

## **Effect of Boron Compounds on Physiological Function in Termite\*<sup>1</sup>**

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### **Introduction**

Boron compounds are good wood preservatives in affecting various wood-deteriorating organisms. Because of their slow-acting toxicity and low repellency, they are expected to perform as properly bait toxicants in fields. As is well known, boron is an essential element to plant growth, but its toxic mechanism has not been elucidated yet. Boron is easy to form complexes with compounds having certain configurations of alcohol groups<sup>1)</sup>. A hypothesis that physiological functions in termite are affected by boron's binding to biological components is based upon this fact. This paper deals with the detection of borate introduced into termite body and effects of borate on physiological function in termite.

### **Materials and Methods**

Boron compounds tested were technical-grade materials of boric acid, disodium tetraborate decahydrate, and disodium octaborate tetrahydrate. Termites were collected from a laboratory colony of *Coptotermes formosanus* Shiraki and exposed to the testing. Two hundred termites starved for two days prior to the experiment were fed on 10 mg sawdust of *Cryptomeria japonica* D. Don, which was stained with Nile blue A<sup>2)</sup> and containing desired dose of boron compounds. After that, all stained termites were transferred to a Petri-dish provisioned with moistened filter paper. Dead termites were counted for 16 days and the amount of boric acid in a live termite body was determined by Ion Chromatographic Analyzer equipped with RI detector. In addition, as for termites fed on boric acid-containing sawdust, the number of each symbiotic protozoan species was counted, and respiration rate of termites was measured.

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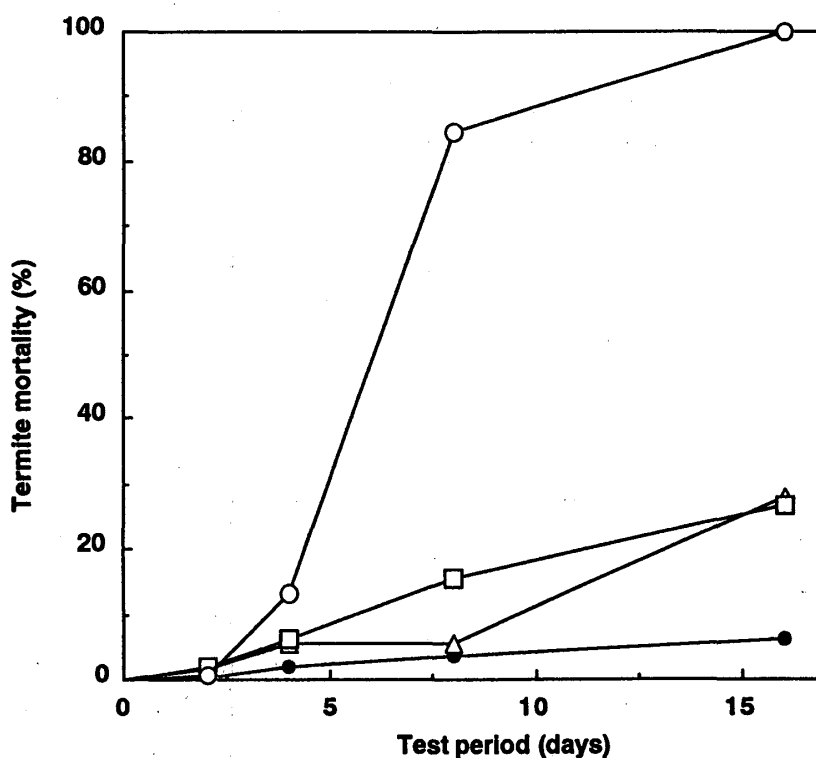


Fig. 1. Mortality of workers of *C. formosanus* fed on boric acid-treated sawdust.  
 Legend: Retention in sawdust (as wood blocks): —●—: 0 kg/m<sup>3</sup>,  
 —△—: 5 kg/m<sup>3</sup>, —□—: 10 kg/m<sup>3</sup>, —○—: 20 kg/m<sup>3</sup>.

