

Dispersion of Seeds of Tree Species by the Leaf-Cutting Ant *Acromyrmex subterraneus molestans* (Hymenoptera: Formicidae) in Viçosa, Minas Gerais State, Brazil

by

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ABSTRACT

Leaf-cutting ants are the main pests in forest plantings, especially at the pre-cutting stage and immediately after the planting or in the beginning of sprouting. However, several genera of Formicidae are important seed dispersers, including the leaf-cutting ants *Atta* and *Acromyrmex*. The present work aimed at studying the interaction between the leaf-cutting ant *Acromyrmex subterraneus molestans* Santschi, 1925 (Hymenoptera: Formicidae) and seeds of tree species in the campus of the “Universidade Federal de Viçosa” in Viçosa, Minas Gerais, Brazil. Seeds foraged by this ant were collected daily, in September 2009, and three behaviors of interaction were evaluated: removal of the attractive structure without transporting the seed (s), removal of the seed to another place (r) and attempt to remove the seed (t). Seeds of the tree species *Copaifera langsdorfii* Desf. (Leguminosae), *Mabea fistulifera* Mart. (Euphorbiaceae), *Ricinus communis* Linnaeus (Euphorbiaceae) and *Senna macranthera* (Collad.) Irwin et Barn. (Leguminosae) were foraged.

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Seeds of the first three present external attractive structures. All the seeds of *S. macranthera* were removed, while those of *M. fistulifera* were only partially removed. *Acromyrmex subterraneus molestans* presented interaction with the seeds of myrmecochorous and non-myrmecochorous species, demonstrating low selectivity during collecting activity. This is the first record of the leaf-cutting ant *A. subterraneus molestans* dispersing seeds of tree species in Brazil.

Keywords: seeds, leaf-cutting ants, interaction, dispersion

INTRODUCTION

Leaf-cutting ants are the main pests in forest plantations (Zanetti *et al.* 2003), especially in the pre-cutting stage and immediately after the planting or in the beginning of sprouting (Zanuncio *et al.* 2004), due to their constant activity, relatively high abundance and wide distribution (Marsaro Júnior *et al.* 2007), losses, costs and difficulties of control (Moreira *et al.* 2004b; Zanuncio *et al.* 2002) and absence of efficient natural enemies (Sossai *et al.* 2005). The cutting of the leaves from the top of the plants and the removal of barks of seedlings are the main damage to tree cultures by leaf-cutting ants (Reis *et al.* 2008).

The genera *Atta* Fabricius, 1804 (Zanetti *et al.* 2008; Zanuncio *et al.* 2002) and *Acromyrmex* Mayr, 1865 (Nickele *et al.* 2009; Poderoso *et al.* 2009) are the main leaf-cutting ants, only found in the Neotropical region (Moreira *et al.* 2004a). Twenty species and nine subspecies of *Acromyrmex* (Forti *et al.* 2006) and nine species and three subspecies of the genus *Atta* have been recorded in Brazil (Delabie 1998).

Leaves are the main material foraged by leaf-cutting ants, but fruits and seeds are a significant portion of the resources used by the ants to cultivate their fungi (Dalling & Wirth 1998; Leal & Oliveira 2000). This type of interaction is known as myrmecochory (Handel & Beattie 1990) and occurs in rainforests, where there is great availability of fruits that fall from the trees and ants that forage on the soil (Pizo & Oliveira 2001). Myrmecochorous plants present seeds with a specialized appendix, named the elaiosome (Fischer *et al.* 2005; Gomez & Espadaler 1998; Passos & Oliveira 2002), which is rich in lipids attractive to the ants (Hughes & Westoby 1992; Mark & Olesen 1996).

Species of the genera *Formica*, *Myrmica* and *Aphaenogaster*, common in temperate forests of Europe and North America, and of *Rhytidoponera*, *Pheidole* and *Iridomyrmex* (Hymenoptera: Formicidae) of Australia can disperse seeds (Handel & Beattie 1990). Genera such as *Cyphomyrmex*, *Mycetarotes*, *Mycocepurus*, *Myrmicocrypta*, *Sericomyrmex* and *Trachymyrmex* and those of the leaf-cutting ants *Atta* and *Acromyrmex* (Attini) can disperse seeds in the cerrado of Brazil (Leal & Oliveira 1998).

The present work aimed at recording the role of the leaf-cutting ant *Acromyrmex subterraneus molestans* Santschi, 1925 (Hymenoptera: Formicidae) in the dispersion of seeds of tree species in a fragment of secondary forest in Viçosa, Minas Gerais State, Brazil.

MATERIAL AND METHODS

The foraging of seeds of tree species by leaf-cutting ants was observed in an area near the Forest Seed Laboratory (LASF) of the “Universidade Federal de Viçosa (UFV)” in Viçosa (20°45'S, 42°55'W), Minas Gerais State, Brazil. Every day, between 08:00 A.M. and 06:00 P.M. (Pizo & Oliveira 2000), in September 2009, seeds that were being foraged by ants were sampled and compared with the material of the LASF for plant identification. Some ants were collected, stored in flasks with alcohol 70% and sent to the Laboratory of leaf-cutting ants of the UFV for identification. The individuals were identified as *Acromyrmex subterraneus molestans* Santschi, 1925 (Hymenoptera: Formicidae).

