Sociobiology 60(1): 20-29 (2013)

Sociobiology
An international journal on social insects

RESEARCH ARTICLE - ANTS

Spatial Distribution and Architecture of *Acromyrmex landolti* Forel (Hymenoptera, Formicidae) Nests in Pastures of Southwestern Bahia, Brazil

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Article History
Edited by:
Edilberto Giannotti, UNESP - Brazil
Received: 24 October 2012
Initial acceptance: 21 November 2012
Final acceptance: 11 March 2013

Keywords
negative binomial, chambers, depth, channels

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Abstract

Ants of the genera *Atta* and *Acromyrmex* (Myrmicinae: Attini) are in general pests for agricultural and pasture areas. In southwestern Bahia pastures, in Brazil, *Acromyrmex landolti* Forel occurs at intermediate densities of 260 nests ha^{-1}. In spite of its economic importance, there is not enough research on the bioecological aspects of such species. This paper aims to study the spatial distribution and the architectural pattern of *A. landolti* nests, as well as to establish the foundations for the improvement of strategies for controlling the pest. The research was carried out during the period of June 2011 and May 2012, in an area of pastures measuring 2.7 ha, in Itapetinga, in Bahia. Twenty five nests were selected. The external mound area, height of the tower, distance between the tower and the external mound area, as well as the tower diameter were all registered. In order to describe the internal architecture, the same nests were completely excavated and five were molded in cement. The spatial distribution of the nests is of aggregated type. The towers height is 2.1 cm and the mean diameter is 1.2 cm. The amount of loose soil is of about 8.0 cm from the tower, with an mean area of 472.9±312.5 cm² and mean volume of 1.4 ± 0.9 l. The depth of the nests varies between 7.0 and 78.0 cm, with an mean of 33.2±21.29 cm. The nests have, in mean, 4.4±2.0 chambers, being two nests with just one chamber (8%) and another nest (4%) with 11 chambers. The highest frequency of chambers (73.6%) occurs in the first 5-10 cm depth. The closest chambers have tunnels of 0.5 cm in length, and 23% of the tunnels measure 1.0 cm in length, with up to 44.7% of the tunnels measuring up to 30 cm. The mean dimensions of the chambers are: width: 6.2 cm; height: 5.1 cm; and length: 5.7 cm. The majority of the chambers are located near the entrance holes.

Introduction

The ants (Hymenoptera: Formicidae) are insects which present a vast taxonomic diversity and occupy a great variety of ecological niche and frequently spread out and become dominant in all habitats of the globe (Hölldobler & Wilson, 1990; Wilson & Hölldobler, 2005). One of the biological characteristics which explains this extraordinary ecological success is partly due to its great capacity of modifying or exploring its environment for nests construction (Hölldobler & Wilson, 1990; Passera & Aron, 2005).

The tribe Attini groups the ants which cultivate fungi and are exclusive to the New World, which adds up to a total of 15 genera and 297 valid species (Bolton et al., 2006; Brandão et al., 2011). The genera which derive from this species, *Atta* and *Acromyrmex*, comprise the real leaf-cutting ants, because they use fresh parts of plants to cultivate their symbiotic fungi reaching the status of agricultural pest in silvicultural and pasture areas. The leaf cutting ants are highly specialized in selecting the plant substrate and in the construction of the nests, with greater structural complexity in the *Atta* species (Forti et al., 2011).

Among the species of the genus *Acromyrmex*, which specialized in grass cutting, we can refer to *Acromyrmex*

Open access journal: http://periodicos.uefs.br/ojs/index.php/sociobiology
ISSN: 0361-6525

landolti Forel and *Acromyrmex balzani* Emery by its vast geographic distribution and damages caused to pastures. *Acromyrmex balzani* was initially described as subspecies of *A. landolti* and later was taken to the category of species by Fowler (1988). They are very similar species, in the morphological aspects of its workers and in the habits of foraging nest construction. Such species construct relatively small nests, however, they generally occur in high densities, causing damage to pastures (Gonçalves, 1961; 1967, Mariconi et al., 1963; Amante, 1967 a, b). In Venezuela it was registered densities of 1,000 and 6,000 nests ha^{-1}(Labrador et al., 1972; Espina & Timaure, 1977) whereas in Paraguay *Acromyrmex landolti fracticornis* Forel may reach a density of 4,400 nests ha^{-1} making it impossible for ranchers to breed cattle in the infested areas (Fowler & Robinson, 1977). In the state of Bahia, Brazil, 900 nests ha^{-1} were found for the specie *A. balzani* (Lewis, 1975).

The nests of leaf-cutting ants can present a casual or uniform spatial distribution in *Atta*, in areas with smaller or bigger density rate of nests, respectively (Caldeira et al., 2005). For nests of *Acromyrmex* spp. casual distributions was already registered (Cantarelli et al., 2006), while aggregated distribution was registered for *A. balzani* (Caldato, 2010).