### Results and Discussion

Of the three boron compounds, boric acid was the most effective. Fig. 1 shows the relationships between the mortality of termites and the retention of boric acid in sawdust. In cases of 5 kg/m<sup>3</sup> and 10 kg/m<sup>3</sup> retentions (as wood blocks), in which 0.72  $\mu\text{g}$  and 1.44  $\mu\text{g}$  of boric acid were ingested on an average by one termite, respectively, approximately 25% mortality was obtained at the end of the test. At the retention of 20 kg/m<sup>3</sup>, in which 2.88  $\mu\text{g}$  boric acid was ingested by one termite, mortality reached almost 100% at the end of test.

The amounts of boric acid remained in termite body were shown in Fig. 2. In cases of 5 kg/m<sup>3</sup> and 10 kg/m<sup>3</sup> retentions, 0.14  $\mu\text{g}$  and 0.19  $\mu\text{g}$  of boric acid were detected in a termite body respectively, from 2nd day to the end of the test. Those were corresponding to 19% and 13% of ingested boric acid during feeding. At 20 kg/m<sup>3</sup> retention, in which 100% mortality was attained, 0.44  $\mu\text{g}$  of boric acid was detected and it was corresponding to 15% of ingested boric acid. The results suggested that more than 80% of ingested boric acid was rapidly eliminated from termite body but the rest was remaining over a long period of time. In the hind gut of termites fed on boric acid-treated sawdust, the number of protozoan species remarkably decreased but were not lost completely. In addition, the respiration rate of termite fed on sawdust of 20 kg/m<sup>3</sup> retention clearly decreased than did in other

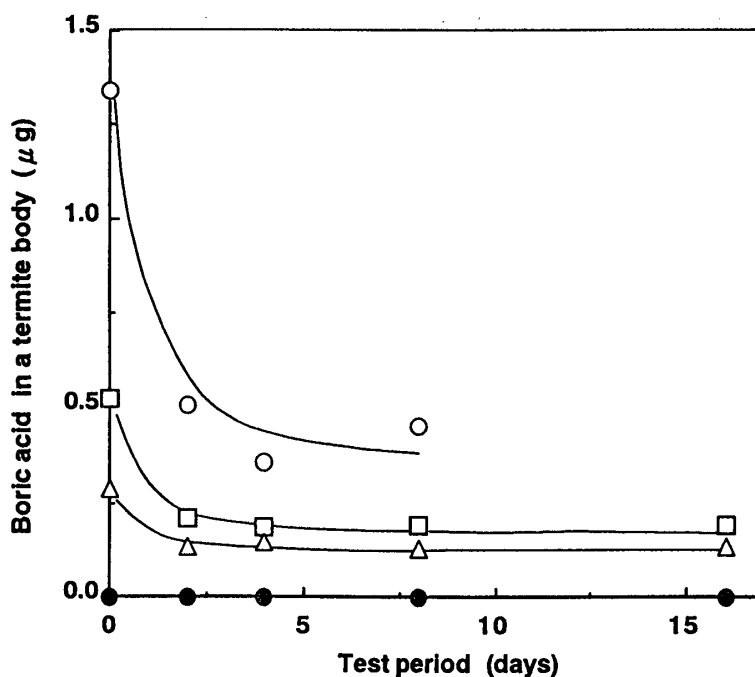


Fig. 2. The amount of boric acid in workers of *C. formosanus* fed on boric acid-treated sawdust.

Legend: Retention in sawdust (as wood blocks): —●—: 0 kg/m<sup>3</sup>,  
—△—: 5 kg/m<sup>3</sup>, —□—: 10 kg/m<sup>3</sup>, —○—: 20 kg/m<sup>3</sup>.

retentions.

From these results, it can be concluded that some part of ingested boric acid is left in a termite body for a long time and causes gradual deterrence of physiological function in termite by its slow-acting toxicity.

### References

- 1) M.R. NAGHI *et al.*: *Prog. Food Nutri. Sci.*, **17**, 331–349 (1993).
- 2) N.-Y. SU *et al.*: *J. Econ. Entomol.*, **87**, 398–401 (1994).