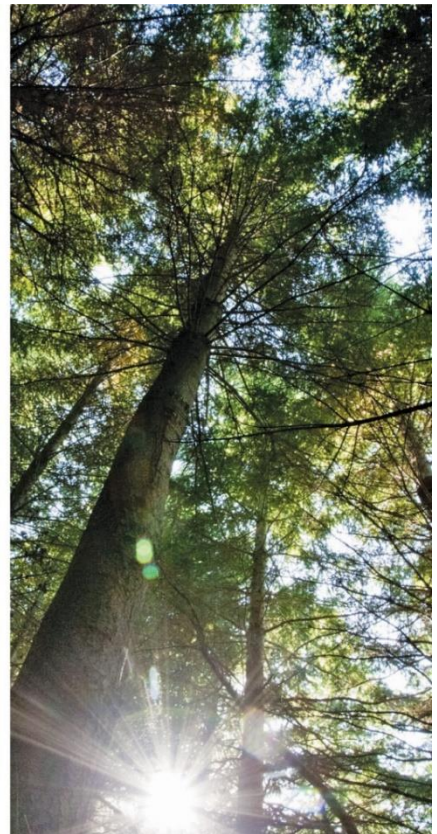
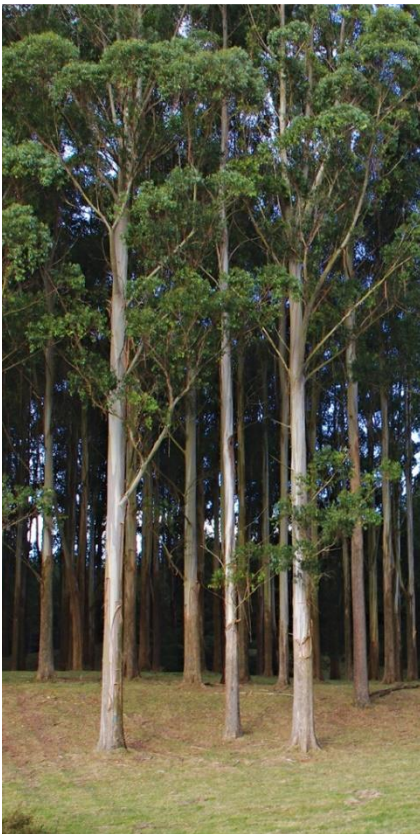


The condition of thermally modified cypress and Douglas fir decking after one year's field exposure

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EXECUTIVE SUMMARY

After one year exposure, there was no decay on any of the untreated *Cupressus macrocarpa*, *Cupressus lusitanica*, *Cupressus x.ovensii* and Douglas fir decking samples. No decay was observed on any of the thermally modified *Cupressus lusitanica* and Douglas fir decking samples. No decay was observed on any of the commercial benchmark decking samples (Accoya and Kebony).

Minor decay was observed on six of the ten untreated unstained sapwood radiata pine samples. No decay was observed on the stained sapwood radiata pine samples or on the H3 CCA treated radiata pine samples.

INTRODUCTION

A decking trial was installed for *Cupressus macrocarpa*, *Cupressus lusitanica*, *Cupressus x.ovensii* and Douglas fir. Samples of *C. lusitanica* and Douglas fir were thermally modified (TM) before exposure. Samples were either solely sapwood or heartwood and were uncoated or stained. Untreated and treated (CCA) radiata pine were included in the trials for comparative purposes. Commercial benchmarks of Accoya and Kebony were included in the trial. The trials were installed in the Whakarewarewa test area on the Scion campus, Rotorua in September 2021. The decking groups included in the test are shown in Table 1.

Table 1: Groups of decking included in the test

Group	Species	Heart/sap mix	Treatment	Coating
1	<i>Cupressus macrocarpa</i> (young)	Heartwood	-	None
2	<i>Cupressus macrocarpa</i> (old)	Heartwood	-	None
3	<i>Cupressus lusitanica</i>	Sapwood	-	None
4	<i>Cupressus lusitanica</i>	Heartwood	-	None
5	<i>Cupressus lusitanica</i>	Sapwood	TM ¹ 220°C	None
6	<i>Cupressus lusitanica</i>	Heartwood	TM 220°C	Stained
7	<i>Cupressus x ovensii</i>	Heartwood	-	None
8	Douglas fir	Heartwood		
9	Douglas fir	Sapwood	TM 230°C	None
10	Douglas fir	Heartwood	TM 230°C	None
11	Accoya	Sapwood	Commercial benchmark	None
12	Accoya	Sapwood	Commercial benchmark	Stained
13	Kebony	Sapwood	Commercial benchmark	None
14	Kebony	Sapwood	Commercial benchmark	Stained
15	Radiata pine	Sapwood	-	None
16	Radiata pine	Sapwood	-	Stained
17	Radiata pine	Sapwood	H3 CCA	None
18	Radiata pine	Sapwood	H3 CCA	Stained