Ants of the genus *Acromyrmex* build their nests in an even simpler way compared with the species of the genus *Atta*, which usually has a small number of chambers. Similarities and differences observed in the architecture of the nests, between genera of Attini (Weber, 1972), also occur between the *Acromyrmex* species of the *Moellerius* group. While most of these species have a typical tube straw surrounding the hole tunnel of the nest, with a unique vertical tunnel, interconnecting the various rounded chambers, the nests of *Acromyrmex heyeri* (Forel, 1899) present an amount of loose soil with two or three entrances, with several vertical tunnels connected to a unique chamber located at depth of approximately 40 cm (Gonçalves, 1961). In *A. balzani*, Mendes et al. (1992) found a total of six chambers and registered a maximum depth of 1.2 m, whereas Silva et al. (2010) found a maximum of fourteen chambers, placed in a depth of 2 m, and the majority of an ellipsoid type. Still regarding this species, the greatest amount of chambers are in the first 30 cm placed in the projection of the loose soil. The ant *A. landolti* build nests with two or three chambers overlapping and linked by a vertical gallery (Weber, 1972).

There is not enough research about the effects of the ant *A. landolti* to the conditions of the Brazilian pastures. On the other hand, it is known that other *Acromyrmex* species, specially *A. balzani*, share similarities in morphological aspects, its workers, foraging habit and nest construction. Therefore, the aims of this paper were: a) to investigate the spatial distribution and architecture of nests of this species in pasture areas in Southwestern Bahia, Brazil, and b) to compare the found characteristics with those already reported for other *Acromyrmex* species. We hope to contribute to improve the foundations of management strategies of *A. landolti* nest spreading in Southern Bahia pastures.

Material and Methods

The experiment was carried out in the period from July 2011 to April 2012, in the farm "Lagoa de Alagoinhas", in the municipality of Itapetinga, Bahia, in Northeastern Brazil. The farm is located at the height of 15°21'S and 40°17'W. It is a rural area mainly taken by extensive cattle pastures (*Brachiaria* sp., Poaceae) with 2.7 ha, having a sub-humid mean annual rain fall of 867 mm and mean temperature of and 25.4◦C. The area of investigation is part of the geomorphological unit known as Depression of Itabuna-Itapetinga, where the type of greatest distribution is the "Chernossolos Argilúvicos Órticos", which correspond to the internal area of the depression, with soils which are imperfectly drained, shallow and rarely deeper than 70 cm. This soil also has high rates of silt and primary minerals (Nacif, 2000).

In order to carry out the research on spatial distribution, the nests of *A. landolti* were located, identified with stacks and geo-referenced by using a GPS (Global Position System) device. Then, a map was generated with the identification of each nest. The map was subdivided in samples of 10 m x 10 m making a total of 270 quadrants of 100 m². The data were submitted to an analysis of dispersion rates to verify which types of spatial distribution of the nests occur in the area. The indexes of dispersion used were the mean/variance ratio or index of dispersion (I) and the index of dispersion of Morisita (Iδ) (Davis, 1993).

For the description of the external structure, twenty nests were randomly selected respecting the following criteria: 1) nest activity - verified by means of the presence of the ants in the entrance holes and the presence of recent loose soil; 2) all selected nests were observed belonging to a set of nests locally organized in nucleus. The following nest characteristics were registered: the measurement of the area of loosen soil distance, height of the tower of the entrance hole to the center of the area of loose soil and its diameter. The amount of loose soil around each nest was collected, stored in plastic bags, identified and taken to the laboratory of Animal Biosystematics LBSA/UESB in order to establish their volumes by using a beaker.

In order to study the internal architecture, the same nests for which external area was investigated, were excavated by means of the procedure described by Moreira et al. (2003, 2004 a, b), plus five other nests (adding to a total of twenty five) selected following the two criteria mentioned above. The five extra nests were molded with cement. The excavation started with the opening of a trench, 140 cm long, 80 cm wide and having a depth of 100 cm, with the center of its side wards border at 25 cm from the entrance hole. Afterwards, by using a compass, and having as a central point the centre of the loose soil, the four cardinal points were marked by the use of fine cords 4 m long, fixed in stacks. The spatial location of the chambers were determined in relation to the axes x (East/West) and y (North/South), to the amount of loose soil as well as to the foraging hole. After applying neutral powder in the foraging hole, by using a manual device, the excavation was carried out from the entrance hole till the chambers and channels. The following measures of the chambers and channels were registered: height, width and length, position in relation to the axes x and y.

The real volume of each chamber was determined by using a plastic bag which involved the whole room of the chamber internally, within which it was injected enough water to fill up all the internal space of the chamber, by means of a beaker. The estimated volume of the chamber was calculated according to the mathematical models of ellipsis and spherical forms.

In order to make cement mould of the nests, the procedures described by Moreira et al. (2004 a, b) were adopted. A mix of 5 kg of cement and 10 L of water was injected, by means of a funnel, in the nest entrance hole till the saturation point. After seven days, the nests were excavated and the measures of the chambers and tunnels were registered. The mean values and deviation rates were also calculated upon the data collected.

Results

A total of 701 nests of *A. landolti* was registered in the study area (Fig. 1). The obtained Morisita Index (Iδ) was 1.53, the index of dispersion or mean/variance ratio (I) was 2.39, confirming a contagious distribution (binomial negative) that characterizes the aggregation of the nests. In each investigated nest of *A. landolti* it was found only one entrance tunnel, despite the existence of up to six towers interconnected. The mean height of towers was of 2.1±0.69 cm, with a minimum height of 1.0 cm and a maximum of 4.0 cm, while the mean diameter found was of 1.2±0.3 cm, with a minimum diameter of 0.7 cm and a maximum of 1.5 cm (Table 1). The amount of loose soil was registered at a mean distance of 8.0±4.5 cm from the entrance to the nest tower, with a minimum distance of 2.0 cm, and a maximum of 20.0 cm. The area of the loose soil measured 472.9±312.5 cm², ranging from 116.3 cm² to 1,600.0 cm², with a mean volume of 1.4±0.9 L, with variation from 0.3 L to 4.8 L. The nests had a maximum depth of 78.0 cm and a minimum of 6.0 cm (Table 2), with mean depth of 33.2±21.29 cm and 98% of the nests being less than 60 cm deep.

