Susceptibility of Larch, Hemlock, and Sitka Spruce to Phytophthora ramorum

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P. ramorum has caused disease on a number of conifers in the U. S.

Douglas-fir, grand fir, white fir, California red fir, coast redwood, Pacific yew, and California **nutmeg**

Phytophthora ramorum Symptoms on Grand Fir

Shoot Dieback

Dieback and canker development

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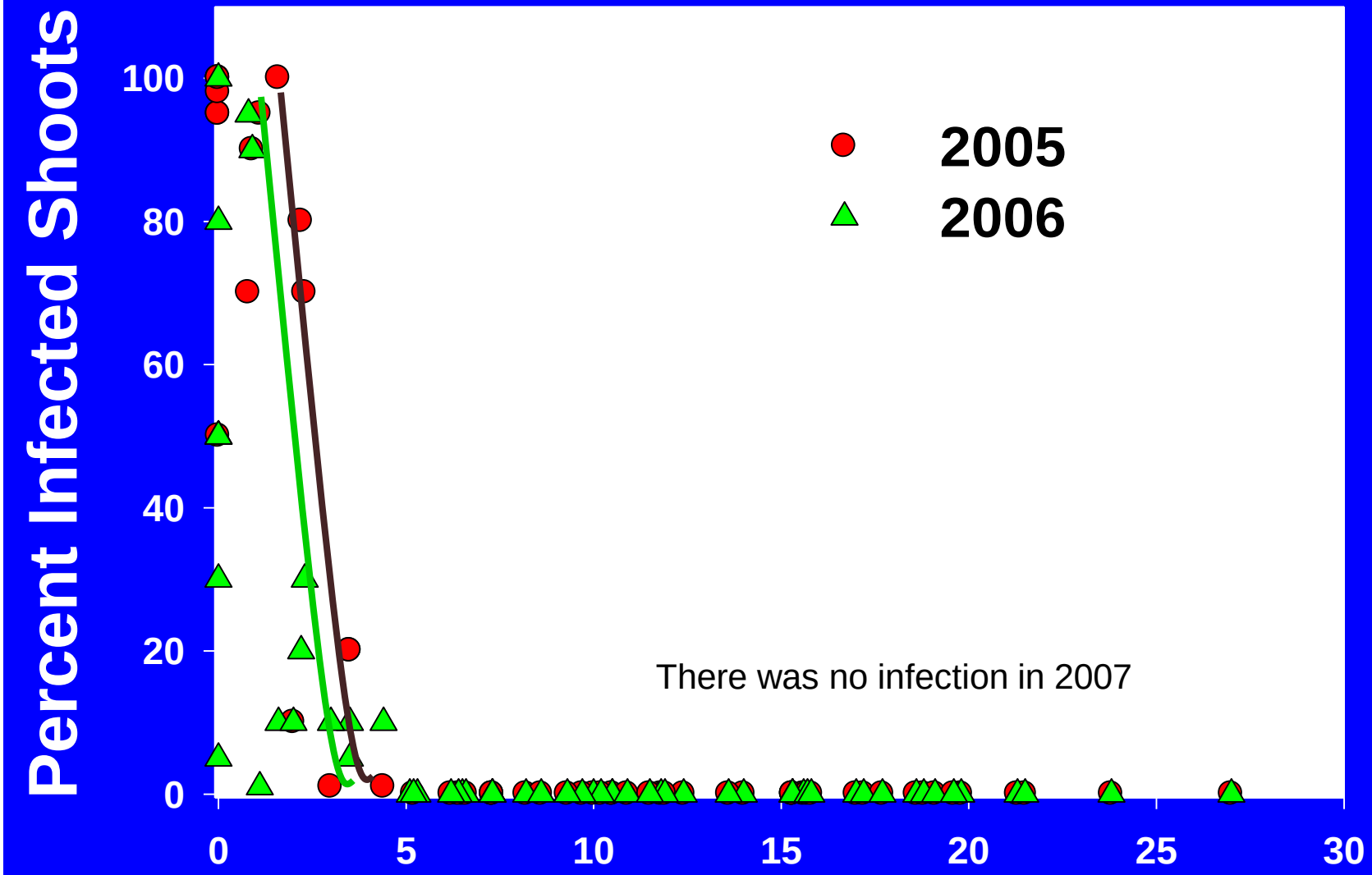
Yearly Variation in Disease Development and Spread



Stem Inoculations on Trees

Sunken cankers, resin flow (DF),branch flagging (DF), and mortality (DF)

Grand fir and Douglas-fir

Situation in the UK

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2009 – Spread of *P. ramorum* to conifers in the UK.