¹ TM indicates Thermal modification treatment

This report includes results for decking tests from the September 2022 assessment.

METHODS

Source of timber

Table 2 shows the source of the timber used in this study, where known. Further details are listed in Appendix 1.

Table 2: Source of timber used in this study

Species	Treatment	Source of timber
<i>Cupressus macrocarpa</i> (young)	-	Manawatu, trees 22 years old
<i>Cupressus macrocarpa</i> (old)	-	Central North Island forest, trees 60-80 years old
<i>Cupressus lusitanica</i>	-	South Auckland sawmill Thermally modified at Scion
<i>Cupressus x ovensii</i>	-	Rotoehu forest, trees 22 years old
Douglas fir	-	Central North Island sawmill Thermally modified at Scion
Accoya radiata pine	Acetylation	Auckland retailer
Kebony radiata pine	Furfurylation	Australian retailer (Mafi)
Radiata pine	-	Rotorua sawmill
Radiata pine	H3 CCA	Rotorua sawmill, treated at Scion

Sample exposure

The decking trial was installed in the Whakarewarewa outdoor test area at Scion in September 2021 (Figure 1). Some of the decking samples were stained with a dark black stain prior to exposure, the other samples were uncoated.

Assessment methods

The decking samples were removed from the wooden bearers (Figure 2) and assessed according to the rating systems in Appendix 2.

RESULTS

Assessment results

Table 3 shows a summary of the decking condition after one year's above ground exposure. A complete set of data is contained in Appendix 3.

No decay was observed in any of the *Cupressus macrocarpa*, *Cupressus lusitanica*, *Cupressus x.ovensii* and Douglas fir.

Six of the untreated uncoated sapwood radiata pine samples had minor decay, suspected to be white rot. No decay was observed in the stained untreated radiata pine sapwood or the H3 CCA treated radiata pine samples.

No decay was observed in any of the Accoya (acetylated) or Kebony (furfurylated) radiata pine samples.

Minor surface checking was observed on many of the samples. The surface of unstained samples had turned a light silver/grey colour, and there was some loss of stain on the stained samples.

Table 3: Summary of decking condition (Index of Condition¹) after one year's exposure

Group	Species	Heart\sap mix	Treatment	Coating	Decay T end ¹	Decay UT end ¹	Surface	Checking
1	<i>C. macrocarpa</i> (young)	Heartwood	-	None	10.0	10.0	2.0	1.2
2	<i>C. macrocarpa</i> (old)	Heartwood	-	None	10.0	10.0	2.0	1.9
3	<i>C. lusitanica</i>	Sapwood	-	None	10.0	10.0	2.0	1.5
4	<i>C. lusitanica</i>	Heartwood	-	None	10.0	10.0	1.8	1.1
5	<i>C. lusitanica</i>	Sapwood	TM 220°C	None	10.0	10.0	1.0	1.0
6	<i>C. lusitanica</i>	Sapwood	TM 220°C	Stained	10.0	10.0	2.4	1.2
7	<i>C. ovensii</i>	Heartwood	-	None	10.0	10.0	2.0	1.6
8	Douglas fir	Heartwood	-	None	10.0	10.0	2.0	1.2
9	Douglas fir	Sapwood	TM 230°C	None	10.0	10.0	2.0	1.4
10	Douglas fir	Heartwood	TM 230°C	None	10.0	10.0	2.0	1.6
11	Accoya radiata pine	Sapwood	Acetylation	None	10.0	10.0	2.0	1.0
12	Accoya radiata pine	Sapwood	Acetylation	Stained	10.0	10.0	2.0	1.0
13	Kebony radiata pine	Sapwood	Furfurylation	None	10.0	10.0	1.0	1.0
14	Kebony radiata pine	Sapwood	Furfurylation	Stained	10.0	10.0	2.0	1.0
15	Radiata pine	Sapwood	-	None	10.0	9.4	2.0	1.2
16	Radiata pine	Sapwood	-	Stained	10.0	10.0	2.0	1.0
17	Radiata pine	Sapwood	H3 CCA	None	10.0	10.0	2.0	1.4
18	Radiata pine	Sapwood	H3 CCA	Stained	10.0	10.0	2.0	1.3

¹ Index of Condition is the average decay rating for all of the samples in a group.

