Pine wood nematode resistance in Finnish plus-tree progenies of Scots pine

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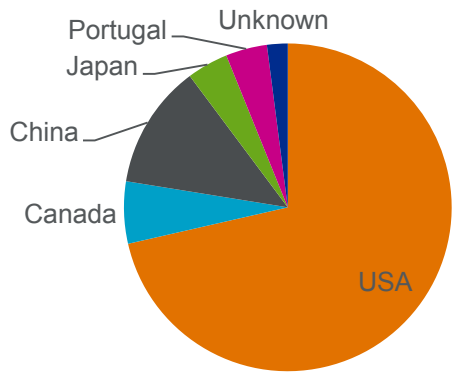
Occurrence of Pine wood nematode (PWN) in Europe

- First documented observation in Finland in 1984 (conifer chips from Canada)
- First documented infestation in Portugal in 1999 – had already spread on large areas
- Portugal applied strict measures to prevent spreading of PWN, but these failed
- In 2008 PWN was observed also in Spain in areas adjacent to Portugal

Risks for spreading to Finland

- Can spread to Finland with timber, chips or wooden package material from countries where PWN is occuring
- Is observed each year in some sampled items (about 2 % of samples contain PWN)
- Because only a small part of all possible contaminated items can be checked, there is risk that PWN can spread to Finnish forests

Observations of PWN in wooden packing material in Finland by country of import in years 1999 - 2009



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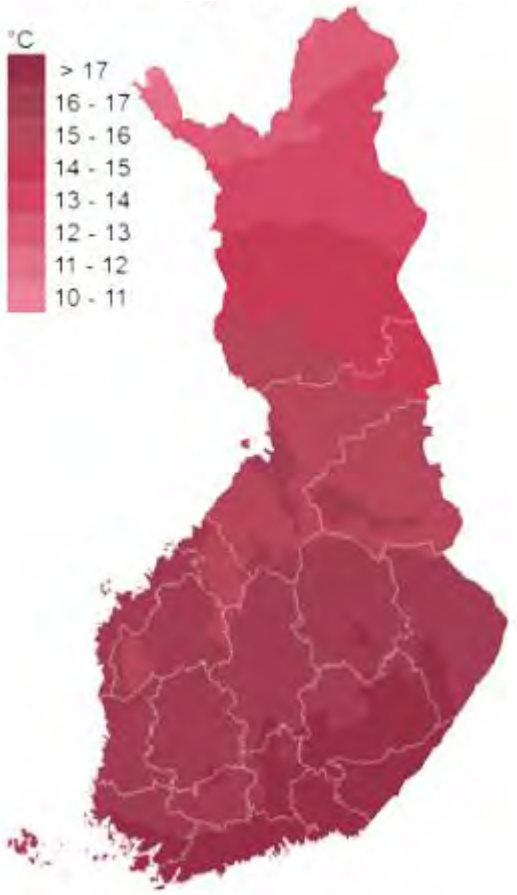
Premises

- Native Scots pine moderately resistant?
- Boreal climate not optimal for PWN
- > 20ºC daily mean temperatures required to cause pine wilting
- Southern Finland is a risky area
- Climate warming
- Vector (*Monochamus* sawyer beetles) not very abundant in Finland
- Uncertainty about the factors influencing the aggressivity of PWN

Average July temperature
1981-2010



Testing of Finnish Scots pine breeding material against PWN

- Former Finnish Forest Research Institute (Metla) and Forestry and Forest Products Research Institute (FFPRI) in Japan started cooperation in 2010
- 61 open-pollinated families of Finnish Scots pine plus trees and two check-lots from natural stands were tested
- Testing took place in the research nursery of FFPRI in Hitachi, Japan, between 2010-2014
- Testing was done in three batches in three consecutive years with one- and two-year-old seedlings; same seedlings were tested in two years
- Testing followed the standard procedures used in Japan for selecting resistant native pines


MIGHTY

Material & Method

- About 80 seedlings/ family were tested
- Seedlots were collected from seed orchards (open pollinated)
- Mother trees belonged to the breeding populations for their outstanding growth and quality
- For the plus trees of 2011 sowing batch also their contents of phenolic compounds in the heartwood were known
- An aggressive strain of pine wood nematode Ka-4, was used for testing (most common in Japan)
- The inoculated dose comprised 10 000 nematodes per seedling

