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CLOSURE BETWEEN *CAMPONOTUS MOROSUS* SMITH, 1858 AND *RETICULITERMES FLAVIPES* (KOLLAR, 1837)

HERMETISMO ENTRE *CAMPONOTUS MOROSUS* SMITH, 1858 Y *RETICULITERMES FLAVIPES* (KOLLAR, 1837)

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ABSTRACT

This study was designed to demonstrate that the Chilean ant species of the genus *Camponotus*: *Camponotus morosus* and termites of the genus *Reticulitermes*: *Reticulitermes flavipes* exhibit closure between them. Five nests per species were examined and transfers were made into the receptors nest (e.q. from *C. morosus* to *R. flavipes*). During two minutes of observation, the identification events recorded in ants were: antennal exploration (EA), mandible opening (AM), as well as the events of rejection: biting (MOR), flexion of the gaster (FG), fight (L), and death (M). In termites, during two minutes of observation the events recorded were: approach to the intruder (ACE), mandible opening (MAN), biting (MOR), and fight (L). For each event, the mean and its standard deviation were calculated. The results showed that *C. morosus* is hermetic in front of *R. flavipes*. On the other hand, *R. flavipes* is not hermetic in front of *C. morosus*.

Key words: Formicidae, Rhinotermitidae, behavioral events, closure, Chile.

RESUMEN

El presente estudio se realizó con las especies *Camponotus morosus* y *Reticulitermes flavipes*, en condiciones de laboratorio. El propósito de esta investigación fue determinar la presencia de acciones de *C. morosus* sobre *R. flavipes* y *R. flavipes* sobre *C. morosus*. Para tal efecto se colectaron individuos de cada especie desde cinco nidos respectivamente, los cuales fueron confinados en nidos artificiales por un período de treinta días para su "aclimatación", previo a las observaciones. Se observaron eventos conductuales entre las especies residentes versus especies intrusas. Los resultados muestran que ambas especies en calidad de residentes, son herméticas y agresivas frente a las especies intrusas. Ambas especies presentaron similitud en el reconocimiento de las especies intrusas, ya que los períodos de latencia fueron similares. En relación a los eventos de agresión, *C. morosus* presentó una mayor frecuencia de dicho evento en comparación a lo observado en *R. flavipes*.

Palabras clave: Formicidae, Rhinotermitidae, eventos conductuales, hermetismo, Chile.

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INTRODUCTION

In Chile, ants are distributed among four Subfamilies: Ponerinae, Dolichoderinae, Myrmicinae, and Formicinae. They are geographically distributed from Arica to Tierra del Fuego, and an altitudinal transect from the

coast to up to 3.000 meters high approximately. Among these ants is important to highlight one group belonging to the Subfamily Formicinae; *Camponotus morosus* Smith, 1858, which has been preferably studied by Ipinza-Regla *et al.* (1991, 1993, 1994, 1996, 1998, 2004). This species is characterized by being "hermetic" or "closed", because it shows agonistic events after homo or hetero-specific "intruder" ants enter the receptor nest (residents).

Globally, 2.761 species of termites have been described in 282 genera. World literature mentions 183 termite species related to building damages. Eighty percent of important termites lives underground (Su and Scheffrahn, 1998).

Currently the province of Santiago, Chile, is undergoing an underground termite pest action, identified as *Reticulitermes hesperus* (Banks, 1920) by entomologists from the National Museum of Natural History in coordination with the International Center for Scientific Research in France. Ripa and Luppichini (2004) include it under the species *Reticulitermes flavipes* (Kollar, 1837), which was detected in Chile for the first time in 1986.

Results of Bayesian, maximum parsimony (MP), and neighbor joining (NJ) analysis of mitochondrial COII, 16S, and 12S gene DNA sequences and soldier morphology identified Chilean samples of a *Reticulitermes* species as the eastern subterranean termite, *R. flavipes* samples had identical gene sequence for all loci examined suggesting a single geographic introduction. The combined DNA sequence for *Reticulitermes santonensis* Feytaud collected from France were almost identical to those of *R. flavipes* samples from Florida which agreed with previous studies suggesting that *R. santonensis* is a junior synonym of *R. flavipes*. One unexpected finding was a *R. flavipes* sample collected from California that closely resembled the Chilean *R. flavipes* in their combined mtDNA sequences. They hypothesize that the Chilean *R. flavipes* may have been introduced from California or vice versa, or that both Chilean and California *R. flavipes* may be have the same origin in North America. Except for one sample from Florida (3% divergence), intra-species variation of *R. flavipes* used in this study was less than 1% (Su *et al.*, 2006).