CONCLUSIONS

After one year exposure, no decay was observed on any of the untreated or thermally modified *Cupressus macrocarpa*, *Cupressus lusitanica*, *Cupressus x.ovensii* and Douglas fir decking samples. No decay was observed on any of the commercial benchmark samples (Accoya and Kebony). Minor decay had developed on six of the ten untreated unstained sapwood radiata pine samples. No decay was observed in the stained sapwood radiata pine samples or in the H3 CCA treated radiata pine samples.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance of Rosie Sargent in sourcing the timber for this study and conducting the thermal modification of some samples.



Figure 1: General view of decking trial at the time of installation (September 2021).



Figure 2: General view of decking trial after one years exposure (September 2022).

APPENDIX 1: SOURCE OF TIMBER FOR DECKING TEST

Table 5: Source of timber for decking tests

Type of wood \ Treatment	Source of timber	Number of trees	Tree age (years)	Selected by	Approximate quantity of timber delivered
Accoya	ITI Timspec	-	-	ITI Timspec	3-4 lengths
<i>Cupressus macrocarpa</i> , young trees, heartwood	Ruapehu sawmill; Bulls region	-	22	Vaughan Kearns	400 lm
<i>Cupressus macrocarpa</i> , old trees, heartwood	Ruapehu sawmill; Waimarino	-	60 - 80	Vaughan Kearns	400 lm
<i>Cupressus lusitanica</i>	MacDirect sawmill, South Auckland	-	-	Scion staff	40-60 lengths
<i>Cupressus x ovensii</i> , heartwood, laminated	SWP sawing study; Rotoehu forest	7	22	Scion staff	182 lm
Douglas fir, mixed heartwood\sapwood	Donelleys sawmill, Reporoa	-	-	Scion staff	-
Kebony	Mafi, Australia	-	-	Mafi, Australia	8 lengths
Radiata pine, mixed heartwood\sapwood	Scion stock	-	-	Scion staff	-
Radiata pine, mixed heartwood\sapwood, H1.2 boron treated	Rotorua timber retailer	-	-	Scion staff	-

APPENDIX 2: RATING SYSTEM

Rating systems used for sample assessments

DECAY/INSECT DAMAGE

- 10 = No decay or insect damage.
- T = "Trace" discolouration, decay suspected but not positively identified.
- 9 = Minor decay or damage at defects, less than 3% of the cross section.
- 8 = Minor but established decay, 3 - 10% of the cross section.
- 7 = Well established pockets or extensive surface damage, 10 - 30% of the cross section.
- 6 = Extensive established and deepening decay, 30 - 50% of cross section.
- 4 = Deep and severe decay, more than 50% of cross section.
- 0 = Disintegrating, failed.

UNCOATED SURFACES

- 1 = As new, no discolouration or mould.
- 2 = Slight surface mould or weathering, light even colour.
- 3 = Prominent mould or weathering, minor surface erosion.
- 4 = Extensive mould or lichen, uneven surface due to erosion.
- 5 = Extensive surface breakdown, original profile details gone.

SURFACE COATINGS

- 1 = Clean and intact, original colour and gloss retained.
- 2 = Surface dulling and colour loss, minor failure on sharp corners.
- 3 = Extensive discolouration, failure and minor loss at defects and sharp corners.
- 4 = Patches failed with substrate exposed over <50% of surface.
- 5 = Extensive failure, >50% of substrate exposed.

CHECKING

- 1 = No surface checks, fine knot checks not visible in damp weather.
- 2 = Minor checks to 0.5 mm wide, not obvious in damp weather.
- 3 = Well established checks to 1 mm wide and 50% board thickness.
- 4 = Many or deep and severe checks over 1 mm wide.
- 5 = Board completely split and allowing obvious water egress.