In the 25 nests that were excavated, the mean number of the chambers found was of 4.4±2.0, two nests (8.0%) having only one chamber and one nest with 11(4.0%) chambers. The most of the nests with 11 (4.0%) have from 3 to 6 chambers (Table 2). The chamber with the smallest depth was found at 0.5 cm below ground level. Most of the chambers were encountered before 20 cm in depth (73.6%), with 33 of them built between 5 and 10 cm. No chamber was found between 30 and 35 cm of depth, and also between 60 and 70 cm (Fig. 2).

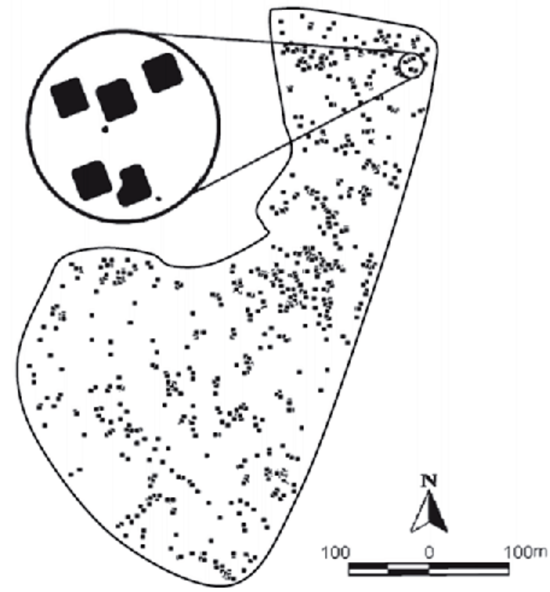

Figure. 1. Aggregated distribution map of the nests of Acromyrmex landolti in the study area (2.7 ha) in Itapetinga-BA, Brazil, 2012 (15°21'3.87"S / 40°17'29.07"W).

The mean width of the chambers was 6.2±7.2 cm (1.5-18.0 cm), the mean height 5.1±2.3 cm (1.5-11 cm) and the mean length 5.7± 2.8 cm (1.5-17 cm) (Table 2). The biggest chamber measured 18.0 cm in width, 10.0 cm in height and 12.0 cm in length. On the other hand, the smaller chamber measured 1.5 cm long (Table 2).

As for the twenty nests marked with neutral powder, the maximum depth registered was 58 cm and the chambers found up to 45 cm in depth were full of fungi, brood and adults. All the chambers located up to 10 cm deep had eggs, larvae and adult ants and there were empty chambers only from this depth onwards. The chambers with soil were found from 25 cm deep onwards, except for the depth interval between 45 cm and 55 cm in depth (Fig. 3). The closest chambers were connected by tunnels measuring 0.5 cm of length. We observed that 23% of the chambers had tunnels with 1.0 cm in length and 44.7% had tunnels measuring up to 3.0 cm of length. In total 85 tunnels were found connecting chambers (Fig. 4).

There was a great variety of real volume of the chambers, from 19.0 mL to 1,335.38 mL, establishing a standard deviation larger to its own mean (223 ± 295.4). The greatest similarity of the chambers, in general, occurred with the spherical form (Table 3). However, considering only the four nests that were similar based on the number of chambers (21 in total), we observed that other forms of chambers seems to occur as evidenced by the expressive lack of fit of chamber geometry to the tested models (sphere or ellipsoid).

As far as the spatial distribution of chambers is con-

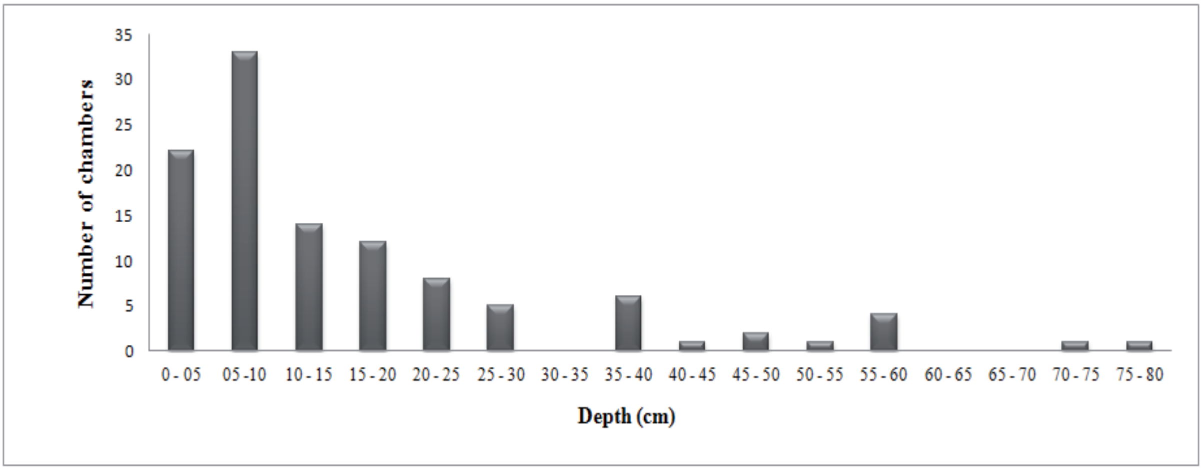

Figure. 2. Frequency of the vertical distribution of the chambers in 25 nests of *Acromyrmex landolti* (n = 110). Itapetinga, BA, Brazil, 2012.

