NOTE

Tests for Intraspecific Agonism in a Louisiana Population of *Coptotermes formosanus* (Isoptera: Rhinotermitidae)[1]

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When termites of different species or conspecifics from different colonies are put together in the laboratory, agonistic behavior often results. However, sometimes there is no agonism in mixed groups of conspecifics, as shown with *Nasutitermes corniger, Armitermes chagresi* (Thorne, 1982. Psyche 89: 133-150), *Reticulitermes lucifugus, R. santonensis* (Clément, 1986. Sociobiology 11: 311-323), *Zootermopsis* spp. (Haverty and Thorne, 1989. J. Insect Behav. 2: 523-543), and *Coptotermes formosanus* (Su and Haverty, 1991. J. Insect Behav. 4: 115-128). Agonistic response is low among termites with homogenous enzyme (Clément, 1986) and, sometimes, cuticular hydrocarbon (Harverty and Thorne, 1989) profiles. Bioassays of agonistic behavior are often used to define colony territories of termites (Nel, 1968. Insectes Soc. 15: 145-156; Thorne, 1982; Jones, S.C., 1987. PhD diss., Univ. Arizona). If kin recognition systems used by termites are genetically controlled, bioassays of agonistic behavior can provide supporting data in studies of relatedness in termite populations. Such redundancy is important since electrophoretic and cuticular hydrocarbon data from termite populations are not always congruent (Korman et al., 1991. Ann. Entomol. Soc. Am. 84: 1-9).

The Formosan subterranean termite, *Coptotermes formosanus* Shiraki, is an oriental rhinotermitid introduced into the southeast United States. In Louisiana, there is a large population of *C. formosanus* along the Calcasieu River near Lake Charles. These termites probably were introduced near the end of World War II from naval traffic (La Fage, 1987. *In* Biology and control of the Formosan subterranean termite [M. Tamashiro and N-Y. Su, eds.]. Hawaii Inst. Trop. Agric. Human Resources, Honolulu, pp. 37-42.); however, the degree of inter-colony relatedness of this population is not clear. The termites infest rotten hearts of cypress trees (*Taxodium distichum* [L.] Rich.) growing in water along the bank of the Calcasieu River. Colonies occur along each of three river branches.

In this laboratory study, I mixed workers (undifferentiated larvae of at least the third instar) and soldiers (defense caste derived from workers) of *C. formosanus* from different colonies and measured agonism with data on survival and feeding rates (after Howick and Creffield, 1980. Bull. Entomol. Res. 70: 17-23). Agonistic responses may shed light on questions of relatedness in this population.

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I collected termites from six colonies of *C. formosanus* along the Calcasieu River (two colonies from each of three river branches). The two colonies from each river branch were paired for future mixing; these colony pairs were blocked in analysis of variance (ANOVA) since relatedness is more likely between neighboring colonies and I wished to maximize differences among ANOVA blocks.

For each colony pair (ANOVA block), one colony was designated "A" and the other "B," creating a factorial treatment arrangement with three levels of inter-colony mixing (colony A non-mixed, colony B non-mixed, A-B mix) and two levels of soldiers (soldiers present or not present) (see Table).

Table. Treatments used to measure effect of mixing *C. formosanus* workers and soldiers from different colonies.

Treatment	Colony(ies)	No. Workers Per Colony	No. Soldiers Per Colony
1	A	240	0
2	B	240	0
3	A	216	24
4	B	216	24
5	A-B	120	0
6	A-B	108	12

There were 36 experimental units (3 blocks × 6 treatments × 2 replicates per block). Units were glass screw-top jars (4.7 cm tall by 4.5 cm ID) with 6.1 g oven-dried vermiculite, 13.7 g deionized water, and one pre-weighed, oven-dried block of wood (*Pinus* sp.) about 1.8 by 1.8 by 1.8 cm. On day 0, termites were added to the units; the colony source and caste of termites added to the units varied according to treatment but always totaled 240 individuals (see Table). All units were kept in a bioclimatic chamber at 27.5 ± 1°C, 97 ± 1% RH, and near-constant darkness until day 14 when the units were dismantled. Percentage group survival was calculated and wood blocks were brushed clean, oven-dried, and re-weighed to determine feeding rate (mg wood eaten per g termite per day).

Analysis of variance was used to test for treatment differences. Significance was accepted at the $\alpha = 0.05$ level.

Percentage survival ($P \geq 0.4$, range = 75.8% to 95.4%) and feeding rates ($P \geq 0.3$, range = 45.7 mg/g/d to 111.4 mg/g/d) were not affected by any combination of mixing or presence of soldiers; there were no main-effects interactions ($P \geq 0.06$) or block effects ($P \geq 0.3$). Inter-colony mixing of termites from this population caused no agonistic behavior, as measured by survival and feeding rates after 14 days. The absence of block effects shows that pairs of neighboring colonies behaved similarly across all three river branches.

Coptotermes formosanus from Lake Charles, LA did not measurably discriminate non-nestmates. If a functioning and genetically controlled kin recognition system is at work in this introduced population, my results could suggest high inter-colony relatedness. However, similar non-aggression could result if a genetically based kin recognition system was disabled by loss of the genetic variability that drives such a system, as might occur from a founder effect. Non-aggression also occurs in inter-colony mixes of this termite from Florida, but inter-colony mixes from Hawaii are sometimes agonistic; the Florida population probably originated from one introduction whereas Hawaii had multiple introductions and its colonies are less likely to be related (Su and Haverty, 1991).

Su and Haverty (1991) could not correlate agonistic behavior with cuticular hydrocarbon data. We cannot yet exclude the possibility of environmental influence on cuticular hydrocarbons (Prestwich, 1983. Annu. Rev. Entomol. 14: 287-311). Probably many factors, such as mandible gland exudates, behavorial differences, and volatile digestive products (Su and Haverty, 1991) affect kin recognition in this species, any of which could be genetically controlled, discernible in "whole-animal" bioassays, and useful in populations research.