The invasive dry-wood termite, *Incisitermes minor* (Hagen), in Japan: infestation, feeding ecology and control strategies

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The dry-wood termite, *Incisitermes minor* (Hagen), is a native to the western region of the United States, and is one of the five most economically important and destructive termites in that country (1,2). Because colonies of *I. minor* live entirely within sound dry wood, this pest insect is easily transported in infested wood products by means of various human activities. Japan is one of the major importers of wood and wood-based materials that can serve as a natural habitat of *I. minor*. The first infestation of *I. minor* in Japan was found in Tokyo, followed by appearances in the west Chiba Prefecture (3). Although *I. minor* has been spreading in Japan for more than 30 years, the detailed study of this pest termite has still not been done so far.

This research focuses on the dry-wood termite *I. minor* as an invasive termite species in Japan, and consists of 3 main parts, dealing with the distribution and infestation, the feeding ecology, and control strategies.

The infestation of *I. minor* in Japan was surveyed (4,5). The results of the survey showed that the infestations were sporadically found in Hyogo, Osaka, Wakayama, Toyama, and Fukui Prefectures. The majority of the infestation was detected by both fecal pellets and attacked timbers. Based on the present survey, roofing materials (39%) were the commonest attacked parts by *I. minor*. The second-most commonly attacked parts were exterior materials (23%) and followed by interior materials (20%). Materials beneath the floor (10%) floor materials (5%), and furniture (3%) were hardly attacked. We found also that the soil and timber treatments with termiticidal chemicals under the floor generally employed for the majority of Japanese houses to protect against attacks by subterranean termites, *Coptotermes formosanus* and *Reticulitermes speratus*, do not guarantee the protection against *I. minor* attacks which commonly start in roofing materials. These results suggest that upper housing timbers should be treated before construction to prevent the nesting of alates of *I. minor*.

In order to identify the parentage assessment of this invasive species, analysis of the individual DNA structure is conducted (6). There were two major clusters of *I. minor* based on their genetic structures living in Japan. Group I consisted of colonies of *I. minor* collected in Kozagawa Town and Nishinomiya City. The colonies collected in the remaining distribution area, including Sendai City, Tokyo, Yokohama City, Kokawa Town, Amagasaki City, were categorized into Group II. The present results provide evidence of multiple invasions of *I. minor* in Japan.

Due to wood is the food source of the pest termite species, the termite feeding behavior is one of the important research targets. Three patterns of feeding behaviors i.e. cutting, pulling, and collecting were observed in *I. minor* using a CCD camera and an AE detector (7). These were similar to those of *C. formosanus*. The other subterranean termite, *R. speratus*, showed only cutting and pulling actions. Among these species, *I. minor* showed the highest p-p amplitude regardless of patterns of feeding behavior. The body length and size of the mandibles of the termites might be correlated with the p-p amplitude of the AE signals of the termites, where *I. minor* have the biggest body length and mandibles among three species of termite.

Although many studies have reported testing methods of wood preferences by dry-wood termite, no standard testing methods for dry-wood termites have been established at present. A new method for testing wood preferences of dry-wood termites was suggested by the present study (8). Five Japanese timbers, four U.S. timbers and one Malaysian timber were evaluated for their resistance to *I. minor* using laboratory choice and no-choice feeding tests with holed specimens. A choice feeding test, combining all test samples, was suggested to be an appropriate method to determine the termite wood preference than no-choice tests in this study, with the higher survival rate in the choice feeding test after the experiment. From this experiment, the ranking of the resistance of the ten commercial timbers against *I. minor* was buna > karamatsu > sugi > western red cedar > Douglas-fir > rubber > western hemlock > hinoki > spruce.

Beside wood species, another factor influencing the feeding activity of termite is environment condition. The effect of ambient temperature and RH on the activity of *I. minor* has been investigated (9).

Among six temperatures (15, 20, 25, 30, 35, and 40°C) and four RHs (60, 70, 80, and 90%) conditions, the optimal temperature and RH for the feeding activities of *I. minor* were 35°C and 70%, respectively. The higher AE events in 24 combinations of six temperatures and four RHs were observed at 35°C-70% and 35°C-80%. The hottest temperature (40°C) caused termites to become moribund, and their feeding activity decreased rapidly. The coolest temperature (15°C) did not kill the termites, but did reduce the feeding activity.

In recent years, the introduction of bait system that use fewer chemicals to the methods of subterranean control has encouraged the application of the system to eliminate *I. minor* colonies (10). The application of a gel formulation against *I. minor* must be considered, since this strategy is less hazardous to the environment. Though the basic effectiveness of the gel was confirmed by the present laboratory experiments, the higher deviation in mortalities of termites in replications was observed. Therefore, the search for special attractants that spread into the whole attacked areas should be conducted to attain the satisfactory remedial treatments.

REFERENCES

[1] Su, N.Y., and Scheffrahn, R. H. (1990) Sociobiology 17:77-94
[2] Cabrera, B.J. and Scheffrahn, R. H. (2004) http://edis.ifas.ufl.edu/ BODY_IN526
[3] Mori, H. (1976) Shiroari (Termite) 27:45-47 (in Japanese)
[4] Indrayani, Y., Yoshimura, T., Fujii, Y., Yanase, Y., Okahisa, Y., and Imamura, Y. (2004) Jpn J Environ Entomol Zool 15 (4):261-268
[5] Indrayani, Y., Yoshimura, T., Fujii, Y., Yanase, Y., Fujiwara, Y., Adachi, A., Kawaguchi, S., Miura, M., and Imamura, Y. (2005) Sociobiology 46:45-64
[6] Indrayani, Y., Matsumura, K., Yoshimura, T., Imamura, Y., and Itakura, S. (2006a) Mol Ecol Notes 6 (4):1249-1251
[7] Indrayani, Y., Yoshimura, T., Yanase, Y., Fujii, Y., Matsuoka, H., and Imamura, Y. (2007a) Sociobiology 49:121-134
[8] Indrayani, Y., Yoshimura, T., Yanase, Y., and Imamura, Y. (2007b). J Wood Sci (in press)
[9] Indrayani, Y., Yoshimura, T., Yanase, Y., Fujii, Y., and Imamura, Y. (2006b) J Wood Sci 53 (1):76-79
[10] Indrayani, Y., Yoshimura, T., and Imamura, Y. (2007c) (Submitted to J Wood Sci)