Several control strategies have been proposed, being quite outstanding among others, biological control performed by ants.

This work intends to show closure in laboratory of the ant *Camponotus morosus* Smith, "red foot ants", against to *Reticulitermes flavipes* (Kollar) "subterranean termite".

MATERIALS AND METHODS

Five nests from *Camponotus morosus* were collected from San Carlos de Apoquindo, 20 Km east to Santiago, which were transported to the Universidad Mayor Zoology and Ethology Laboratory, Campus Huechuraba. These nests were artificially installed (Nests C1, C2, C3, C4 and C5). Nests consisted in a 9 x 9 x 9 cm (length x height x width) clear plastic box. Specimens were fed with a blend made of apple sauce, honey, and chicken carcass (Ipinza-Regla *et al.*, 1991). Nests were kept at 20º C ± 2º C and a relative humidity of 45 to 50%.

Termites (one soldier for eight workers and neotenic species for nest) were collected from five different nests separate between them about 500 meters for prevent the policaly from the commune of Quinta Normal from dwelling homes, and were transported and placed into artificial nests (Nests T1, T2, T3, T4 and T5) in the laboratory, as done with ants. Nests consisted in a 50 x 10 x 10 cm clear plastic box, with its lid. Feeding consisted of wood pieces, obtained from collecting area, and corrugated cardboard. Termite nests were kept at 27º C and 90% relative humidity, maintained within a dark incubator.

After three weeks of laboratory insect captivity behavioral events were performed, which will be described afterward.

Ant transfers to "resident" termite nests and termite transfers to "resident" ant nests.

"Intruder" (nests T1 to T5) termites belonging to *Reticulitermes flavipes* nests were placed one by one until reaching a number of 10 termites per nest, inside nests of "resident" *Camponotus morosus* ants.

Equivalently, "intruder" ants from nests C1, C2, C3, C4 and C5 were transferred one by one until reaching a number of 10 ants per nest to the corresponding nests of the "resident" termites; nests T1, T2, T3, T4 and T5.

Ants and termite receptor nest behaviors were recorded during two minutes, respectively. Latency times were recorded also. This correspond to an interval occurring when an individual is introduced into the nest of another individual, or time 0 (calculated in seconds) until next behavioral action occurs.

The following behavioral events were recorded from the receptor ant nests: antennal exploration (EA), mandible opening (AM), biting (MOR), gaster flexion (FG), fight (L), and death (M); against "intruder" termites.

In relation to receptor "resident" termite behavioral events against "intruder" ant presence, it was recorded the following behaviors described by Sepúlveda (1997): quick encounter to the alien and brief follow up by one or more termites (ACE), mandible opening and closure (MAN), biting (MOR), and fight (L).

A statistical description was made based on the results obtained; calculations of mean and standard deviation of contact numbers, and latency time of displaying of behavioral events.

RESULTS AND DISCUSSION

In Table I we could observe a high number of *C. morosus* samples showing behavioral events, when one individual was introduced coming from *Reticulitermes flavipes* nests. Therefore, when 50 *Reticulitermes flavipes* ants from nest 1 were introduced, *C. morosus* performed antennal exploration (EA) to 42 individuals, with a mean of 3,65 contacts. In this research, the most frequent event was biting (MOR), 40 to 49 bites, with averages of 3,6 to 5,91 contacts per ant. The next event was antennal exploration (EA) and the least frequent event was fight (L). Biting was performed in an average of four to six times after each *R. flavipes* introduction.

All events observed show a high variability, when considering standard deviation values. At first glance, manifestation of these events does not show differences among the five nests of *R. flavipes*. This high number of behavioral event presentations confirm the closure of this species. This fact has been observed in other researches performed by Ipinza-Regla *et al*. (1991, 1993, 1994, 1996, 1998 and 2004) who confronted *C. morosus* ants with same species individuals, as well as ants from other species.

In relation to time (Table II), the most premature events -when first contact was made by introducing *R. flavipes* to a *C. morosus* nest- were antennal exploration (EA) as well as biting (MOR), with a fluctuant presentation that depends on which *R. flavipes* nest is being considered. We could observe that after presence of nest T1 termites the first event was antennal exploration (EA) that took 17.1 s. Next, it came all remaining events, showing similar times. After T2 and T3 termite introduction the first event was biting (MOR) and the remaining events showed similar timing. With respect to T4 and T5, *Camponotus* ants showed in first place antennal exploration (EA) or biting (MOR), respectively. These events show a quite similar timing with mandible opening (AM). All of these events were shown before minute two; instead, death (M) is the event that always occurs after two minutes of observation. As well as contact numbers, time is very heterogeneous.