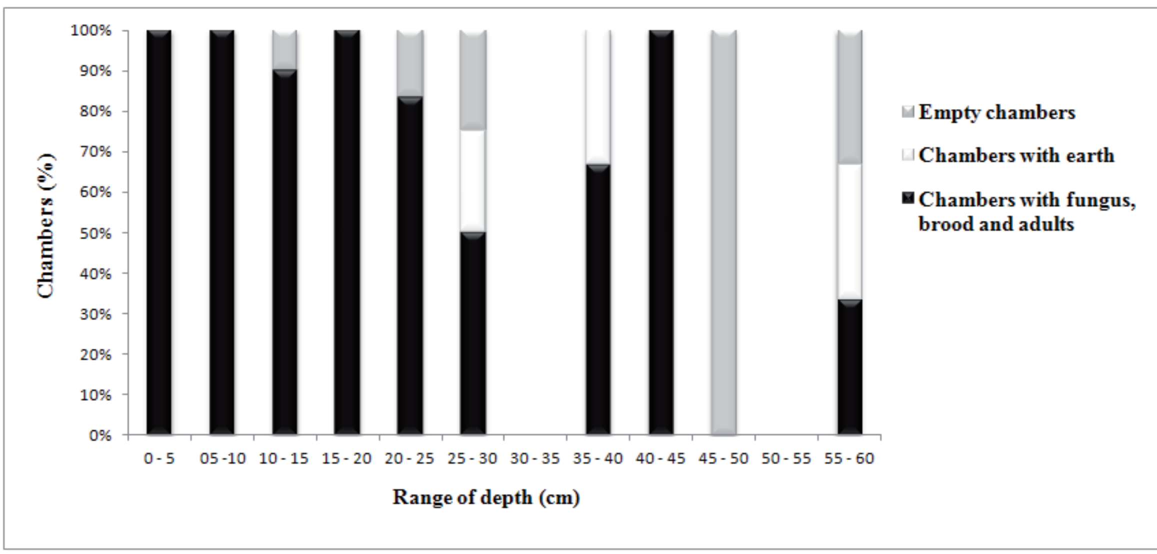

Figure 3. Percent (%) average of empty chambers with fungus and soil, and creates adult, 20 nests of *Acromyrmex landolti* at different depths. Itapetinga, BA, Brazil, 2012.

cerned, in relation to the axes x and y, the data show that in the majority of nests the chambers are near the entrance hole. Furthermore, the same nests had chambers between the hole and the amount of loose soil, with chambers located before the foraging hole or even sidewards in relation to such hole position (Fig. 5).

Discussion

The aggregated spatial distribution of *A. landolti* nests found in this research was also verified for *A. balzani* in pastures of São Paulo State, Brazil (Caldato, 2010). Nevertheless, nest distribuition differed from the spatial distribution of *Acromymex* spp. nests observed in Argentina, which followed the Poisson model (Cantarelli et al., 2006).

Several factors influence directly or indirectly the spatial distribution of ant nests. For instance, the presence of competitors can be highlighted (Hölldobler & Wilson, 1990), habitat complexity, edaphic condition, climate change (Fowler, 1983) as well as the composition and spatial distribution pattern of the existing vegetation in the nesting area (Zanetti et al., 2000).

In *Acromyrmex striatus* Roger, the influence of such factors is observed in the choice of type of soil by the recently fertilized females during the nest foundation, in the definition of success and in the abundance of the species. It was reported a higher density of colonies in areas of exhausted soil than in areas of natural fertile soil (Diehl-Fleig & Rocha, 1998).

In order to explain the trend towards aggregated distribution of nests of *A. balzani*, Mendes et al. (1992) worked on the hypothesis that there are "marks" of positive conditions derived from the presence of types of grass preferred by this species, a factor that shows clear influence of vegetation cover in the spatial distribution of nests.

The same hypothesis can be considered to explain the aggregation of nests of *A. landolti*. In support of this hipothesis we call attentions on the fact that the pastures in the

