# A Study of the Termite Resistance of Foreign Chipboard Treated with Boric Acid and Other Compound

by
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SUMMARY

Of the preservatives tested, only 1.0 percent sodium pentachlorophenate, 1.0 percent copper pentachlorophenate, 10.0 percent boric acid, and 2.0 per cent boric acid plus 0.5 percent sodium pentachlorophenate gave significant protection to chipboards against infestations of *Macrotermes gilvus* Hagen, *Microcerotermes losbañosensis* Oshima, *Coptotermes vastator* Light, and *Cryptotermes cyanocephalus* Light, for a period of 5 years. However, there were no significant differences in effectiveness between preservatives used.

Two and three percent boric acid were effective only up to two years.

*M. gilvus* was found to be the most destructive and voracious feeder followed by *C. vastator, M. losbañosensis,* and *C. cyanocephalus,* in that order.

INTRODUCTION

This is a cooperative study between the Forest Products Research Institute and two British firms, Borax Consolidated Limited, manufacturer of boron compounds, and British Plimber Limited, manufacturer of chipboards.

Seven sets of experimental chipboard panels were received with an accompanying letter from R. D. Warnes of British Plimber Ltd., explaining some details about the chipboard samples. Each panel measured 1/2" x 10" x 12" and treated, accordingly, as follows:

a. 50 pieces containing 1.0% copper P.C.P.
b. 50 pieces containing 1.0% sodium P.C.P.
c. 50 pieces containing 2.0% boric acid
d. 50 pieces containing 3.0% boric acid
e. 50 pieces containing 10.0% boric acid
f. 50 pieces containing 2.0% boric acid plus 0.5% sodium P.C.P.
g. 50 pieces untreated, marked "CONTROL"

This test was conducted in the Forestry Campus, College, Laguna, during the period starting in October, 1959 and ending in October, 1964.

The object of this study was to determine the relative resistance of chipboards treated with boric acid and other compounds against some species of Philippine termites.

MATERIALS AND METHODS

The panels were each cut into 1/2" x 2-1/2" x 12" test pieces, producing 200 pieces from each set. Every test specimen was labeled with aluminum tag with appropriate symbols for treatment, species of termite, replication, and test piece number.

Five active mounds or nests each of *Coptotermes vastator* Light, *Macrotermes gilvus* Hagen, and *Microcerotermes losbañosensis* Oshima were located and over each colony, a shed, about 4 feet high, was built. The sheds were walled and roofed with veneers during the first two years but later replaced with asphalt paper. Inside each shed, a wooden platform was laid immediately above the mound or nest, where 10 bundles, each consisting of seven specimens representing the seven treatments, were exposed. Each bundle was bound securely with wire in such a way that every test specimen was sandwiched by 2 pieces of white lauan (*Pentacme contorta* (Vid.) Merr. & Rolfe) board of the same dimensions as the test specimens (Fig. 1).

The remaining 350 specimens were exposed to *Cryptotermes cyanocephalus* Light inside 5 compartments of a screened cage in the F.P.R.I. insectary. Ten specimens of each treatment were placed in each cage. The The test pieces were arranged in several layers interlaced with layers of drywood-termite-infested lumber (Fig. 2).

Originally, the statistical design for this test was "Split-Plot". However, the occurrence of mixed infestations by subterranean termites in some sheds rendered the "split-plot" design inapplicable. Another design was used wherein all subterranean termite species were treated as one group and *C. cyanocephalus* Light as another group.

Inspections of the chipboards were made at yearly intervals. Degree of termite damage was determined by visual examination. Index of effectiveness of the preservatives was based on the number of termite-infested chipboards.

## RESULTS AND DISCUSSION

Table 1 shows the percentage of chipboards that were attacked by subterranean termites under each treatment. Based on the least mean percentage of board specimens damaged by termites, 1.0 percent copper pentachlorophenate, 1.0 percent sodium pentachlorophenate, 10.0 percent boric acid, and 2.0 percent boric acid plus 0.5 percent sodium pentachlorophenate were found to be significantly more effective than the control. These preservatives gave protection to chipboards against infestation of *C. vastator* Light, *M. gilvus* Hagen, and *M. losbañosensis* Oshima, for a period of 5 years. Two and three percent boric acid were not significantly better than the control.

As shown in Table 2, 1.0 percent sodium pentachlorophenate had the least mean percentage of drywood-termite-infested chipboards followed by 2.0 percent boric acid plus 0.5 percent sodium pentachlorophenate, 10.0 percent boric acid, 1.0 percent copper pentachlorophenate, 3.0 percent boric acid, and 2.0 percent boric acid, in that order. Chipboards treated with any of the four preservative treatments found effective against subterranean termites were also found to be significantly more resistant than the untreated boards against attack of drywood termite.