The activity of the leaf-cutting ant *A. subterraneus molestans* as a seed disperser was evaluated according to the following behaviors: removal of the attractive structure without transporting the seed (s), removal of the seed to another place (r) and attempt to remove the seed (t). The relation between these behaviors and the size of the seeds was also evaluated. The average weight was used as a parameter of the size of the seeds (Pizo & Oliveira 2001), achieved by weighing samples of ten fresh seeds. The transport of the seeds to the nest of *A. subterraneus molestans* was also observed.

RESULTS AND DISCUSSION

Seeds of four tree species were foraged by *A. subterraneus molestans*: *Copaifera langsdorfii* Desf. (Leguminosae), *Mabea fistulifera* Mart. (Euphorbi-

aceae), *Ricinus communis* Linnaeus (Euphorbiaceae) and *Senna macranthera* (Collad.) Irwin et Barn. (Leguminosae). The first three species present seeds with external structures attractive to ants (Leal & Oliveira 1998; Martins *et al.* 2006; Peternelli *et al.* 2009; Webster 1994), typical of myrmecochorous species (Handel & Beattie 1990). The seeds of *S. macranthera* do not present external attractive structures, but even seeds of non-myrmecochorous species may be rich in lipids, proteins and carbohydrates and, therefore, they may also be attractive to ants. However, this kind of interaction is still poorly known (Pizo & Oliveira 2001).

The foraging of seeds by *A. subterraneus molestans* demonstrates their significance for leaf-cutting ants, since attractive structures of myrmecochorous seeds are used as substrate for the cultivation of the symbiotic fungus of these insects (Leal & Oliveira 1998) and to feed their larvae (Christianini *et al.* 2007; Fischer *et al.* 2005). Additionally, they present substances which are easily metabolized by the larvae and important for the biosynthesis of acids not synthesized by Hymenoptera, such as linoleic and linolenic acids (Fischer *et al.* 2008). During foraging, the ants recognize nonvolatile lipids of these structures (Youngsteadt *et al.* 2008) through chemoreceptor sensilla located in the insect antennae (Azevedo *et al.* 2008). However, non-myrmecochorous seeds, such as those of *Senna macranthera*, do not present these compounds (Fischer *et al.* 2008; Hughes *et al.* 1994) and their recognition occurs by volatile organic compounds (Youngsteadt *et al.* 2008) that act similarly to cuticle hydrocarbons in the communication between ants (Serrão *et al.* 2009). Thus, the non-myrmecochorous seeds are not recognized after the complete volatilization of the compounds in the environment, which explains the foraging of seeds of a high number of myrmecochorous plants.

The attractive structures of the seeds of *C. langsdorffii* and *R. communis* was removed by the worker ants of *A. subterraneus molestans* because they are too big to be carried (Table 1). This may occur because large seeds demand more time and energy to be carried, which exposes the ants to competition and natural enemies (Christianini *et al.* 2007). On the other hand, all the seeds of *S. macranthera* were removed from the location and carried to the nest. Three interactions were observed between *A. subterraneus molestans* and seeds of *M. fistulifera*, but few seeds were removed to the nest by the ants, presumably because they were also difficult to carry.

Table 1- Behavior of the leaf-cutting ant *Acromyrmex subterraneus molestans* (Hymenoptera: Formicidae) according to the size of the seeds of each plant. Viçosa, Minas Gerais, Brazil. *s= remove the attractive structure without transporting the seed; r= remove the seed to other place; t= try to remove the seed.

Tree plant species	Family	Behavior	Seed weight (g)
<i>Copaifera langsdorfii</i>	Leguminosae	s*	0.786 ± 0.117 a**
<i>Mabea fistulifera</i>	Euphorbiaceae	s, r, t	0.089 ± 0.015 c
<i>Ricinus communis</i>	Euphorbiaceae	s	0.643 ± 0.039 b
<i>Senna macranthera</i>	Leguminosae	r	0.052 ± 0.003 c

**Averages followed by the same letter do not differ by the Tukey test (p< 0.05).

Only small seeds (*M. fistulifera* and *S. macranthera*) were dispersed by *A. subterraneus molestans*. Large seeds (*C. langsdorfii* and *R. communis*) were not dispersed, but their attractive structures were removed by the ants. These results indicate that the ants presented a higher selectivity to the size rather than to the type of seeds (myrmecochorous or non-myrmecochorous). Leaf-cutting ants are not preferably dispersers of seeds (Milesi & Casenave 2004), but those of the genus *Acromyrmex* disperse seeds of several tree species, such as *M. fistulifera* (Paternelli *et al.* 2009), *Ocotea pulchella* Mart. (Lauraceae), *Prunus sellowii* Koehne (Rosaceae), *Virola sebifera* Aubl. (Myristicaceae) (Leal & Oliveira 1998) and *Psidium cattleianum* Sabine (Myrtaceae) (Passos & Oliveira 2003).

Acromyrmex subterraneus molestans damages tree species, but plays an important role in forest dynamics. Besides dispersing small seeds, it helps the germination process, reduces the incidence of fungi and the attack of predators by removing the attractive structures of the larger seeds (Leal & Oliveira 1998).

This is the first record of the leaf-cutting ant *A. subterraneus molestans* dispersing seeds of tree species.

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