

Development of the fungal staining on the conifer wood in laboratory and outdoor conditions

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Facade

- Frequently made of wood
- Contributes to aesthetic appearance of the building
- Larch and Spruce are the key materials for facades in Alpine region



2010



2016



Brick house ...



Problem

- Larch is very „respected“ by the architects
- Larch is very costly
- Selection of the alternative sources
- Scots pine



Aim

- To determine aesthetic performance of the Scots pine wood



Material and methods

- **Materials:**

- Norway spruce
- European larch
- Scots pine sapwood
- Scots pine heartwood

- **Laboratory**

- 100 × 50 × 8 mm

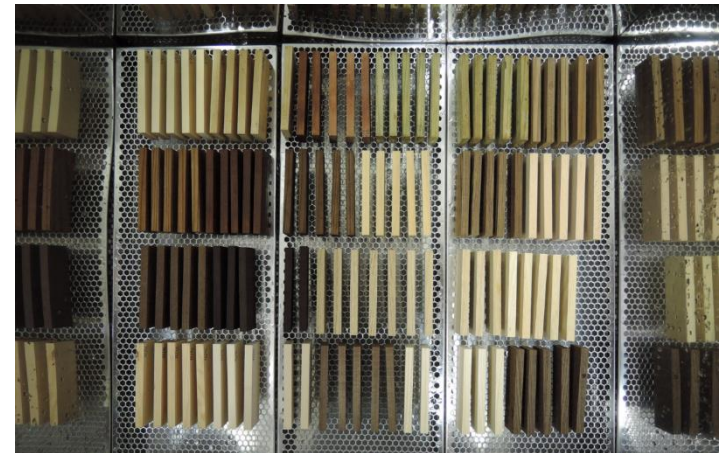
- **Field trial**

- 375 × 100 × 20 mm

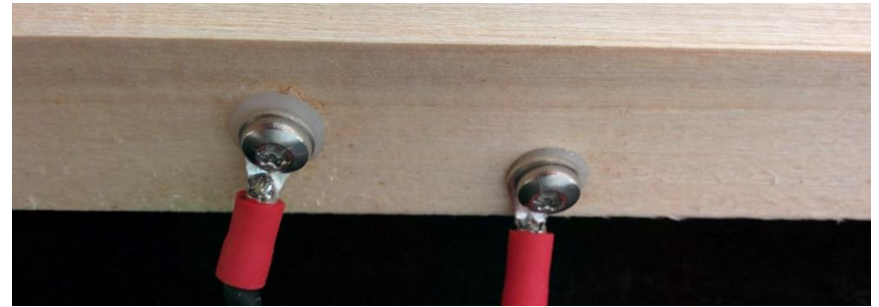


Methods - laboratory

- Exposure to blue stain fungi EN 152
- Exposure in condensing environment
- Exposure to 100 % RH
- Exposure in chambers with various RH at 25°C and 20°C.



Methods – field trial



Grading of staining

EN 152

- **0 = not blue stained:** no blue stain can be detected visually on the surface;
- **1 = weakly blue stained:** few spots of blue stain on the surface;
- **2 = slightly blue stained:** small areas of blue stain none larger than 1.5 mm in width and 4 mm in length.
- **3 = severely blue stained:** major parts of wood stained.

As a percentage of surface covered with stains



Results



Laboratory tests – EN 152

Average
grade

LD			0,0
PA			2,6
PS-SW			3,0
PS-HW			2,6

Development of staining at various RH Laboratory

		Exposure (weeks)									
RH (%)	Wood	1	2	3	4	5	6	7	8	9	10
98	<i>L. decidua</i>	0,2	0,5	1,3	1,3	1,5	1,7	1,8	1,9	2	1,9
	<i>P. abies</i>	1,1	1,6	2,3	3	3	3	3	3	3	3
	<i>P. sylvestris sap</i>	1,2	1,8	2	3	3	3	3	3	3	3
	<i>P. sylvestris heart</i>	0	0,3	1	1,3	1,2	1,2	1,5	1,5	1,7	1,7
87	<i>L. decidua</i>	0,6	1,1	1,5	1,9	2,2	2,3	2,4	2,6	2,8	2,8
	<i>P. abies</i>	0	0,4	0,5	1	1	1	1	1	1	1
	<i>P. sylvestris sap</i>	0,1	0,3	0,6	1,1	1	1	1	1	1,1	1,1
	<i>P. sylvestris heart</i>	0	0,4	0,9	1,1	0,9	0,9	1	1	1	1