Schedule of inoculation test to Scots pine

Schedule for the inoculation test

<table>
<tr><th></th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td rowspan="2">1st Group</td><td rowspan="2">Sowing</td><td colspan="2">1st Inoculation test</td><td rowspan="2">Planting</td><td rowspan="2"></td></tr>
<tr><td>-1 (first)</td><td>-2 (second)</td></tr>
<tr><td rowspan="2">2nd Group</td><td rowspan="2"></td><td rowspan="2">Sowing</td><td colspan="2">1st Inoculation test</td><td rowspan="2">Planting</td></tr>
<tr><td>-1 (first)</td><td>-2 (second)</td></tr>
<tr><td rowspan="2">3rd Group</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Sowing</td><td colspan="2">1st Inoculation test</td></tr>
<tr><td>-1 (first)</td><td>-2 (second)</td></tr>
</table>

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How to make inoculation test

1st Inoculation -1 test of Scots pine - 2011 -

Survival rate : 3.8 %

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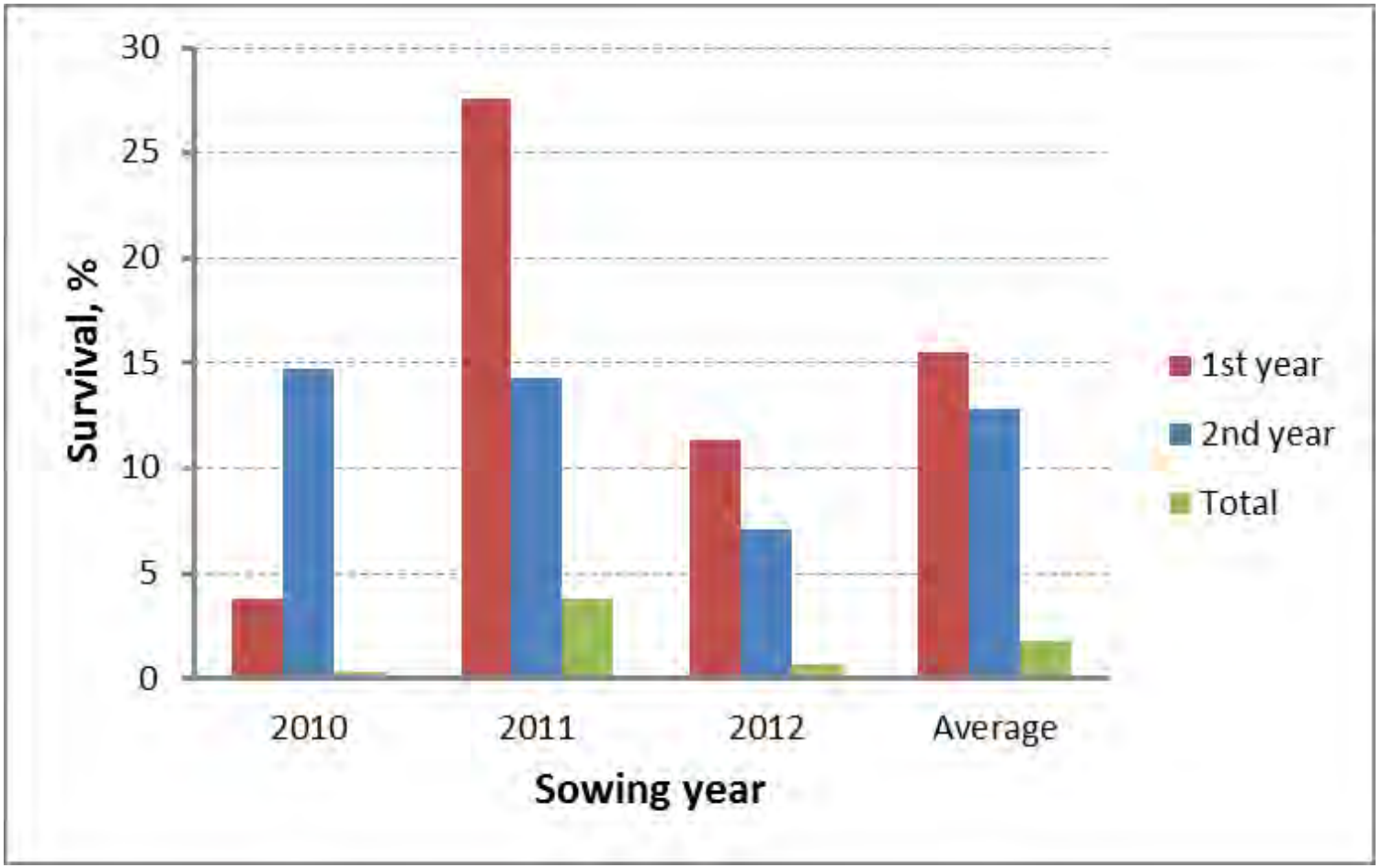
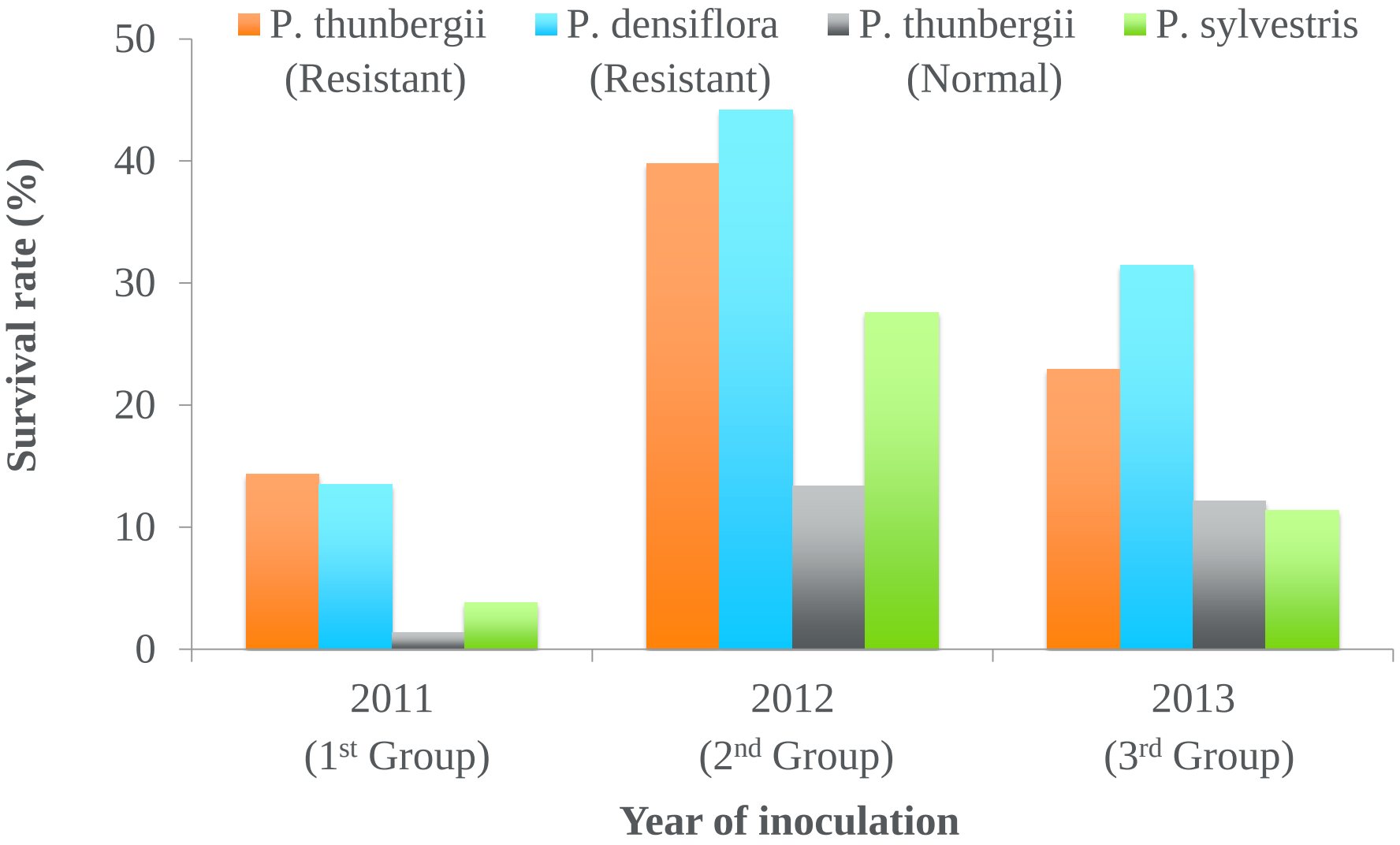
Survival after different testing occasions by sowing batches