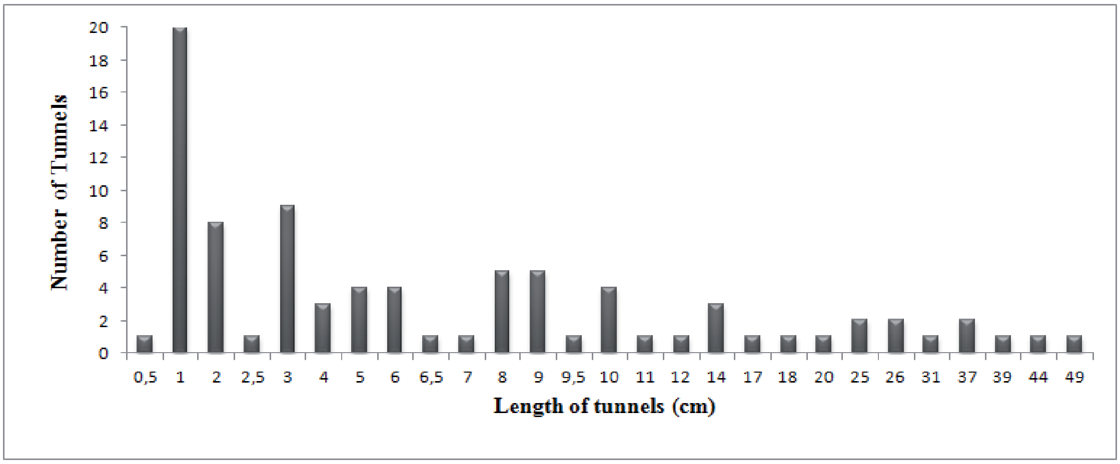

Figure 4. Length distribution of tunnels 85 acromyrmex landolti 25 nests in Itapetinga-BA, 2012.

Southwest of Bahia are not very uniform in the "varietal" composition of grass stands, besides being subject to disturbances, such as overgrazzing and regular fires can contribute to the presence of such "marks" with more adequate vegetation substrate.

There was a great variety of dimensions in the external structure of nests. It was also confirmed the presence of an entrance hole in each nest, despite the existence of nests with up to six interconnected towers, what matches with other data for *A. balzani* (Mendes et al., 1992; Andrade, 1991, Pimenta et al., 2007; Silva et al., 2010). The typical tower found in *A. landolti* nests, is probably a mechanism that regulates the temperature and the internal humidity of the colony, thus protecting the nest entrance against changes of temperature and other climate factors, and invasion of predators (Perdomo, 2008).

The distance of the tower to the amount of loose soil in the nests of *A. landolti* was in mean (8.0±4.5 cm) smaller than the recorded mean for the nests of *A. balzani*, in Botucatu, São Paulo (Caldato, 2010). Moreover, the mean area

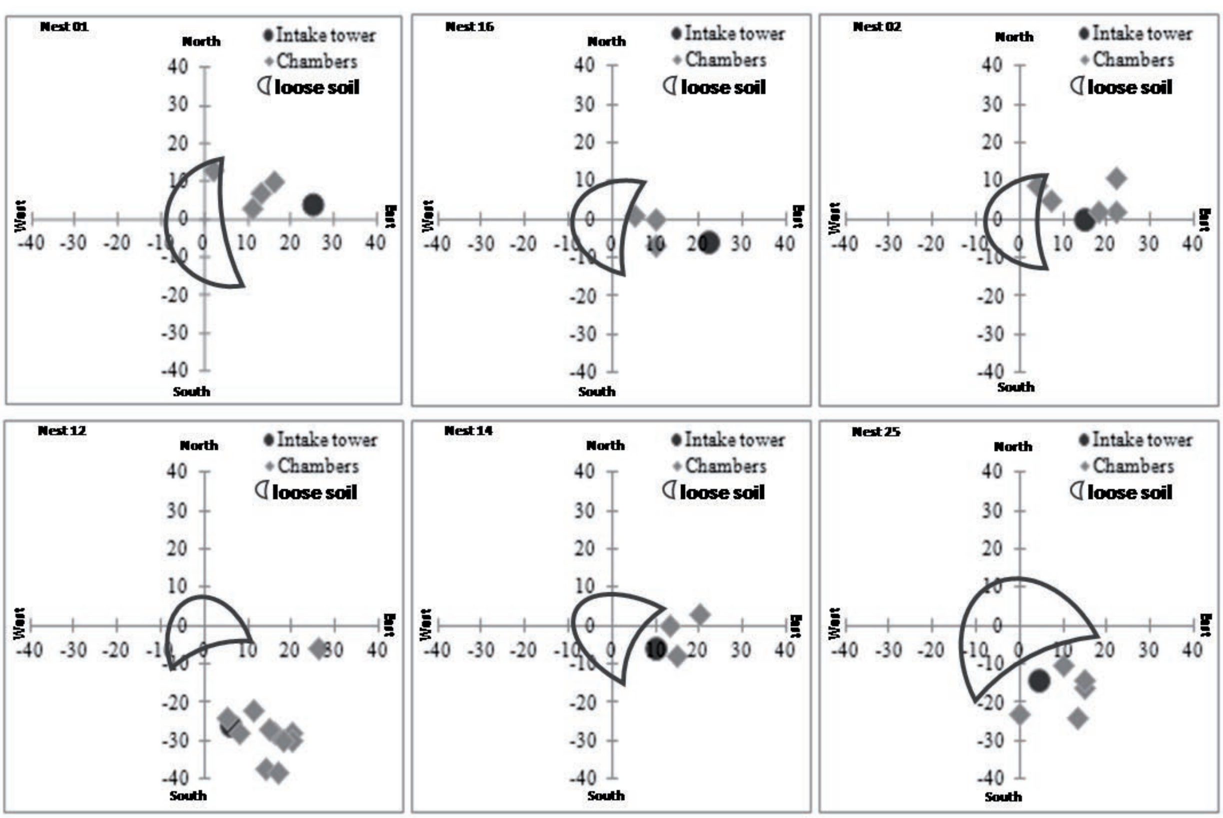

Figure. 5. Schematic drawing of the boundary area of loose soil, the arrangement of the intake tower and the chambers relative to loose soil nests of *Acromyrmex landolti*: N01 and N16-chambers arranged between the area of loose soil and inlet pipe, N02, N12, N14 and N25 - most chambers disposed before and sides of the tower. Itapetinga, BA, Brazil, 2012.

of the loose soil was 472.9±312.5 cm², ranging from 116.3 cm² to 1,600.0 cm², with a mean volume of 1.4±0.9 L, with variation of 0.3 L to 4.8 L.

