlers Rd.	good	100	20	variable	mod	low
"	(Kootenay Nat.	"	60	5	low-high	low-mod	"
"	Park)	"	100	30	" "	mod	"
46	Cartwright L.	good	100	30	mod-high	high	low
"	(Between Brisco and Bugaboos)	"	"	20	" "	mod-high	"
47	Sawdust Cr.	low	100	60	v. high	low	low
"	(Kimberley)	"	"	10	" "	v. high	"
"		moderate	"	40	"	high	low-mod
"		"	"	50	" "	high	low
55	Telkwa	moderate	100	10	moderate	low	high
"	(high elev)	mod-good	"	"	"	mod	mod
56	Elk Valley	good	100	30	mod-high	high	high
"	(Sparwood)	"	"	20	" "	"	mod
57	Indadaklin	good	100	5	v. low	mod	low
"	(west side of	"	50	5	" "	"	"
"	S Arrow Lakes	"	90	5	" "	"	"

Prove- nance #	Origin	Vigor	Dothistroma		Remarks	Cronartium	Endocro- nartium
			%	%			
			Trees Infected	Needles Infected			
59	Anahim L.	moderate	100	20	variable	high	high
"	(Chilcotin)	low	"	50	v. low-v. high	"	"
"		good	90	5	" " " "	mod	low
60	Mt. Lemoray	good	100	10	low	low	low
"	(Pine Pass SW	"	80	10	variable up to 10	"	"
"	of Chetwynd)	moderate	90	5	" " " "	mod	low-mod
61	Purden	good	80	5	v. low	low	low
"	(Hwy 16 E of	moderate	60	5	" "	"	"
"	Prince George)	mod-good	30	5	" "	"	"
"		good	100	5	" "	low-mod	"
62	McKale R.	good	20	5	v. low	low	low
"	(McBride)	"	90	5	" "	"	"
63	Albreda (Hwy	good	80	5	v. low	low	low
"	5 between						
	Valemount &						
	Blue River)						
64	Wendle Park	moderate	100	10	v. low-mod	mod	low
"	(Barkerville)	mod-good	60	5	" " "	"	high
65	Lynx L.	good	40	5	v. low	mod-high	low
"	(S of Prince	mod-good	60	5	" "	low	"
"	George near	" "	80	5	" "	"	"
	Baldy Hughes)						
66	Stone Mt.	low-mod	100	10	moderate	v. high	low
"	(Alaska Hwy W	moderate	100	20	"	mod	low-mod
	of Fort Nelson)						
67	Hinton	good	100	20	moderate	high	low
"	Alberta	mod-good	100	20	"	mod	mod
"	N of Jasper	moderate	"	"	"	low-mod	low
"		mod-good	"	15	"	mod	low
68	Kananaskis	mod-good	high				
			100	30	high	high	low
"	(Alberta)	moderate	"	"	"	"	"
"		"	"	25	"	mod	"
"		"	"	30	"	low	"
69	Carbondale R.	moderate	100	30	mod-high	low	low
"	(BC-Alberta	"	"	20	" "	"	low-mod
"	border S of	"	"	"	" "	"	low
	Blairmore)						
70	Flathead	low-mod	100	20	moderate	high	low

Prove- nance #	Origin	Vigor	Dothistroma		Remarks	Cronartium	Endocro- nartium
			% Trees Infected	% Needles Infected			
71	Flyhills	mod-good	100	40	high	high	low
"	(near Salmon Arm)	" "	"	"	"	"	high
72	Larch Hills	good	100	10	moderate	low	low
"	(near Salmon	"	"	20	"	mod	"
"	Arm)	"	"	10	"	mod	"
73	Manning Park	low-mod	100	30	high	v. high	high
"	(low elev)	low	"	"	"	" "	"
74	Manning Park	low	100	30	mod-high	high	mod
"	(high elev)	"	"	20	" "	mod	low-mod

KEY:	rating ¹	% needles infected
<u>Dothistroma pini</u>	v. low	5 or less
	low	5-10
	moderate	11-20
	high	21-40
	v. high	41+
<u>Cronartium coleosporioides</u>	low	<u># trees</u> ² 3
	low-moderate	3-5
+	moderate	6-10
	high	10-15
<u>Endocronartium harknessii</u>	v. high	15+

¹ ratings are relative only

² number of trees within 90 tree replication with stem or branch infections of either disease