APPENDIX 3: INDIVIDUAL ASSESSMENT DETAILS

Individual decking sample assessment details after one year's exposure

Sample number	Decay		Surface	Checking	Comments ¹
	T end	UT end			
Group 1: <i>Cupressus macrocarpa</i> (young), heartwood, no coating					
4331	10	10	2	1	
4332	10	10	2	3	Slight mould
4333	10	10	2	1	Slight mould
4334	10	10	2	1	Slight mould
4335	10	10	2	1	Slight mould
4336	10	10	2	1	Light coloured patch on top
4337	10	10	2	1	
4338	10	10	2	1	Slight mould
4339	10	10	2	1	Slight mould
4340	10	10	2	1	Slight mould
Group 2: <i>Cupressus macrocarpa</i> (old), heartwood, no coating					
4171	10	10	2	1	
4172	10	10	2	3	Slight mould
4173	10	10	2	1	Slight mould
4174	10	10	2	1	Slight mould
4175	10	10	2	1	Slight mould
4176	10	10	2	1	Light coloured patch on top
4177	10	10	2	1	
4178	10	10	2	1	Slight mould
4179	10	10	2	1	Slight mould
4180	10	10	2	1	Slight mould
Group 3: <i>Cupressus lusitanica</i>, sapwood, no coating					
4111	10	10	2	1	
4112	10	10	2	1	
4113	10	10	2	2	Light mould underneath
4114	10	10	2	2	Split full length underneath
4115	10	10	2	2	
4116	10	10	2	1	
4117	10	10	2	1	
4118	10	10	2	2	
4119	10	10	2	1	
4120	10	10	2	2	
Group 4: <i>Cupressus lusitanica</i>, heartwood, no coating					
4101	10	10	2	2	Knot at middle
4102	10	10	2	1	Light mould underneath
4103	10	10	2	1	Light mould underneath
4104	10	10	2	1	Light mould underneath
4105	10	10	2	1	Large knots
4106	10	10	2	1	
4107	10	10	2	1	
4108	10	10	2	1	Light mould underneath
4109	10	10	1	1	
4110	10	10	1	1	

¹ Comments include other observations.

Sample number	Decay		Surface	Checking	Comments ¹
	T end	UT end			
Group 5: <i>Cupressus lusitanica</i>, sapwood, 220°C TM, no coating					
4081	10	10	1	1	
4082	10	10	1	1	
4083	10	10	1	1	
4084	10	10	1	1	
4085	10	10	1	1	
4086	10	10	1	1	
4087	10	10	1	1	
4088	10	10	1	1	
4089	10	10	1	1	
4090	10	10	1	1	
Group 6: <i>Cupressus lusitanica</i>, sapwood, 220°C TM, stained					
4091	10	10	2	1	Knot under mid length
4092	10	10	2	1	Knot on edge
4093	10	10	3	1	
4094	10	10	3	2	
4095	10	10	2	1	
4096	10	10	2	1	Knot on top UT end
4097	10	10	2	1	
4098	10	10	2	2	
4099	10	10	3	1	
4100	10	10	3	1	
Group 7: <i>Cupressus ovensii</i>, heartwood, no coating					
4181	10	10	2	1	
4182	10	10	2	2	
4183	10	10	2	1	
4184	10	10	2	2	
4185	10	10	2	2	
4186	10	10	2	1	
4187	10	10	2	2	Pith split
4188	10	10	2	1	
4189	10	10	2	2	
4190	10	10	2	2	
Group 8: Douglas fir, heartwood, no coating					
4141	10	10	2	1	Knot checks on top
4142	10	10	2	1	
4143	10	10	2	2	
4144	10	10	2	1	Shelling on one growth ring
4145	10	10	2	1	
4146	10	10	2	2	
4147	10	10	2	1	
4148	10	10	2	1	
4149	10	10	2	1	
4150	10	10	2	1	

¹ Comments include other observations.