It was observed that 2.0 percent and 3.0 percent boric acid could give significant protection to chipboards against attack of the four species of Philippine termites for only 2 years.

After 5 years of exposure, 81.71 percent of the chipboards were damaged by subterranean termites and 52.28 percent by drywood termite.

A breakdown of the total number of chipboards attacked by subterranean termites is shown in Table 3. Degree of damage was classified into three distinct categories which are as follows:

a. Slight—damaged portion was 1/3 or less of the total volume of the chipboard.
b. Moderate—damaged portion was more than 1/3 but less than 2/3.
c. Severe — volume damaged was 2/3 or more.

As shown in the Table, damage was slight on 54.43 percent of infested chipboards, moderate on 14.57 percent, and severe on 31.0 percent.

Table 4 shows a breakdown of the total number of chipboards attacked by *C. cyanocephalus* Light, a drywood termite species.

Of the total 183 boards infested, 97.26 percent were slightly-damaged and 2.74 percent were moderately-damaged. There was no case of severely-damaged chipboards noted.

The four species of termites differed in their mode and rate of feeding (Fig. 3). *M. gilvus* was observed to be the most voracious feeder. In severe cases, infested chipboards were almost eaten up, leaving only small fragments. On the other hand, *C. cyanocephalus* was noted to be the slowest feeder. Damaged by this species was characterized by the light deep nibbles and in very few cases the holes coalesced, forming wide infested area or areas. *C. vastator* and *M. losbañosensis* were almost identical in their mode of infestation. Both species converted damaged chipboards into "semicarton" nests. However, *C. vastator* was a faster feeder than *M. losbañosensis.*

## CONCLUSION

Treatments such as 1.0 percent sodium pentachlorophenate, 1.0 percent copper pentachlorophenate, 10.0 percent boric acid, and 2.0 percent boric acid plus 0.5 percent sodium pentachlorophenate gave significant protection to chipboards against attack of *Coptotermes vastator* Light, *Macrotermes gilvus* Hagen, *Microcerotermes losbañosensis* Oshima, and *Cryptotermes cyanocephalus* Light, for a period of 5 years. Since the chipboards were exposed to termites under very severe conditions in this test, it is expected that boards treated with the 4 preservatives mentioned above could give longer service when used under conditions with lesser termite hazards.

TABLE 1.—*Percentage of chipboards that were attacked by subterranean termites in each treatment, after 5 years of exposure.*

| TREATMENTS | REPLICATIONS | | | | | | | | | | TOTAL ANGLE | MEAN ANGLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | | II | | III | | IV | | V | | | |
| | Percentage of chipboards that were attacked[1] | | | | | | | | | | | |
| | Actual | Angle | Actual | Angle | Actual | Angle | Actual | Angle | Actual | Angle | | |
| 1.0% sodium pentachlorophenate | 76.6 | 61.07 | 53.3 | 46.89 | 66.6 | 54.70 | 76.6 | 61.07 | 93.3 | 75.00 | 298.73 | 59.55 |
| 1.0% copper pentachlorophenate | 66.6 | 54.70 | 63.3 | 52.71 | 66.6 | 54.70 | 70.0 | 56.79 | 83.3 | 65.88 | 284.78 | 56.96 |
| 2.0% boric acid | 80.0 | 63.44 | 90.0 | 71.56 | 63.3 | 52.71 | 86.6 | 68.53 | 100.0 | 90.00 | 346.24 | 69.25 |
| 3.0% boric acid | 96.6 | 79.37 | 80.0 | 63.44 | 86.6 | 68.53 | 86.6 | 68.53 | 93.3 | 75.00 | 354.87 | 70.97 |
| 10.0% boric acid | 96.6 | 79.37 | 80.0 | 63.44 | 60.0 | 50.77 | 83.3 | 65.88 | 90.0 | 71.56 | 331.02 | 66.20 |
| 2.0% boric acid plus 0.5% sodium pentachlorophenate | 70.0 | 56.79 | 60.0 | 50.77 | 83.3 | 65.88 | 83.3 | 65.88 | 96.6 | 79.37 | 318.69 | 63.73 |
| Control | 100.0 | 90.0 | 90.0 | 71.56 | 96.6 | 79.37 | 100.0 | 90.00 | 96.6 | 79.37 | 410.30 | 82.06 |
| TOTAL | | 484.74 | | 420.37 | | 426.66 | | 476.68 | | 536.18 | 2,344.63 GRAND TOTAL | |

[1] Actual percentage values are based on 30 replications. Angles correspond to values of actual percentages as given in Table 11.12.1 of "Statistical Methods" by George W. Snedecor.

