Comparative study of the resistance of six bamboo species to attack by *Coptotermes formosanus* Shiraki and *Coptotermes gestroi* Wasmann (Blattodea: Rhinotermitidae)

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Bamboo is widely grown and utilized as a construction material around the world, particularly in the tropics. At present, there are about 70 bamboo species and varieties recorded from Hawaii. The objective of our study was to determine the relative resistance of six Hawaii-grown bamboo species to attack by *Coptotermes formosanus* Shiraki (Formosan subterranean termite) and *Coptotermes gestroi* Wasmann (Asian subterranean termite). Four-week laboratory feeding trials were performed as described in standard E1-09 of the American Wood Protection Association (AWPA 2009). Samples of each of the six bamboo species were individually exposed to 200 termites (with 10% soldiers); and termite mortality, wood mass loss, and visual appearance of the samples (on a scale of 0-10) were recorded at the conclusion of the trail. Mean mass losses of the six species as a result of termite feeding ranged from 14-29%; with the two most resistant bamboo species, *Gigantochola pseudoarundinacea* and *Bambusa oldhamii*, demonstrating significantly greater resistance to termite attack than the most susceptible bamboo species, *Guadua anguistifolia*, with both termite species. *Dendrocalamus brandisii, Dendrocalamus latiflorus*, and *Bambusa hirose* were intermediate in their termite resistance. Overall, we observed very little difference in wood preference between *C. formosanus* and *C. gestroi*. Although bamboo is a very promising construction material, and species clearly differ in their susceptibility to termite attack, all six species evaluated in the present study would require additional protection for use under conditions of high termite pressure.

Table 1 - Mean visual rating, Mean mass losses, Mean percent mass loss and Mean percent termite mortality of bamboo blocks exposed to *Coptotermes formosanus* for 4 weeks in a no-choice laboratory test. Wood blocks visually rated using AWPA Standard - 2009 rating system; 10 (sound), 9.5 (trace, surface nibbles permitted), 9 (slight attack up to 3% of cross sectional area affected), 8 (moderate attack, 3-10 % of cross sectional area affected), 7 (moderate/severe attack, penetration, 10-30% of cross sectional area affected), 6 (severe attack,30-50% of cross sectional area affected), 4 (very severe attack, 50-70% of cross sectional area affected) or 0 (failure).

Bamboo Species	Mean Visual Rating	Mean Mass Loss (g)	Mean Percent Mass loss (%)	Mean Percent Termite Mortality (%)
Guadua angustifolia (GA)	5.20 (±1.10)	0.6912 (±0.1066) a	24.77 (±2.12)	18.90 (±5.67)cd
Bambusa hirose (BH)	6.00 (±1.41)	0.6214 (±0.0689) a[a]	22.98 (±4.11)	24.90 (±3.34)abc
Dendrocalamus latiflorus (DL)	7.00 (±0.0000)	0.5744 (±0.0546)ab	22.56 (±2.63)	25.40 (±6.55)bd
Dendrocalamus brandisii (DB)	6.00 (±0.00)	0.5227 (±0.0661)ab	19.68 (±3.95)	30.10 (±12.53)bd
Bambusa oldhamii (BO)	6.40 (±0.55)	0.4838 (±0.0663)b	16.76 (±4.16)	38.10 (±6.54)b
Gigantochola pseudoarundinacea (GP)	7.40 (±0.55)	0.4300 (±0.0265)b	14.20 (±0.952)	32.30 (±5.03)bd

[a] Values in parentheses are standard deviations; means within a column followed by the same capital letter do differ significantly at the 5 percent level (ANOVA,Tukey's HSD).

Mass losses of control woods were as follows: *Bambusa hirose* (BH) = 5.840% (±1.252), *Bambusa oldhamii* (BO) =5.253% (±0.734), *Dendrocalamus brandisii* (DB) = 8.123% (±0.891), *Dendrocalamus latiflorus* (DL) = 5.213% (±0.363), *Gigantochola pseudoarundinacea* (GP) = 2.620% (±0.865) and *Guadua angustifolia* (GA) = 4.960% (±0.355).

Table 2 - Mean visual rating, Mean mass losses, Mean percent mass loss and Mean termite mortality of bamboo blocks exposed to *Coptotermes gestroi* for 4 weeks in a no-choice laboratory test. Wood blocks visually rated using AWPA Standard - 2009 rating system; 10 (sound), 9.5 (trace, surface nibbles permitted), 9 (slight attack up to 3% of cross sectional area affected), 8 (moderate attack, 3-10 % of cross sectional area affected), 7 (moderate/severe attack, penetration, 10-30% of cross sectional area affected), 6 (severe attack,30-50% of cross sectional area affected), 4 (very severe attack, 50-70% of cross sectional area affected) or 0 (failure).

Bamboo Species	Mean Visual Rating	Mean Mass Loss (g)	Mean Percent Mass loss (%)	Mean Percent Termite Mortality (%)
Guadua angustifolia (GA)	5.20 (±1.10)	0.6514 (±0.0399)a	29.14 (±3.28)	18.90 (±3.52)d
Bambusa hirose (BH)	6.00 (±1.41)	0.5700 (±0.1009)ab[a]	26.94 (±8.02)	41.00 (±13.98)abc
Dendrocalamus	6.00	0.6068	26.69	28.10

latiflorus (DL)	(±0.00)	(±0.0602)a	(±2.64)	(±5.79)acd
Dendrocalamus brandisii (DB)	7.00 (±0.00)	0.4665 (±0.0136)bd	22.10 (±2.23)	27.60 (±2.79)acd
Bambusa oldhamii (BO)	6.40 (±0.55)	0.4526 (±0.0980)bc	19.09 (±2.87)	49.60 (±9.83)b
Gigantochola pseudoarundinacea (GP)	7.40 (±0.55)	0.3928 (±0.0284)cd	14.51 (±1.241)	41.50 (±9.07)abc

[a] Values in parentheses are standard deviations; means within a column followed by the same capital letter do differ significantly at the 5 percent level (ANOVA, Tukey's HSD).

Mass losses of control woods were as follows: *Bambusa hirose* (BH) = 4.530% (±1.770), *Bambusa oldhamii* (BO) =7.360% (±4.510), *Dendrocalamus brandisii* (DB) = 6.370% (±0.996), *Dendrocalamus latiflorus* (DL) 5.833% (±0.424), *Gigantochola pseudoarundinacea* (GP) = 3.7033% (±0.0950) and *Guadua angustifolia* (GA) = 4.710% (±1.395).