Colour Changes - ΔE

RH = 87%

Larch Spruce Pine S Pine H

6,6	1,8	2,4	5,4
7,8	2,9	2,9	5,6
10,8	10,5	9,1	9,5
11,0	10,9	9,7	8,7
11,9	11,2	9,8	9,9
12,0	11,6	9,9	9,6
12,3	11,9	10,1	10,0
12,4	12,2	10,5	10,1
12,5	12,4	10,6	10,2
12,7	12,8	11,0	10,3
13,0	12,8	10,9	10,3

RH = 98%

Larch Spruce Pine S Pine H

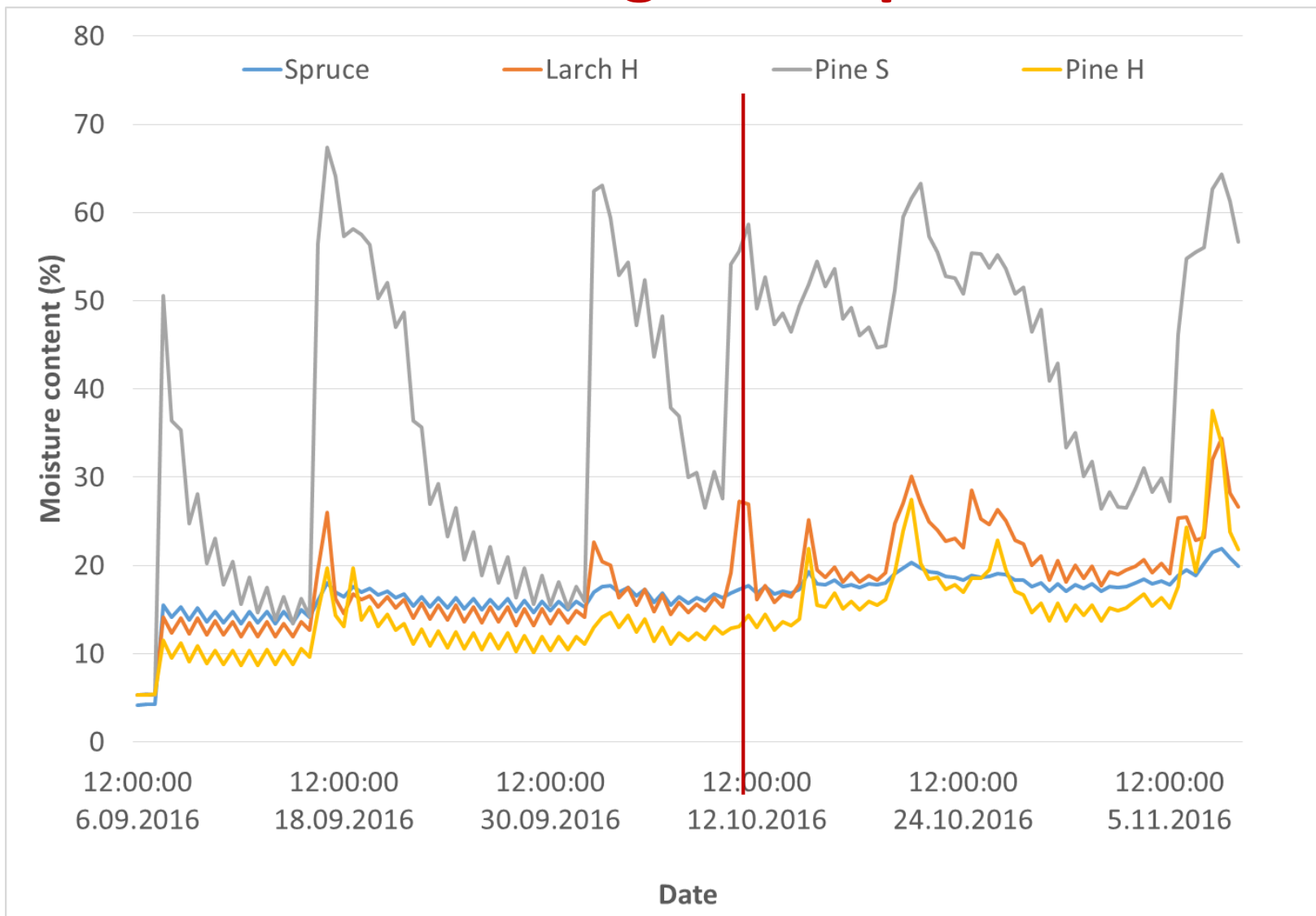
8,1	3,3	3,2	9,0
10,8	4,7	5,2	9,5
11,2	9,6	9,6	10,5
11,6	10,2	10,1	10,4
12,4	10,8	10,7	11,5
12,7	10,9	10,9	11,6
12,9	11,5	11,2	11,4
13,2	11,4	11,2	11,5
13,3	11,7	11,7	12,2
13,5	12,0	11,7	11,7
13,7	12,1	11,8	11,7