## ANALYSIS OF VARIANCE

| Source of variation | D. F. | S. S. | M. S. | Comp. F-value | Probability | H. S. D. 0.5 |
|---|---|---|---|---|---|---|
| Treatments | 6 | 2,062.13 | 343.69 | 6.36 | < .01 | 14.87 |
| Replications | 4 | 1,282.48 | 320.62 | 5.94 | < .01 | |
| Error | 24 | 1,296.44 | 54.02 | | | |
| Total | 34 | | | | | |

TABLE 2.—*Percentage of chipboards that were attacked by* C. cyanocephalus *Light, a drywood termite, in each treatment, after 5 years of exposure.*

| TREATMENTS | REPLICATIONS | | | | | | | | | | TOTAL ANGLE | MEAN ANGLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | | II | | III | | IV | | V | | | |
| | Percentage of chipboards that were attacked[1] | | | | | | | | | | | |
| | Actual | Angle | Actual | Angle | Actual | Angle | Actual | Angle | Actual | Angle | | |
| 1.0% sodium pentachlorophenate | 60.0 | 50.77 | 40.0 | 39.23 | 20.0 | 26.56 | 10.0 | 18.44 | 30.0 | 33.21 | 168.21 | 33.64 |
| 1.0% copper pentachlorophenate | 70.0 | 56.79 | 60.0 | 50.77 | 40.0 | 39.23 | 20.0 | 26.56 | 50.0 | 45.00 | 218.35 | 43.67 |
| 2.0% boric acid | 70.0 | 56.79 | 70.0 | 56.79 | 60.0 | 50.77 | 70.0 | 56.79 | 60.0 | 50.77 | 271.91 | 54.38 |
| 3.0% boric acid | 60.0 | 50.77 | 50.0 | 45.00 | 50.0 | 45.00 | 90.0 | 71.56 | 30.0 | 33.21 | 245.54 | 49.11 |
| 10.0% boric acid | 70.0 | 56.79 | 40.0 | 39.23 | 20.0 | 26.56 | 40.0 | 39.23 | 50.0 | 45.00 | 206.81 | 41.36 |
| 2.0% boric acid plus 0.5% sodium pentachlorophenate | 60.0 | 50.77 | 50.0 | 45.00 | 50.0 | 45.00 | 20.0 | 26.56 | 20.0 | 26.56 | 193.59 | 38.78 |
| Control | 90.0 | 71.56 | 90.0 | 71.56 | 60.0 | 50.77 | 100.0 | 90.0 | 60.0 | 50.77 | 334.66 | 66.93 |
| TOTAL | | 394.24 | | 347.58 | | 283.89 | | 329.14 | | 284.52 | 1,639.57 GRAND TOTAL | |

[1] Actual values are based on 10 replicates. Angle values correspond to values of actual percentages as given in Table 11.12.1 of "Statistical Methods" by G. W. Snedecor.

ANALYSIS OF VARIANCE

| Source of variation | D. F. | S. S. | M. S. | Comp. F-value | Probability | H. S. D. $_{0.5}$ |
|---|---|---|---|---|---|---|
| Treatments | 6 | 3,725.46 | 620.91 | 5.24 | $<.01$ | 22.11 |
| Replications | 4 | 1,230.48 | 307.62 | 2.59 | $<.05>.01$ | |
| Error | 24 | 2,845.80 | 118.58 | | | |
| Total | 34 | | | | | |

TABLE 3.—*Breakdown of the total number of chipboards attacked by subterranean termites in each treatment into 3 distinct categories of damage.*

| Treatments[5] | Total number of chipboards attacked | Percentage of damaged chipboards | | |
|---|---|---|---|---|
| | | Slight | Moderate | Severe |
| 1 | 110 | 65 | 16 | 29 |
| 2 | 105 | 79 | 7 | 19 |
| 3 | 126 | 63 | 23 | 40 |
| 4 | 133 | 80 | 21 | 32 |
| 5 | 122 | 77 | 12 | 33 |
| 6 | 117 | 70 | 14 | 33 |
| 7 | 145 | 33 | 32 | 80 |

[5] Same as those enumerated in Tables 1 and 2.

TABLE 4.—*Breakdown of the total number of chipboards attacked by* C. cyanocephalus *Light in each treatment into 3 distinct categories of damage.*

| Treatments[6] | Total number of chipboards attacked | Percentage of damaged chipboards | | |
|---|---|---|---|---|
| | | Slight | Moderate | Severe |
| 1 | 16 | 100.0 | — | — |
| 2 | 24 | 100.0 | — | — |
| 3 | 33 | 97.0 | 3.0 | — |
| 4 | 28 | 100.0 | — | — |
| 5 | 22 | 100.0 | — | — |
| 6 | 20 | 100.0 | — | — |
| 7 | 40 | 90.0 | 10.0 | — |

[6] Same as those enumerated in Tables 1 and 2.