Japanese larch, grand fir, Douglas-fir, western hemlock & Sitka spruce

Japanese Larch in the UK

Photos: Venche Talgø and Forestry Commission, England.

Grand Fir in the UK

Photos: Venche Talgø

Grand Fir in the UK

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In light of what is happening in the UK, we have conducted several experiments to examine the susceptibility of several larch species, hemlock and Sitka spruce to *P. ramorum*

Host	2011		2012
	Spring	Fall	Spring
European larch (*Larix decidua*)	+	+	+
Japanese larch (*L. kaempferi*)	+	+	+
Western larch (*L. occidentalis*)	+	+	+
Eastern larch or tamarak (*L. laricina*)	+	+	+
Douglas-fir (*Pseudotsuga menziesii*)	+	+	
Western hemlock (*Tsuga heterophylla*)	+		
Eastern hemlock (*T. canadensis*)	+		
Sitka spruce (*Picea sitchensis*)	+		

Isolates

- NA1, WSU #106-0018, Douglas-fir, CA
- NA2, WSU #109-0074, Salal, WA
- EU1, WSU #107-0038, Pieris, OR

Inoculum Concentration

- 2011: 6-9 x 10^5 zoospores/ml
- 2012: 3-4 x 10^5 zoospores/ml
- Check = water alone

