Nota de Investigación

Devolution rates of grass by *Atta capiguara* (Hymenoptera, Formicidae) in field conditions

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Introduction

The leaf-cutting ants are a major problem in agriculture and forest plantations, despite the efforts of industries and researcher to develop strategies and effective products for controlling these insects.

There are several biological, behavioral and ecological particularities that guarantee the leaf-cutting ants great success in the exploration of the resources planted by the man. The term leaf-cutting ants include the genera *Atta* and *Acromyrmex*, known in Brazil as 'saúvas' and 'quenquéns', respectively. They belong to the tribe Attini, the only group of ants that developed the ability to cultivate a fungus garden, the primary source of food of the larvae (Littledyke and Cherret, 1976). Thus, the leaves cut by those ants are used as a substrate for the culture of a specific fungus, which is a very complex process of cultivation involving a great number of individuals, potentially reaching a million in a single colony. This characteristic behavior differentiates the leaf-cutting ants from other species, because this fungus garden is used as an energy basis for offspring production (Littledyke and Cherret, 1976).

Of the ten *Atta* species that occur in Brazil, at least five are of great economic importance. One of them, *Atta capiguara* (Gonçalves) - (saúva-parda) - stands out for the fact that they cut grasses and sugarcane almost exclusively and present a great colonization capacity (Forti, 1985). Although they cut grasses, they present clear preferences for certain species. Vitório (1996) studying the selectiveness of *A. capiguara* for grasses, in field conditions, obtained the following decreasing order of acceptance: *Hyparrhenia rufa*, *Paspalum notatum* cv. Common, *Andropogon gayanus* cv. Planaltina, *P. notatum* cv. Pensacola, *Brachiaria decumbens, Cynodon dactylon* cv. Coast Cross, *B. brizantha*, *B. humidicula* and *Melinis minutiflora*. Also, according to the author, the grasses with low oil and wax contents, absence of crystals in the vascular bunch and with larger mesophyll area was preferred by *A. capiguara*. Lapointe et al. (1996) studying resistance of grasses to *Acromyrmex landolti* (Forel), determined different growth rates of the symbiotic fungus, when extracts of those which presented resistance in the field were included in the fungus culture. Extracts of *B. decumbens*, *B. brizantha* and *B. humidicula* had inhibitory effects on fungus growth.

Several factors affect the plant selection for the leaf-cutting ants. The anatomical, biochemical and physiologic characteristics of the different plants species appear to be related to their acceptance or rejection by the leaf-cutting ants. Prominent among the chemical factors is the production of secondary metabolites and tannin, whose amounts are related with the age (Swain, 1979), increased hardness, reduced water content and nutritional poverty of the leaf (Scriber and Feeny, 1979; Bowers and Porter, 1981). Physical factors such density, trichome type, leaf thickness, presence of latex and light exhibition are also associated with the refund rates and substrate selection (Stradling, 1978; Waller, 1982). Nutritional necessities, genetic varieties (Pretto, 1996) and distribution of palatable resources (Forti, 1985) can also influence substrate selection.

In *A. capiguara* field colonies are often observed refusing grass fragments as well as toxic baits used as control method on the mound nests. This fact

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leads to several questions about the selection process of fungus substrate, in the sense that selection happens at the moment of cutting and transport; yet there may also exist a second moment of selection inside the nest when the substrate is incorporated in the fungus garden.

Thus, the objective of the present study was to determine the devolution rates of some grass species for which *A. capiguara* presents a well-known behavior of selectiveness in the attempt of obtaining subsidies for a better understanding of the foraging behavior of this leaf-cutting ant species.

Material and methods

The experiment was done in a grassland near of Fazenda Experimental Lageado -FCA/UNESP, Botucatu, SP, in July 1997. Four colonies of *A. capiguara* were selected and marked and, in each one, was assigned to one provisioning hole presenting high foraging activity. In each selected hole were placed pieces of plastic tubes of approximately 0.5 cm in length, previously prepared with orange juice (1000 ml) and sugar (1000 g) solution and dehydrated pulp citric (2000 g), as external coating to increase the attractiveness of the material. The objective of this procedure was to verify if the selected holes really belonged to the marked colonies, as well as to verify the places where the evaluations would be accomplished. After 24 hours of the artificial pellet offering, the colonies were observed for devolution of the pellets and then mapped (Fowler et al., 1993).

The grass species used were the following ones: *Hiparrhenia rufa* (Ness) Stapf, *Paspalum notatum* Flügge, *Brachiaria humidicola* (Rendle) Schweickerdt, *Brachiaria decumbens* Stapf, *Brachiaria brizantha* (Hosh ex A. Rich) Stapf and *Saccharum officinarum* L. In addition, bait pellets without active ingredient were included as another treatment. Young leaves (not completely developed) of the mentioned species were cut in fragments of approximately 1 cm in length. The fragments were cut into various forms for differentiation of the species in the moment of the evaluations.

One hundred (100) fragments of each treatment were offered, only once, about 20 cm from the provisioning hole, beside the trail, for each colony. The evaluations were accomplished 24 and 48 hours after the fragments offering, with soil of the mound of each colony collected separately. In the laboratory, the soil was submitted to sifting with the separated plant fragments placed in Petri dishes with water (20 ml) for hydration, providing a more precise identification of their forms and, therefore, of the refused grass species. The obtained data were transformed in $(x + 0.5)^{1/2}$ and submitted to variance analysis, with the means compared by the Tukey test (5%).