Sample number	Decay		Surface	Checking	Comments ¹
	T end	UT end			
Group 9: Douglas fir, sapwood, 230°C TM, no coating					
4131	10	10	2	1	
4132	10	10	2	1	
4133	10	10	2	2	
4134	10	10	2	2	
4135	10	10	2	2	
4136	10	10	2	2	
4137	10	10	2	1	
4138	10	10	2	1	
4139	10	10	2	1	
4140	10	10	2	1	
Group 10: Douglas fir, heartwood, 230°C TM, no coating					
4121	10	10	2	3	
4122	10	10	2	2	
4123	10	10	2	2	Shelling on top
4124	10	10	2	1	Shelling on top
4125	10	10	2	1	Shelling on top
4126	10	10	2	1	
4127	10	10	2	2	
4128	10	10	2	2	
4129	10	10	2	1	Shelling on top, checks on edge
4130	10	10	2	1	Checks on edge

¹ Comments include other observations.

Sample number	Decay		Surface	Checking	Comments ¹
	T end	UT end			
Group 11: Accoya, sapwood, acetylation, no coating					
4061	10	10	2	1	
4062	10	10	2	1	
4063	10	10	2	1	
4064	10	10	2	1	
4065	10	10	2	1	
4066	10	10	2	1	
4067	10	10	2	1	
4068	10	10	2	1	
Group 12: Accoya, sapwood, acetylation, stained					
4071	10	10	2	1	
4072	10	10	2	1	
4073	10	10	2	1	
4074	10	10	2	1	
4075	10	10	2	1	
4076	10	10	2	1	
4077	10	10	2	1	
4078	10	10	2	1	
Group 13: Kebony, sapwood, furfurylation, no coating					
4151	10	10	1	1	
4152	10	10	1	1	
4153	10	10	1	1	
4154	10	10	1	1	
4155	10	10	1	1	
4156	10	10	1	1	
4157	10	10	1	1	
4158	10	10	1	1	
4159	10	10	1	1	
4160	10	10	1	1	
Group 14: Kebony, sapwood, furfurylation, stained					
4161	10	10	2	1	
4162	10	10	2	1	
4163	10	10	2	1	
4164	10	10	2	1	
4165	10	10	2	1	
4166	10	10	2	1	
4167	10	10	2	1	
4168	10	10	2	1	
4169	10	10	2	1	
4170	10	10	2	1	

¹ Comments include other observations.

Sample number	Decay		Surface	Checking	Comments ¹
	T end	UT end			
Group 15: Radiata pine, sapwood, untreated, no coating					
4211	10	9	2	1	
4212	10	10	2	1	Mycelium, mid WR ² (7)
4213	10	10	2	1	Mycelium, mid WR (8)
4214	10	9	2	1	WR, top WR (8)
4215	10	9	2	1	WR, mycelium, mid WR (9)
4216	10	9	2	1	WR, mycelium, mid WR (7)
4217	10	9	2	1	WR, mycelium, mid WR (7)
4218	10	9	2	1	WR, mycelium, mid WR (7)
4219	10	10	2	2	Mycelium, mid WR (8)
4220	10	10	2	2	Mycelium, mid WR (7)
Group 16: Radiata pine, sapwood, untreated, stained					
4221	10	10	2	1	
4222	10	10	2	1	
4223	10	10	2	1	
4224	10	10	2	1	
4225	10	10	2	1	
4226	10	10	2	1	
4227	10	10	2	1	
4228	10	10	2	1	
4229	10	10	2	1	
4230	10	10	2	1	White mould
Group 17: Radiata pine, sapwood, H3 CCA treated, no coating					
4191	10	10	2	1	Light mould underneath
4192	10	10	2	2	Light mould underneath
4193	10	10	2	1	Light mould underneath
4194	10	10	2	1	Light mould underneath
4195	10	10	2	1	Light mould underneath
4196	10	10	2	2	Light mould underneath
4197	10	10	2	2	Light mould underneath
4198	10	10	2	2	Light mould underneath
4199	10	10	2	1	Light mould underneath
4200	10	10	2	1	Light mould underneath
Group 18: Radiata pine, sapwood, H3 CCA treated, stained					
4201	10	10	2	1	Light mould underneath
4202	10	10	2	1	Light mould underneath
4203	10	10	2	1	Light mould underneath
4204	10	10	2	1	Light mould underneath
4205	10	10	2	1	Light mould underneath
4206	10	10	2	2	Light mould underneath
4207	10	10	2	2	Light mould underneath
4208	10	10	2	2	Light mould underneath
4209	10	10	2	1	Light mould underneath
4210	10	10	2	1	Light mould underneath

¹ Comments include other observations.

² WR = white rot