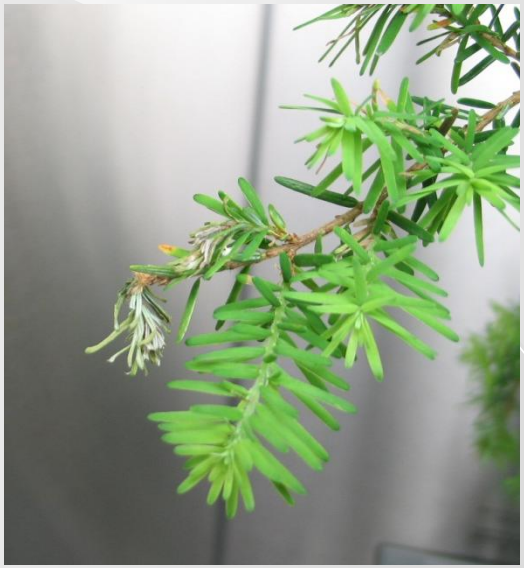
Biocontainment Room

19-20C, continuous fluorescent light

Bags removed after 5 days

NA2 European Larch

NA2 W. Hemlock



NA2 Sitka spruce

Check W. Larch

NA2 W. Larch

Effect of genotype on symptom development

Genotype	% w/ sym	Length (cm)
CK	0	0.0
EU1	73	5.5
NA1	60	5.3
NA2	98	5.3

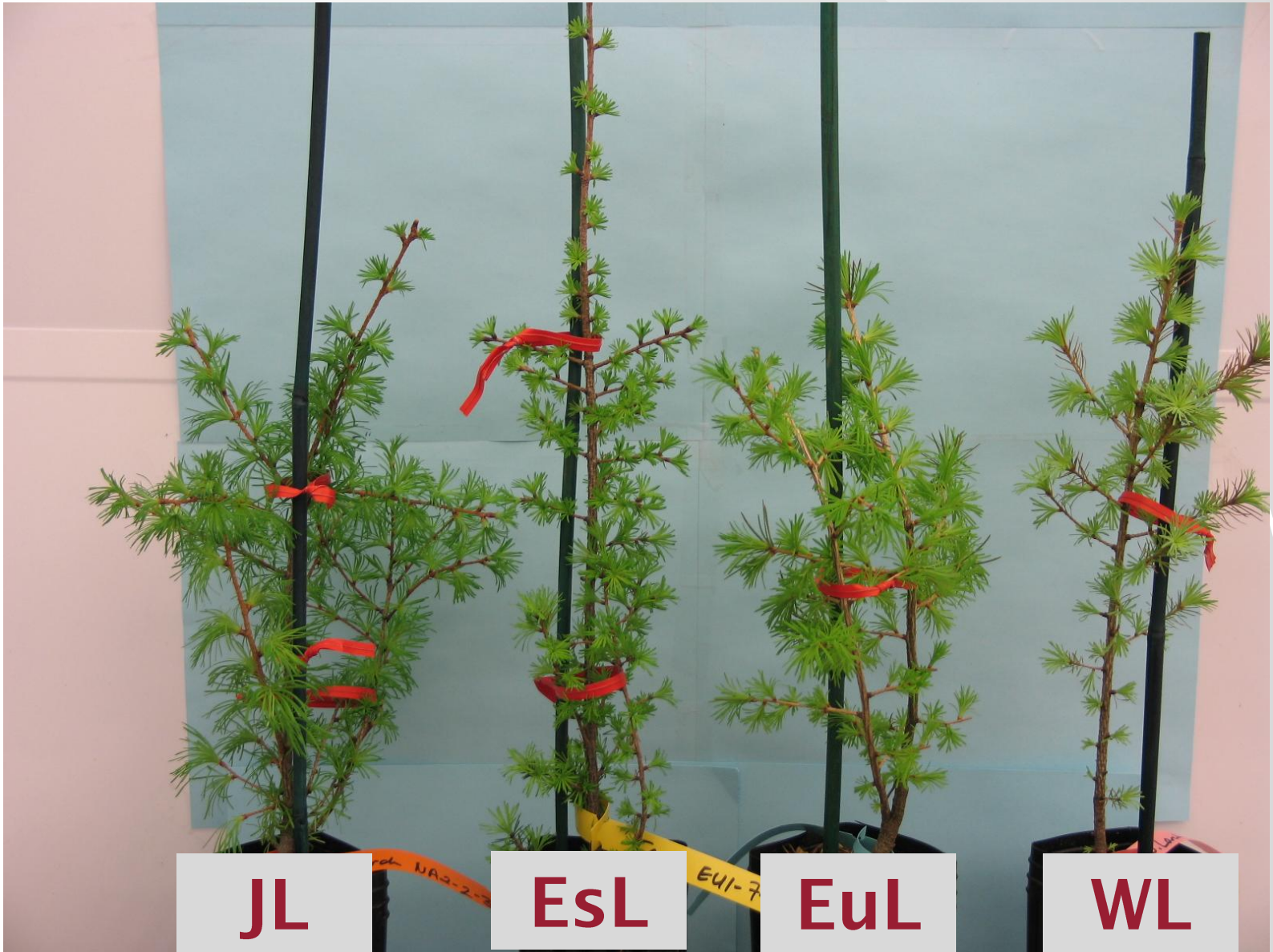
2011 test after 8 to 10 days

Percentage of conifer seedlings with symptoms and lesion length

Species	% w/ sym	Length (cm) Max	Length (cm) Avg.
West. larch	93	*29.5	12.7
Eur. larch	80	5.5	3.5
Jap. larch	73	4.5	3.4
Sitka spruce	73	4.0	2.7
Douglas-fir	67	2.5	2.5
East. larch	73	4.2	2.4
West. Hemlock	100	2.5	1.5
East. Hemlock**	53	0.0	0.0

*Probably the result of multiple lesions coalescing
**Symptoms restricted to needles

2012 Test



Isolate had no effect on:

- % of symptomatic bundles
- Total length of lesions
- Symptom severity ratings
- % mortality

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Eastern Larch 21 days

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Western Larch 21 days

European Larch – 21 days

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Japanese Larch – 21 days

Larch spp.	% Bundles with sym. @ 21 days	T. length of lesions @ 21 days	% Mortality @ 55 days
Western	60.1a	40.0a	58.3a
Japanese	32.7ab	35.7a	42.8a
European	44.0ab	25.9ab	63.9a
Eastern	15.3b	8.5b	0.0b

2011 Late Season Inoculation Trial

- Limited symptoms developed (e.g., a few gray needles, yellow/brown needle tips, a faint lighter-colored needle banding, single yellow needles, etc).
- No difference between inoculated seedlings and controls.
- Isolations from symptomatic needles 8 weeks after inoculation resulted in a single positive recovery of *P. ramorum* from a Japanese larch inoculated with the NA2 isolate.

Summary

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- There was limited difference in the ability of the NA1, NA2 and EU1 isolates used in these experiments to cause disease.
- Initial symptoms developed on individual needles or needle bundles and included shoot dieback with lesions that extended into the previous year's stems to mortality on some species.
- All of the conifer species exhibited some level of symptom development, but symptom severity and recovery of *P. ramorum* was most common on the four larch species.
- Although all of the larch were susceptible, the western larch had the highest level of mortality and percentage of isolation positives for all the genotypes.
- Late season inoculations did not lead to disease development.

What is the risk to PNW forests?

Photos: Venche Talgø and Forestry Commission, England.

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WSU SOD Research & Education Program

http://www.puyallup.wsu.edu/ppo/sod.html

Thank You

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