Results and discussion

Four hours after the offering, it was verified that all the grass fragments had been carried inside the nests, so that rejection was not verified for any treatment. On the basis of the data obtained (Table 1), in the two evaluations (24 and 48 hours), most of the fragments were refused 24 hours after the offering of the treatments. The variance analysis, accomplished with the accumulated data and transformed in $(x + 0.5)^{1/2}$ indicated highly significant differences among the treatments. The analysis of the Table 2 reveals that the *Brachiaria* species presented, on the average, the largest devolution rates, although *B. humidicola* did not differ statistically from the other treatments. The other treatments were similar to each other, with null refund rates (*S. officinarum* and bait pellets) or statistically similar to zero (*P. notatum* and *H. rufa*).

These results showed a possible second moment of substrate selection by *A. capiguara* that probably occurs inside the nest, before its incorporation in the fungus garden.

The *Brachiaria* species used in the present work are considered resistant to the attack of the ant *A.*

Table 1. **Acumulated number of grass fragments and baits with no active ingredient refused in *Atta capiguara* colonies, after 48 hours. Botucatu-SP, Brasil, 1997.**

Treatments	Colony 1	Colony 2	Colony 3	Colony 4
B. brizantha	3	6	7	17
P. notatum	0	0	0	1
B. humidicula	4	0	4	5
B. decumbens	0	7	18	23
H. rufa	1	0	0	1
S. oficinarum	0	0	0	0
Pellets	0	0	0	0

Table 2. **Devolution mean rate (%) of grass fragments and bait pellets with no active ingredient, in four mature colonies of *Atta capiguara*, in field conditions. Botucatu-SP, Brasil, 1997.**

Treatments	Devolution mean rate[a] (%)
B. decumbens	12.00 a*
B. brizantha	8.25 a
B. humidicula	3.25 ab
H. rufa	0.50 b
P. notatum	0.25 b
S. officinarum	0.00 b
Pellets	0.00 b

a. CV = 48.99%
Tukey test DMS (5%) = 1.8016

* Different letters after devolution mean rate values show a significant difference according to the Tukey test $P < 0.05$)

landolti, with the resistance mechanism related to the inhibitory growth effect of the respective fungus garden (Lapointe et al., 1996).

In colonies of *Atta sexdens rubropilosa* Forel, as soon as the leaf fragments were taken inside the nest by the forager, several workers started a preparation process before plant incorporation into the fungus garden. Initially the leaves are licked and cut in very small fragments. At the same time, other workers transported these fragments up to the surface of the fungus culture. Subsequently, the fragments were shredded into progressively smaller pieces until they were quite small, when a new stage started, i.e., chewing of the entire borders of these fragments, which induced softening and moistening by sap exudation. The final step was the introduction of these substrates in the outermost region of the fungus culture (Andrade et al., 2002).

In young laboratory colonies of *A. capiguara*, the same procedure occurs with some differences regarding the larger size of the incorporated vegetable fragments. The beginning of the substrate preparation process, when the ants have a more direct contact with the chemical substances present in the plant, probably is the time of distinction between appropriate or inappropriate substrates for a fungus garden. On the other hand, the final disposition of the loaded and unreturned material is not known, and may have been incorporated or discarded in the garbage chambers. New studies could aid in the comprehension of those aspects.

When pellets of citric pulp are applied in recommended dosages in order to the control this species, it is common to verify return of the same ones in the mound nests to the provisioning holes. In the present experiment, there was no return of bait pellets without active ingredient, probably because amount used (100 units/colony) was much lower than the recommended commercial dosage. The hypothesis that the absence of toxin could have influenced the result can be discarded since Andrade (1997) did not detect that *A. sexdens* workers learned about the undesirable effects of toxicant substances administered in sub-dosages.

Finally, in the conditions in which the present study was developed, we may concluded that substrates selection for *A. capiguara* also happens inside the nest, and that the transporting certain substrates inside the colony does not necessarily imply its incorporation into fungus garden.

Acknowledgements

L.C. Forti gratefully acknowledge the support of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) of Brazil (Grant: 306504/88-0).

Resumen

En julio de 1997 en la estación experimental Lageado de la Universidad Estatal Paulista, en Botucatu, SP, Brasil, se realizó un trabajo de campo para observar el rechazo de hojas de varias gramíneas, desde el interior de colonias de hormigas. Se escogieron cuatro colonias de *Atta capiguara* en las cuales se colocaron, a 20 cm de distancia, a disposición 100 fragmentos de hojas de *Hiparrhenia rufa* (Ness) Stapf, *Paspalum notatum* Flügge, *Brachiaria humidicola* (Rendle) Schweickerdt, *Brachiaria decumbens* Stapf, *Brachiaria brizantha* (Hosh ex A Rich) Stapf y *Saccharum officinarum* L. Adicionalmente se colocaron cebos en forma de peletes. Las observaciones del rechazo se hicieron a las 24 y 48 horas en las entradas de cada colonia. Se encontró un rechazo diferencial de las gramíneas por la hormiga, siendo mayor en *B. decumbens* y *B. brizantha*, lo que explica la tolerancia relativamente alta de estas especies a la plaga, y una alta preferencia por *P. notatum* y *S. officinarum*.

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