On the other hand, when analyzing *R. flavipes* reactions before alien individuals were introduced (Table III), it stands out the fact that there were recognition manifestations and aggression to only C1 and C2 nest samples, from the five nests of *R. flavipes* whom they were confronted to. The most frequent observed event was mandible opening and closure (MAN), with nine to four contacts in C1 and C2, respectively. Next event was biting (MOR) and behind it there were quick intruder encounter (ACE), and fight (L). These results can be understood as a non very hermetic or closed behavior of *R. flavipes* against *C. morosus*.

With respect to behavioral presentation time (Table IV), the first event shown is intruder encounter (ACE), followed by mandible opening and closure (MAN) or biting (MOR). And the last event presented was fight (L), with an average time of more than two minutes.

Table I. Mean number of contacts of *C. morosu*s behavioral event against *R. flavipes* individuals coming from five nests.

		BEHAVIORAL EVENTS				
R. flavipes NESTS		E.A.	A.M.	MOR	F.G.	FIGHT
T_1	Mean	3,65	2,84	3,6	1,91	1,34
	Est. Desv. n	1,77	1,77	1,91	0,57	0,33
		42	31	40	26	18
T_2	Mean	2,99	2,15	5,91	1,6	1,75
	Est. Desv. n	1,9	1,22	2,87	0,69	0,98
		47	38	49	35	44
T_3	Mean	2,41	2,27	4,42	1,58	1.24
	Est. Desv. n	1,92	1,84	2,48	0,82	0.46
		39	20	47	36	27
T_4	Mean	1,88	1,68	4,14	1,47	1,76
	Est. Desv. n	1,18	1,22	2,49	0,89	1,26
		39	26	48	31	25
T_5	Mean	2,00	1,97	4,7	1,81	1,26
	Est. Desv. n	1,37	1,01	2,5	0,92	0,73
		34	25	43	30	17

Table II. Latency time (in second) of the first contact of *C. morosus* behavioral event against *R. flavipes* individuals coming from five nests.

		BEHAVIORAL EVENTS					
R. flavipes NESTS		E.A.	A.M.	MOR.	F.G.	FIGHT	DEATH
T_1	Mean	17,10	26,70	26,12	27,75	23,4	66,64
	Est. Desv. n	19,49	21,71	22,96	20,54	25,9	30,65
		42	31	40	26	18	22
T_2	Mean	29,89	35,04	19,57	30,55	30,79	93,38
	Est. Desv. n	24,94	26,80	21,36	28,48	32,96	29,20
		47	38	49	35	44	24
T_3	Mean	35,80	40,68	25,68	33,93	32,38	84,63
	Est. Desv. n	33,43	39,43	29,38	31,38	27,93	26,44
		39	20	47	36	27	17
T_4	Mean	24,66	39,45	26,06	35,84	34,64	92,64
	Est. Desv. n	20,30	28,54	26,54	22,74	23,14	25,77
		39	26	48	31	25	23
T_5	Mean	27,57	39,43	23,19	32,59	29,08	97,85
	Est. Desv. n	25,60	32,71	26,11	32,76	36,99	19,29
		34	25	43	30	17	17

Table III. Mean number of contacts per behavioral event of *R. flavipes* against *C. morosus* individuals coming from two nests.

		BEHAVIORAL EVENTS			
C. morosus NESTS		ACE	AM	MOR	FIGHT
C_1	Mean	2,5	1,9	1,92	1,5
	Est. Desv. n	0,71	0,71	0,5	0,71
		2	9	4	2
C_2	Mean		1,65		
	Est. Desv. n		0,81		
			4		

Table IV. Latency (in seconds) time of first contact of *R. flavipes* behavioral event against *C. morosus* individuals coming from two nests.

		BEHAVIORAL EVENTS			
C. morosus NESTS		ACE	AM	MOR	FIGHT
C_1	Mean	39	59,3	52,5	67,5
	Est. Desv. n	22,6	50,2	59,2	60,1
		2	9	4	2
C_2	Mean		37,3		
	Est. Desv. n		39,8		
			7		

CONCLUSIONS

According to results can be concluded the following:

1. Ants *Camponotus morosus* behave hermetically when confronted to *Reticulitermes flavipes* termite individuals.

2. Termites *Reticulitermes flavipes* showed little hermetic behavior or closure when confronted to *Camponotus morosus* ant individuals.

3. *Camponotus morosus* at less in laboratory place could be a possible termite control.

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