

Decay and Termite Resistance of Western Juniper Sapwood and Heartwood Under Tropical Conditions

32 Month Report

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Introduction

Western juniper is often viewed as an invasive weed in many parts of the Great Basin of the U.S. The heartwood of this species has a reputation for decay resistance although there are relatively few data on performance. Expanded markets for this material will require the development of more performance data on termite and decay resistance.

In this report, we assess the performance of western juniper sapwood and heartwood over 20 months under an exterior tropical exposure to fungal and termite attack.

Materials and Methods

Western juniper (*Juniperus occidentalis*) boards containing mixtures of heartwood and sapwood were cut into 50 by 125 mm long specimens. The samples were segregated into all heartwood, all sapwood and mixed sap/heart samples. Samples of each material were allocated to termite tests or ground proximity tests.

The termite tests followed the American Wood Protection (AWPA) Association Standard while the decay testing was performed using the ground proximity method described in AWPA Method E18.

In the termite tests, hollow concrete blocks were laid directly on the soil in a 1 m square in an area with known attack by *Coptotermes formosanus*. This species is considered to a very aggressive wood destroyer and is found in the southern US as well as Hawaii and the tip of Southern California. A series of southern pine sapwood stakes were driven into the ground in the block openings to provide avenues for termite workers to explore upward. A sheet of 6 mm thick southern pine plywood was then placed on top of the concrete blocks. The sheets were only placed on the blocks for the first exposure because they were not necessary for encouraging termite attack. . The test pieces were arranged on the array so that every piece was surrounded by 19 mm by 19 mm southern pine sapwood sticks (Figure 1). This allowed foraging termite workers to explore throughout the array and to be able to choose to attack specific wood samples while avoiding those that might be repellent. The entire assembly was covered to prevent overhead wetting. This arrangement posed little or no risk of chemical leaching.

The degree of termite damage was visually assessed after each 6 or 12 month exposure using the following scale

- 10 no attack although some slight grazing allowed
- 9.5 slight grazing
- 9.0 termite attack but little penetration
- 8.0 termite penetration
- 7.0 substantial termite attack
- 4.0 termite attack renders sample barely serviceable
- 0 sample destroyed



Figure 1. Example of test samples in a termite array one month after installation..

In the decay or ground proximity test, solid concrete blocks were laid on vegetation-free soil and the test blocks were laid on the blocks (Figure 2). The assembly was then covered with a shade cloth that allowed rainfall to penetrate, but limited direct ultra-violet light and drying. The test site receives almost 4 m of rainfall per year and average temperatures range from 25 to 30 C. The ground proximity test presents an extreme above ground challenge at this site and untreated pine sapwood will decay under these conditions within 18 to 24 months.

The degree of damage is visually assessed at selected intervals using a scale from 0 to 10 where:

10	Sound, no evidence of deterioration
9.5	Sound with slight discoloration
9.0	Some slight decay evident
7.0	Decay obvious, but sample still serviceable
4.0	Decay severe, sample barely serviceable
0	Sample destroyed

Results and Discussion

Termite Tests: Untreated pine sapwood samples were completely destroyed after each 6 month test period, illustrating the continuous aggressive nature of termite attack on the site. The various western juniper samples differed slightly in the extent of attack.

Western juniper heartwood exhibited excellent resistance to termite attack with no evidence of attack 1 year after treatment. Samples had some evidence of minor nibbling after 32 months of exposure, however, none of the heartwood samples were rated below 9.

Sapwood samples were heavily attacked on some faces after the first 6 months of exposure, indicating that they had little resistance to termite attack. While termite attack has continued on the samples over the next 32 months, only one of 5 samples was destroyed. All of the remaining specimens were rated as 4 or lower, indicating that the termites had largely destroyed the samples.

Sapwood/heartwood samples sustained extensive attack on the sapwood portions of each sample indicating that adjacent heartwood had little effect on sapwood termite resistance (Figure 3). However, 8 of the 15 samples were still rated as 7 after 32 months of exposure. And 2 others rated 9 or 10. Thus, while the heartwood did not appear to protect the sapwood, the presence of sapwood did not appear to allow the termites to initiate attack in this portion and then move into the adjacent heartwood. This would suggest that all heartwood boards may be required where this material is used under high termite pressure.

The results indicate that juniper heartwood provides excellent resistance to Formosan termite attack, while the presence of sapwood will result in some termite damage.

Decay Tests:

Ground proximity tests present a substantial above ground decay hazard. The test site receives extensive rainfall under near tropical conditions. Untreated pine sapwood samples will begin to fail within 1.5 to 2 years after installation. Naturally durable heartwood species such as teak, redwood or western redcedar have been exposed under these conditions for 4.5 years with no evidence of fungal attack (these tests are still underway).

Heartwood samples of western juniper exhibited no evidence of fungal decay after 1 year of exposure but had begun to experience some slight decay and discoloration at 20 months. Sapwood samples have begun to show some evidence of early decay at 12 months, although advanced decay was not evident on any of the samples. Samples with a mixture of sapwood and heartwood also exhibited some signs of early decay in the sapwood, but the ratings were intermediate between all heartwood and all sapwood samples. Examination of sapwood samples after 20 months of exposure indicated that many samples had begun to experience substantial visible decay, particularly along the edges, although most samples were still serviceable. Samples with a mixture of sapwood and heartwood were only slight better than the pure sapwood samples. These results would suggest that heartwood had little or no effect on performance of adjacent sapwood.

Examination of samples after 20 months showed that fungal attack had begun to affect all of the materials to some extent. The ratings for all heartwood samples averaged 8.0, while those for the mixed sap/heart were 6.6. More importantly, two heartwood samples had extensive decay (rating of 4) and 5 of the mixed sap/heart samples had failed. As expected, the non-durable all sapwood samples had the lowest ratings and 3 of the 5 samples had failed.

The declining levels of performance for both the heartwood and mixed sap/heart samples likely reflect the extreme leaching exposure. The blocks are exposed to over 4 m of rainfall per year and sit on concrete blocks that tend to hold moisture close to the wood surface. This environment creates excellent conditions for extractives loss.



Figure 2. Reassembled ground proximity decay test after 6 months of exposure. Materials in this array include two naturally durable tropical hardwoods, merbau and ipe.

Table 1. Decay and termite ratings of western juniper sapwood and heartwood samples after 20 months of exposure in Hilo, Hawaii. ¹								
Material	Termite Rating				Decay Rating			
	6 mo	12 mo	20 mo	32 mo	6 mo	12 mo	20 mo	32 mo
Sapwood	5.8	3.2	3.2	2.6	9.7	9.3	7.8	2.2
Heartwood	10.0	10.0	9.2	9.7	10.0	10.0	9.2	8.0
Sap/Heart	7.7	7.2	5.3	6.1	9.97	9.8	7.9	4.5
Pine	0	0	0	0	-	-	-	-

¹Values represent means of 5 for the sapwood samples and 15 samples for the heartwood and sap/heart combination for each exposure (termite or decay).

Conclusions

Western juniper heartwood continues to show excellent resistance to termite attack. While fungal attack has begun on the heartwood samples, the materials are still largely sound with only 2 of 15 samples being unservicable. The presence of sapwood has a detrimental effect on the performance of western juniper against both fungi and termites. There is no evidence that heartwood improves the performance of adjacent sapwood in a sample.



Figure 3. Example of termite attack on the sapwood portion of a mixed heart/sap western redcedar sample exposed to formosan termite attack for 6 months in Hilo, Hawaii.