In a general perspective, comparing our results with those of Silva et al. (2010), we observe that the area and the volume of loose soil of the nests of *A. landolti* are respectively 73% and 52% smaller than those of *A. balzani*. Manufacturers of bait pesticides use area of loose soil to calculate the doses of such pesticide to control cutting-ants from 8 to 10g of bait/m^2 to *Atta* and of 8 to 10 g/nest to *Acromyrmex*, which has smaller nests. Considering that, in mean, the area of loose soil of *A. landolti* was of 472.9 cm^2, with only one nest with area greater than 1 m² (N3) (Table 1), the recommendation implies over dosage of the product, leading to a non-usage of baits or to the return of the dosage to the amount of loose soil. This could increase the possibilities of adverse effects on the non-target mirmecofauna.

Nests of *A. landolti* are less deep in relation to those of *A. balzani*, with maximum depth of 78.0 cm, whereas for *A. balzani* there are records of nests of up to 210 cm (Silva et al., 2010), 160 cm (Caldato, 2010), 124 cm (Mendes et al., 1992), 95 cm (Pimenta et al., 2007) and 60 cm (Gonçalves, 1961) of depth. Similarly, the nests of *A. landolti* have their first chamber almost at the same level of the ground (from 1.5 to 9 cm deep in the soil), whereas in the case of *A. balzani*, the depth of the first chamber ranges from 4.0 (Caldato, 2010) to 30 cm (Silva et al., 2010), suggesting that the upper chamber of the nest is more superficial in the former species.

The highest frequency of the chambers was registered in the first 20 cm of depth (Fig. 2), and chambers between 30 and 35 cm were not found. Between 60 and 65 cm and 65 to 70 cm, just one record since 98% of the nests presented depth inferior to 60 cm. The differences between the two species may be due to the specific preferences in edaphoclimatic conditions according to their nesting habits (Forti et al., 2011), and to distinct local conditions for nesting in the study areas above cited.

In nests of leaf-cutting ants, the number of chambers, as well as its occupation, varies as a function of many factors, such as age of the nest, site of nest construction, among others. It is possible that there exists a pattern for internal architecture of *A. landolti* nests, with three to six chambers, since 88% of excavated nests had in mean, 2.3 chambers (Soares et al., 2006), while for *A. balzani* there are records varying from 3 to 6 and from 3 to 14 chambers with an mean of 8.6 chambers per nest (Silva et al., 2010). Caldato (2010) registered the polydomy in *A. balzani* calling each unit of a nest of a subnest, totaling, in some cases, eight subnests and until 33 chambers in a single nest. Considering the close phylogenetic relationships between *A. balzani* and *A. landolti*, the hypothesis of polydomy nest must be investigated for *A. landolti*.

It was observed that three of the studied nests of *A. landolti* had chambers interconnected between them by tunnels distinct of the vertical one. This suggests that this ant has a relative plasticity in the architecture of its nests, building structures adapted to provide better conditions for the colony. This result differs from other ones relative to several *Acromyrmex* species that were reported to have nests with a unique vertical tunnel that interconnect the chambers (Weber, 1972; Mendes, 1990; Soares et al., 2006; Caldato, 2010).

The differences in nest chamber dimensions show the inexistence of a pattern, the same result found for nests of *A. balzani* located in Bahia (Silva et al., 2010), São Paulo and Rio Grande do Sul (Gonçalves, 1961), Minas Gerais (Mendes et al., 1992) and Goiás (Pimenta et al., 2007).

Regarding the occupation of the chambers, those with fungi, eggs, pupas and adults were found up to 30 cm deep (Fig. 3), while chambers containing soil where noted below 25 cm. No chamber containing trash was observed since this ant deposits the trash out of the nest, near the amount of loose soil. This result is in agreement with Caldato (2010) for *A. balzani*, which presented the biggest amount of chambers in the first 30 cm, with predominance of fungi.

The volume of the nest chambers of *Acromyrmex* is very variable, not only within a species but also between species. In our study we found chambers of *A. landolti* with a minimum volume of 19 mL (Nest 10) and maximum of 1,335 ml (Nest 18), with mean of 91.5±65.0 ml (N10) and 509.3±436.9 ml (N18). Silva et al., (2010), for *A. balzani*, with registers of bigger mean volume of 205.5±142.1 ml, with bigger volume 25 ml and smaller 31 ml. Mendes et al. (1992), for the same species, estimated a volume of 910.1 ml, in mean, whereas Pimenta et al. (2007) recorded 1435.8 ml for the bigger and 3.6 ml for the smaller chamber of *A. balzani*, resulting in a great difference in bigger volumes as well as for *A. landolti*.