FIG. 1.—*Representative bundles of chipboard exposed to subterranean termites, showing the manner chipboards were sandwiched by white lauan* (Pentacme *contorta* (*Vid.*) *Merr. & Rolfe*) *boards of same size.*

FIG. 2.—*Chipborads exposed to C.* cyanocephalus *Light, a drywood termite species, in a compartment of a screened cage in the F.P.R.I. insectary.*

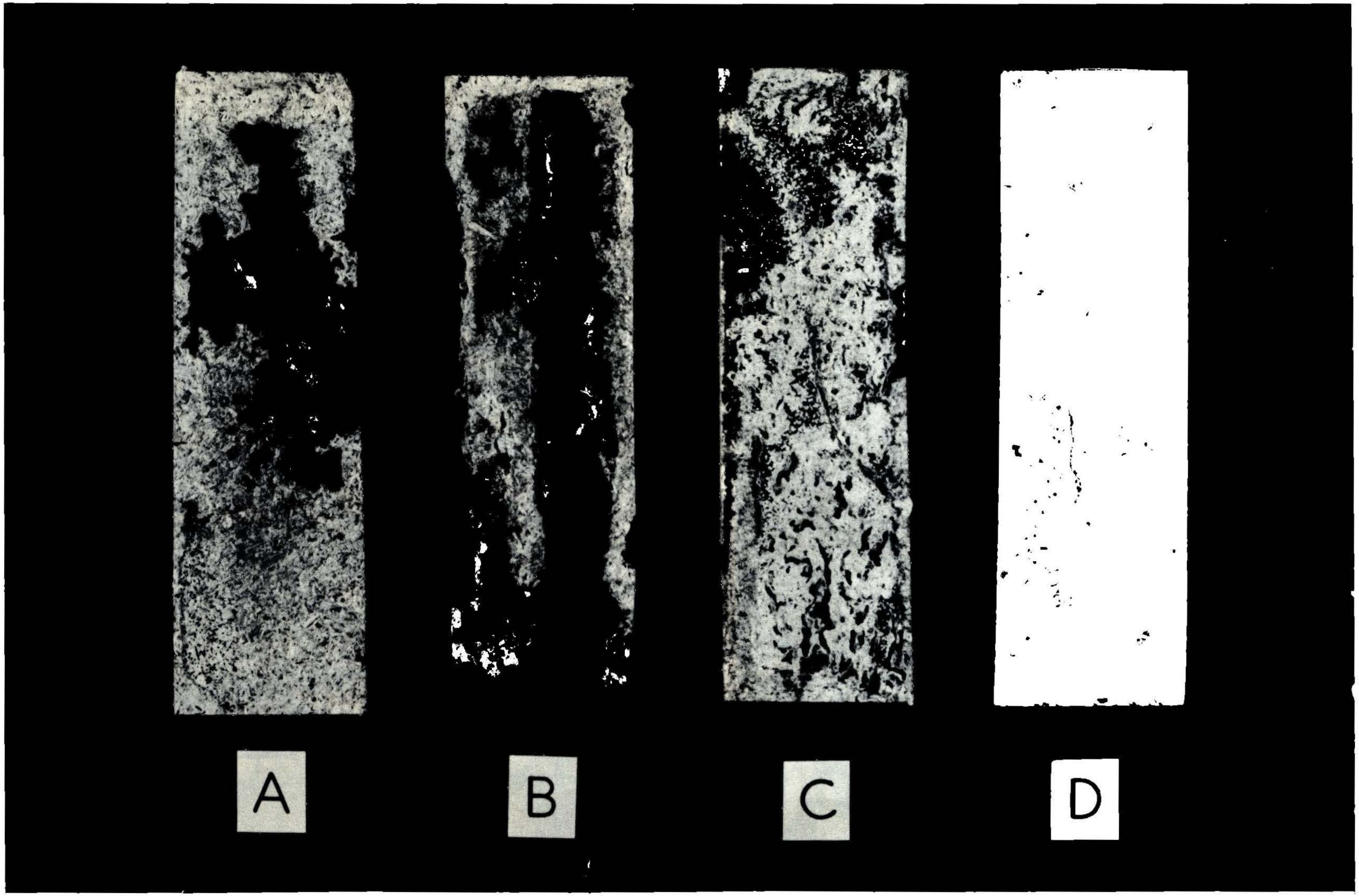


FIG. 3.—*Representative samples of untreated boards, showing the nature of damage made by the four test species of Philippine termites. A refers to C. vastator,* B *to* M. gilvus, C *to* M. losbañosensis, *and* D *to* C. cyanocephalus.