	F	(p)
	34.078	(0.000)
	1.269	(0.289)
	7.468	(0.001)

Comparison with Japanese red (*Pinus densiflora*) and black pine (*P. thunbergii*) progenies



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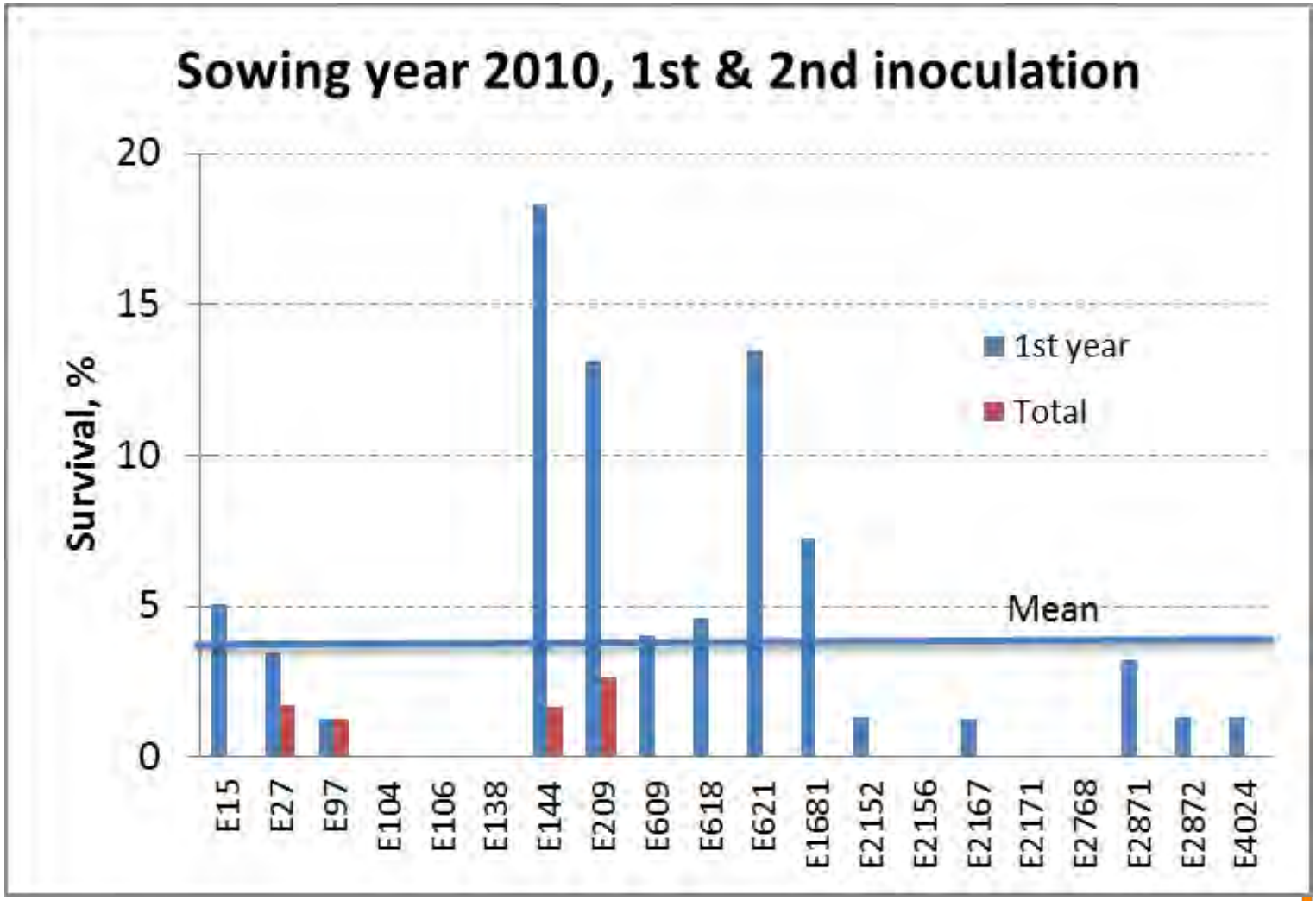
Nematode resistance by family