Field test results



MC of wood during the exposure

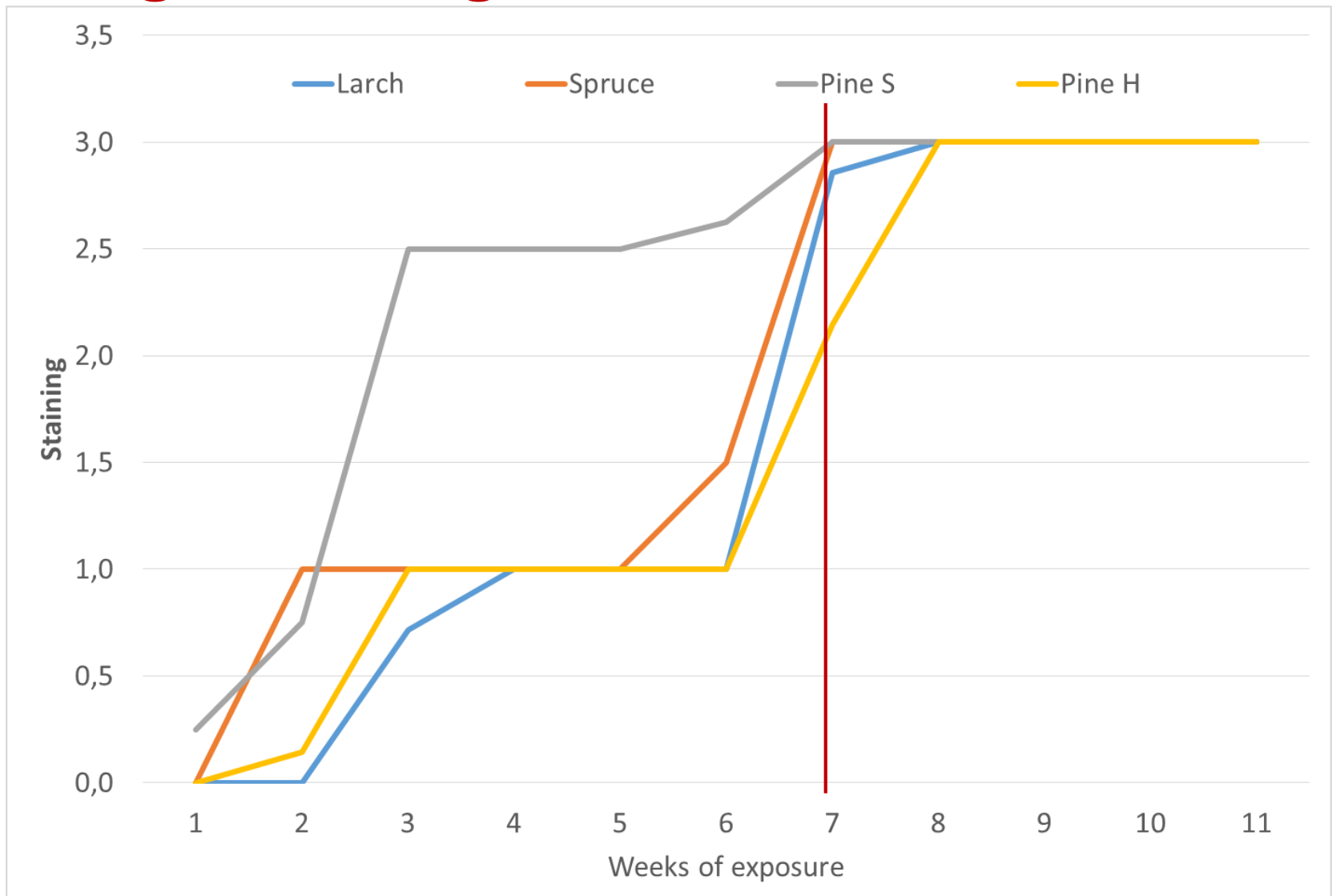


Summary of the MC

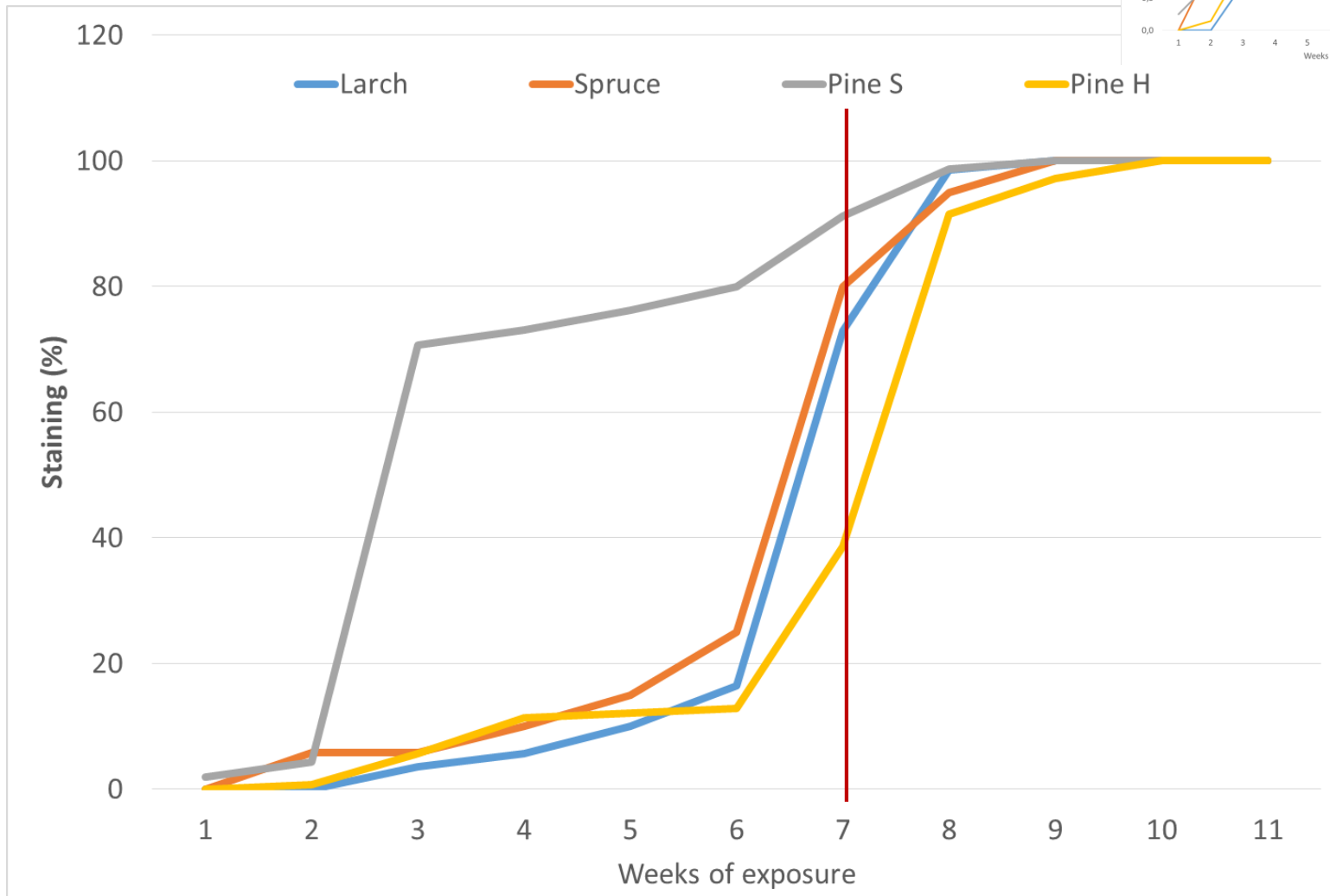
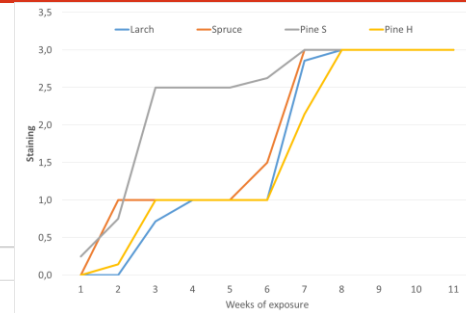
	Larch	Spruce	Pine sap	Pine h
MIN	12,3%	13,6%	13,2%	8,7%
MAX	34,8%	23,1%	64,3%	34,5%
Average	19,1%	17,2%	39,2%	14,8%
Median	18,2%	17,2%	44,4%	14,1%
MC > 25%	20	0	96	4