It was not possible to establish a pattern for the chambers of *A. landolti* based on the tested models (sphere and ellipsoid) since the relationship among real values and estimated ones were distant in 1.0 ml in the majority of cases. Many authors consider the ellipsoid form as the most common one for *A. balzani* (Mendes et al., 1992; Pimenta et al., 2007; Poderoso et al., 2009; Silva et al., 2010). However, by observing the data presented for 21 chambers of 4 nests only 42,9% of the chambers presented similarity to the spherical form, characterizing the fact that other forms of chambers were found that are not adjusted to the models compared, therefore not allowing a possible estimate of a pattern.

For most of the nests of *A. landolti*, the chambers are located between the foraging hole and the amount of loose soil (N01 and N16 of in Fig. 5) or in the proximity of the foraging hole. However, it was observed the ocurrence of chambers radially distributed from the principal tunnel that presents an inclined orientation (N02 in Figure 5) or situated before and laterally in relation to the entrance tunnel (N12,

Table 1. Distance from tower to loose soil (cm), tower height (cm), tower diameter (cm), loose soil area (cm²) and volume of loose soil (L) in twenty nests of *Acromyrmex landolti*. Itapetinga, BA, Brazil, 2012.

Nests	Distance from tower to loose soil (cm)	Tower height (cm)	Tower diameter (cm)	Loose soil area (cm²)	Volume of loose soil (L)
N1	09.5	1.5	1.5	432.0	1.3
N2	06.0	2.0	1.5	308.0	0.9
N3	06.0	2.0	1.0	1600.0	4.8
N4	10.0	1.5	1.3	300.0	1.0
N5	06.0	2.0	1.0	493.0	1.5
N6	06.0	2.5	1.0	608.0	1.8
N7	04.0	1.5	1.0	558.0	1.7
N8	04.0	2.0	1.5	441.0	1.3
N9	04.0	1.0	1.0	425.0	1.3
N10	08.5	2.5	1.5	720.0	2.2
N11	07.0	2.0	1.3	429.0	1.3
N12	17.0	2.0	1.0	116.3	0.3
N13	20.0	3.0	1.0	476.0	1.5
N14	05.0	2.5	1.5	180.0	0.5
N15	05.0	1.5	0.8	496.0	1.5
N16	12.0	4.0	1.5	198.0	0.6
N17	08.0	2.5	1.5	440.0	1.3
N18	12.0	3.0	1.0	700.0	2.1
N19	02.0	1.5	0.8	200.0	0.7
N20	07.0	2.0	0.7	338.0	1.2
Mean	08.0	2.1	1.2	472.9	1.4
Standard deviation	04.5	0.7	0.3	312.5	0.9
Minimum	02.0	1.5	0.7	116.3	0.3
Maximum	20.0	4.0	1.5	1600.0	4.8

Table 2. Mean, standard deviation (S), maximum (Max.) and minimum (Min.) of chamber dimensions (width, height and length), and depth of nests of *Acromyrmex landolti*. Itapetinga, BA, Brazil, 2012.

Nests	Depth (cm)	Number of Chambers	WIDTH (cm)				HEIGHT (cm)				LENGTH (cm)			
			Mean	S	Max.	Min.	Mean	S	Max.	Min.	Mean	S	Max.	Min.
N1	58	4	6.1	1.8	7.0	3.5	6.5	2.5	9.0	3.0	6.6	2.3	9.0	3.5
N2	40	5	5.4	2.3	8.0	3.0	3.4	0.9	5.0	3.0	6.5	2.5	9.0	3.5
N3	36	3	9.7	3.5	13.0	6.0	6.7	2.5	9.0	4.0	9.7	2.1	12.0	8.0
N4	58	6	4.8	1.2	7.0	3.5	4.0	1.3	6.0	2.5	5.1	2.0	7.5	2.5
N5	21	6	5.1	1.6	7.0	3.5	3.3	0.6	4.0	2.5	4.7	2.8	8.5	2.5
N6	23	4	6.5	2.5	10.0	4.0	5.8	2.6	8.0	3.0	5.0	1.8	7.0	3.0
N7	7	1	8.0	-	8.0	8.0	8.0	-	8.0	8.0	10.0	-	10.0	10.0
N8	8	1	7.0	-	7.0	7.0	8.0	-	8.0	8.0	9.0	-	9.0	9.0
N9	18	4	5.3	1.7	7.0	3.0	4.6	2.2	7.0	2.5	6.1	1.3	7.5	5.0
N10	50	4	5.5	2.9	9.0	2.0	4.0	1.7	5.0	1.5	5.1	1.7	7.0	3.5
N11	18	6	4.9	2.2	9.0	3.0	3.7	2.1	7.0	2.0	4.5	2.5	9.0	2.0
N12	42	11	4.8	1.5	8.0	3.0	4.0	1.0	5.0	2.0	4.4	1.4	6.0	1.5
N13	8	6	5.3	3.1	10.0	1.5	5.2	3.2	9.0	2.0	5.6	3.5	10.0	2.0
N14	16	3	6.2	2.5	9.0	4.5	6.7	2.1	9.0	5.0	5.8	2.3	8.0	3.5
N15	27	3	5.2	0.8	6.0	4.5	4.8	2.0	7.0	3.0	6.3	1.2	7.0	5.0
N16	6	3	7.3	4.5	12.0	3.0	6.0	3.6	10.0	3.0	4.7	3.1	8.0	2.0
N17	19	3	6.8	2.3	9.0	4.5	7.2	2.8	10.0	4.5	8.7	3.5	12.0	5.0
N18	30	6	8.0	1.4	10.0	6.0	6.5	2.4	11.0	4.0	9.0	4.4	17.0	5.0
N19	14	3	5.8	3.3	9.0	2.5	4.2	1.4	5.0	2.5	5.3	3.1	8.0	2.0
N20	23	6	5.7	1.5	7.0	3.0	4.9	1.7	6.0	2.5	5.8	2.3	8.0	2.0
N21	45	4	5.3	1.6	7.0	3.5	5.5	2.0	8.0	3.5	4.1	0.6	5.0	3.5
N22	78	3	4.7	0.6	5.0	4.0	4.8	1.0	6.0	4.0	3.3	0.6	4.0	3.0
N23	74	6	6.0	3.8	11.0	1.5	5.5	3.1	10.0	2.0	4.2	2.6	8.5	1.5
N24	56	4	6.8	4.6	12.0	2.0	6.6	3.4	11.0	3.0	5.6	3.7	10.0	1.5
N25	55	5	9.4	5.2	18.0	5.0	7.4	1.8	10,.0	5.0	6.9	3.2	12.0	3.5