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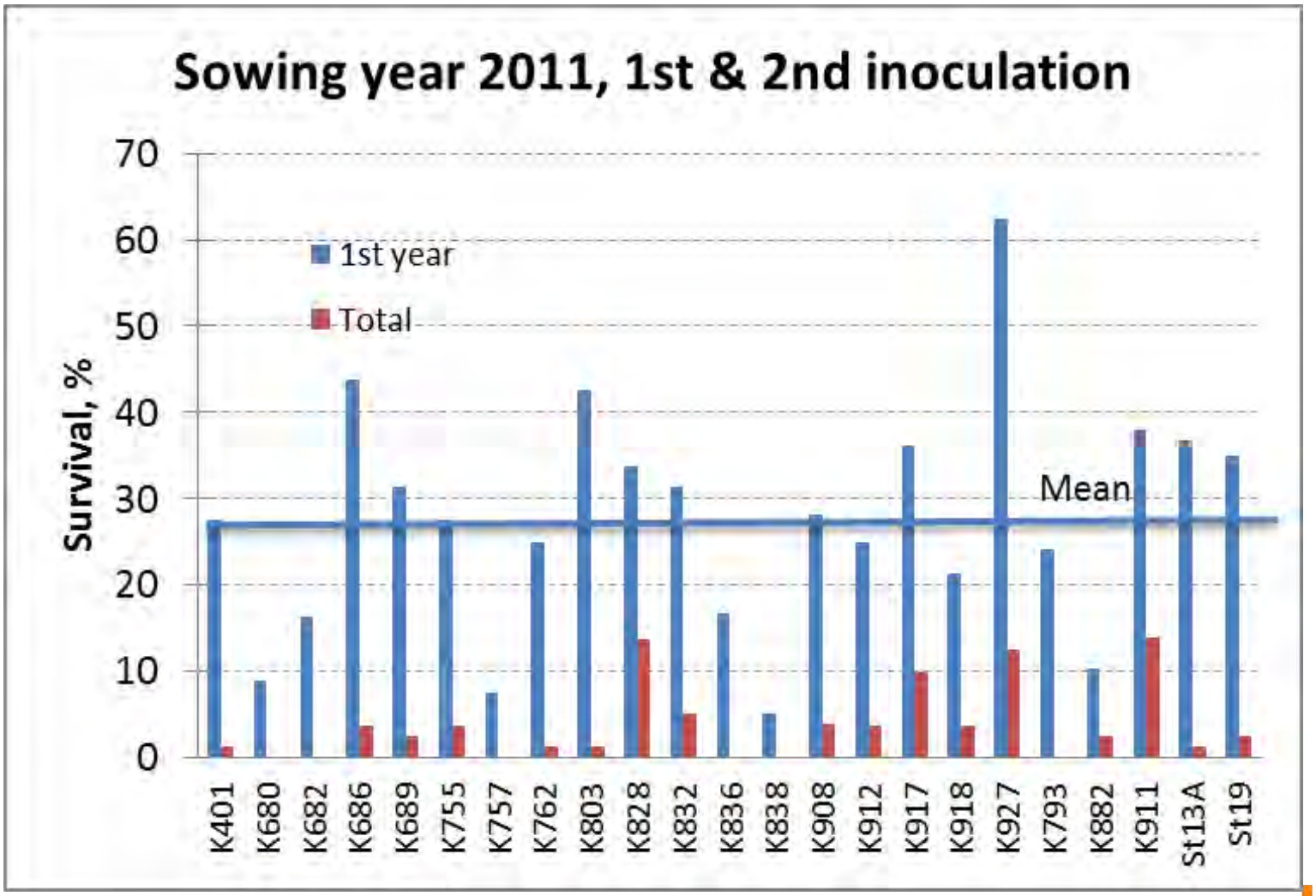
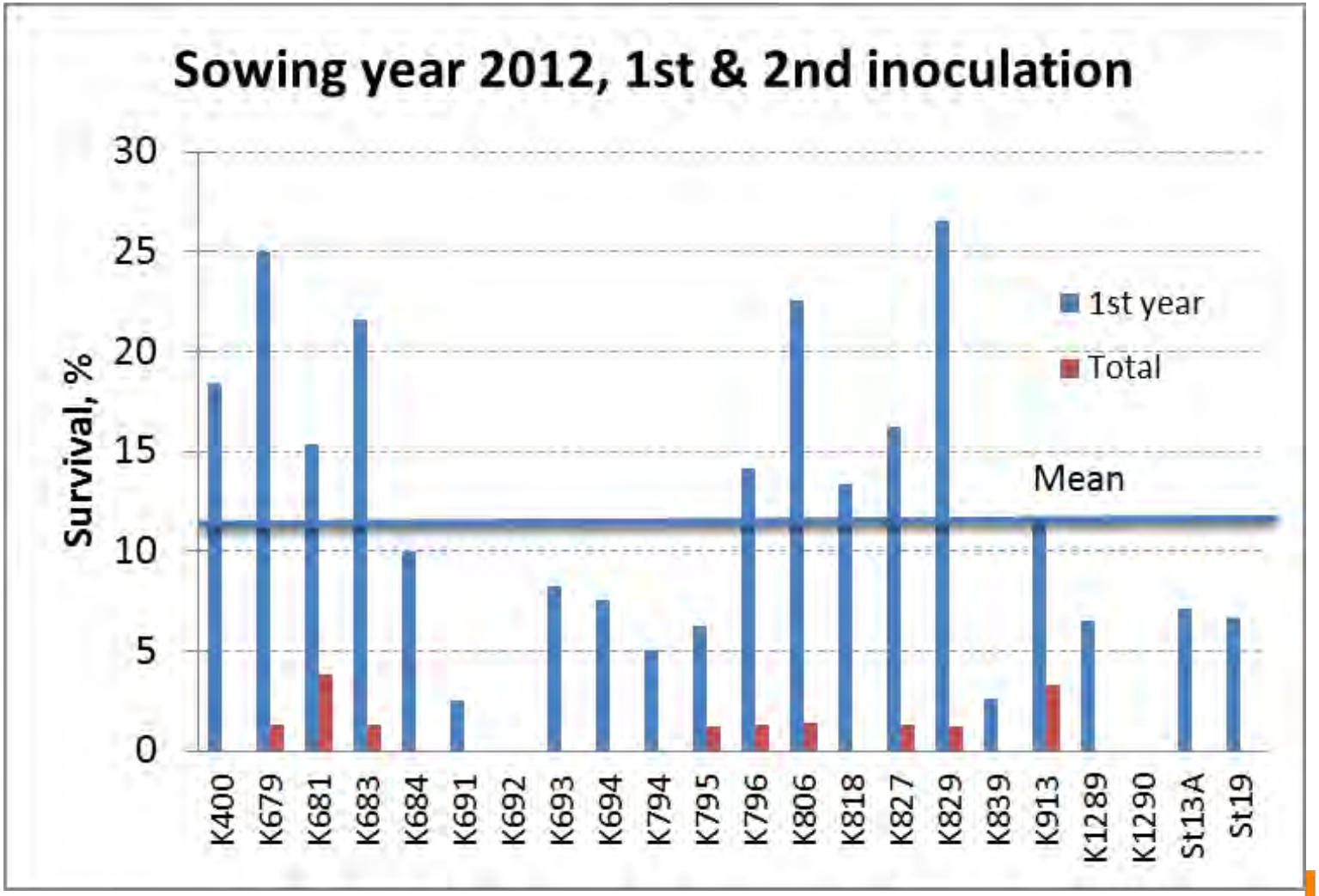


Nematode resistance by family



Correlation between nematode resistance and…

Progeny performance (n=52…61)

	Height	Height sum	Quality
1st inoculation	-0.036	0.183	-0.048
2nd inoculation	-0.042	0.048	0.035

Chemical content of the wood of grafts (n=17…18)

	Total phenolics	Resin acids	Stilbenes
1st inoculation	-0.164	-0.380	0.061
2nd inoculation	-0.264	-0.209	-0.129

→ Nematode resistance was not associated with these traits

Conclusions

- The nematode resistance of Scots pine is in general low
- Progenies of Finnish Scots pine plus trees seem to differ in nematode resistance
- The resistance is not connected to any studied growth, quality or wood chemical character
- Year-to-year variation in the severity of nematode attack (caused by weather conditions?)
- It seems possible to develop a nematode resistant population of Scots pine with the method developed in Japan
- The few survived individuals comprise a special population with a genetically elevated resistance to PWN

  →A gene reserve for future needs (the survivors are grafted)

Thank you!

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