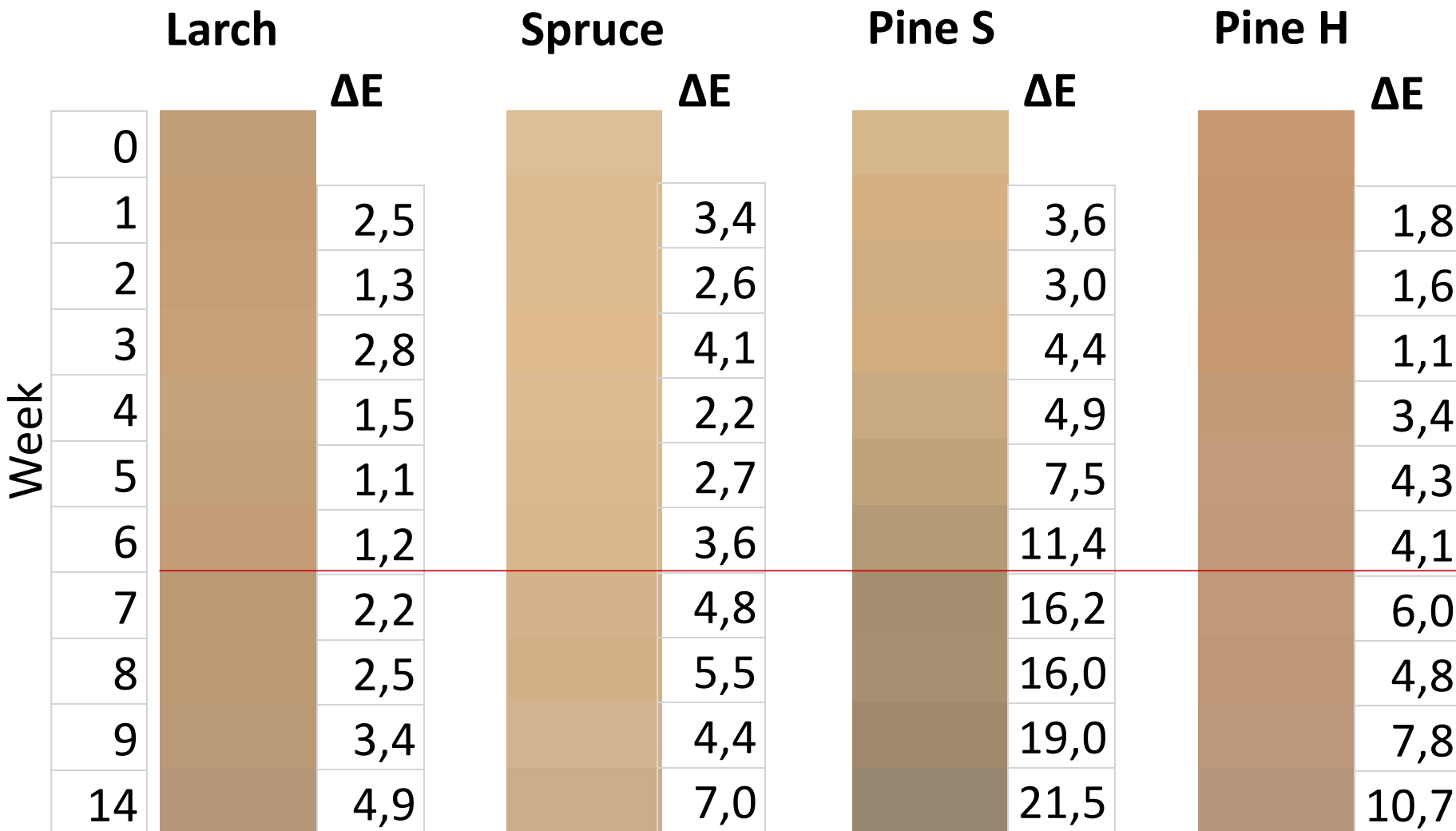
Fungal staining outdoor



Staining outdoor - percentage



Colour changes



Conclusions – summary - rank

	Larch	Spruce	Pine S	Pine H
EN 152	1	2-3	4	2-3
RH 98%	2	3-4	3-4	1
Outdoor staining	1-3	1-3	4	1-3
Outdoor Color	1	2	4	3



Conclusions

- Larch wood performed the best in the majority of the laboratory tests
- Performance of spruce wood and Scots pine heartwood is comparable
- Scots pine sapwood exhibited the lowest performance



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