Table 3. Real and Estimated volume (ml) by geometric similarity of the sphere and ellipsoid and the relationship between real and estimated volume (V1/V2 and V1/V3), mean, standard deviation (S), maximum (Max.) and minimum (Min.) four nests of *Acromyrmex landolti*. Itapetinga, BA, Brazil, 2012.

Nest	Chambers	Volume of real chambers (V1)	Ellipsoid volume (V2)	Sphere Volume (V3)	V1/V2	V1/V3
N2	1	141	75.4	95.3	1.9	1.5
	2	289	99	133	2.9	2.2
	3	218	167.6	179.6	1.3	1.2
	4	34	16.5	16.6	2.1	2.0
	5	47	18.8	19.4	2.5	2.4
	Mean	145.8	75.5	88.8	2.1	1.6
	S	109.5	62.7	71.2	0.6	1.5
	Maximum	289	167.6	179.6	2.9	1.6
	Minimum	34	16.5	16.6	1.3	2.0
N5	1	32	13.1	14.1	2.4	2.3
	2	30	13.7	14.1	2.2	2.1
	3	40	18.8	19.4	2.1	2.1
	4	196	124.6	143.8	1.6	1.4
	5	183	117.3	133	1.6	1.4
	6	51	27.5	29.5	1.9	1.7
	Mean	88.7	52.5	59	2	1.5
	S	78.6	53.3	61.9	0.4	1.3
	Maximum	196	124.6	143.8	2.4	1.4
	Minimum	30	13.1	14.1	1.6	2.1
N10	1	96	62.8	65.4	1.5	1.5
	2	176	148.4	167.1	1.2	1.1
	3	19	5.5	6.7	3.5	2.8
	4	75	78.5	79.4	1	0.9
	Mean	91.5	73.8	79.7	0.6	1.1
	S	65	58.8	66.3	1.1	1.0
	Maximum	176	148.4	167.1	3.5	1.1
	Minimum	19	5.5	6.7	1	2.8
N18	1	172	91.6	95.3	1.9	1.8
	2	660	345.6	381.7	1.9	1.7
	3	1335	881.2	982.3	1.5	1.4
	4	300	131.9	133	2.3	2.3
	5	284	117.3	133	2.4	2.1
	6	305	201.1	206.5	1.5	1.5
	Mean	509.3	294.8	322	1.9	1.6
	S	436.9	301.5	339.3	0.4	1.3
	Maximum	1335	881.2	982.3	2.4	1.4
	Minimum	172	91.6	95.3	1.5	1.8

N14 e N25 in Figure 5), similarly to the result of Soares et al. (2006) on *A. rugosus rugosus*. In *A. balzani*, there seems to have a pattern of spatial distribution of the chambers because they are located between the tower projections and the amount of loose soil, overlapping and connected by only one vertical channel (Gonçalves 1961; Pimenta et al., 2007; Caldato, 2010).

The research about morphometrics of the nests of *A. landolti*, showed that this species can alter the form of its nest constructions, maybe as an adaptation to local edaphoclimatic conditions or as a response to the age of the colony. It is also possible to draw a hypothesis of the effect of the edaphic conditions of the study area classified as "Chernossolo Argilúvico Órtico" and characterized by its short depth, rarely being further than 70 cm, presenting a bad draining system, having high levels of silt and rich in primary minerals (Nacif, 2000). This could have been the most important factor determining the charateristics of *A. landolti* nest structure.

Overall the data obtained show that the spatial distribution of *A. landolti* is of the aggregated type. The external nest architecture of *A. landolti* and *A. balzani* are very similar, since both of them have a typical tower surrounding the entrance with an amount of loose soil in the vicinity, making this a pattern. However, nests of *A. landolti* in its external and internal structures have dimensions different from other ant species of the same genus. *Acromyrmex balzani* differs by having smaller size in several structural parts of the nest and less depth for nesting. Also, these two species differ because *A. landolti* presents an internal architectural pattern relatively variable and distinct, with an opening tunnel that may bifurcate and connect more than two chambers. However, there is a similarity between their nests because they have a number of chambers relatively low.

Acknowledgments

We thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES, Universidade Estadual do Sudoeste da Bahia - UESB/ Programa de Pós-Graduação em Agronomia and Lagoa de Alagoinhas Farm. Two anonymous reviewers contributed to improve the initial version of this article.

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