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Scientific Note

First published record of *Atta opaciceps* Borgmeier, 1939 (Hymenoptera: Formicidae) attacking neem (*Azadirachta indica* A.Juss.) in Brazil, with observations on foraging behavior

Daniel M. Pacheco, Rodolfo M. de Souza, Andressa Ribeiro, Antônio C. Ferraz-Filho, Luciana B. Silva

Universidade Federal do Piauí, Bom Jesus, PI, Brazil.
Corresponding author: marquesdaniel@ufpi.edu.br

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Abstract. This study reports the first published record of *Atta opaciceps* Borgmeier, 1939 (Hymenoptera: Formicidae: Myrmicinae) attacking neem trees (*Azadirachta indica* A. Juss., Meliaceae) in Brazil. Observations were conducted over eight consecutive days in an urban afforestation transect located at the Universidade Federal do Piauí, Bom Jesus campus. Intense foraging activity by an active colony resulted in progressive defoliation of *Az. indica* individuals. Soldier and worker ants were collected from different nest openings and identified based on external morphological characters through comparison with voucher specimens deposited in an institutional entomological collection and previously identified by a specialist; voucher specimens from the present study were subsequently deposited in a biological collection. Foraging activity was exclusively restricted to neem trees during the observation period and was characterized by the detachment of leaflets through petiolule cutting, followed by their fall to the ground and subsequent retrieval, with a low incidence of the typical semicircular cuts commonly observed on fresh leaf tissues. This harvesting strategy, previously reported for other *Atta* Fabricius, 1804 species foraging on neem, may represent a flexible behavioral response to the chemical defenses of this host, potentially reducing exposure to volatile bioactive compounds present in fresh tissues. These observations contribute to the knowledge of the interaction between *At. opaciceps* and neem and highlight the need for further studies to elucidate the mechanisms underlying this foraging behavior.

Keywords: Leaf-cutting ants, chemical defense, behavioral plasticity, herbivory, plant-insect interaction.

Neem (*Azadirachta indica* A. Juss., Meliaceae) is a fast-growing perennial tree native to Myanmar and arid regions of the Indian subcontinent, widely used for centuries in traditional medicine and, more recently, as a source of botanical pesticides (Cardoso et al. 2025). In Brazil, the species was introduced in 1996 and has since been extensively used in urban afforestation programs, particularly in northeastern regions, due to its high adaptability and potential for biomass and bioenergy production (Neves 2004; Moro et al. 2013; Simão Neto et al. 2023). In addition, neem is cultivated for the extraction of bioactive compounds from leaves and fruits (Fernandes et al. 2019).

These compounds, including azadirachtin, salannin, and nimbin, as well as other limonoids, exhibit insecticidal, repellent, and growth-regulating effects against a wide range of insect pests (Dhakad et al. 2025; Quintero et al. 2025; Singh et al. 2025). Despite these well-documented properties, *Az. indica* is not entirely resistant to herbivory, and several insect taxa have been reported attacking this species under field conditions (Souza et al. 2009a; Matias et al. 2011; Costa et al. 2013; Castro et al. 2020).

Among these herbivores, leaf-cutting ants of the genus *Atta* Fabricius, 1804 (Hymenoptera, Formicidae, Myrmicinae) are particularly noteworthy due to their high capacity for biomass removal and their economic impact in agricultural and forest systems (Hölldobler & Wilson 1990; Wirth et al. 2003; Souza et al. 2009b; Chiles et al. 2022). The leaf-cutting ants (Attini) cultivate a symbiotic fungus using freshly collected plant material, forming a complex mutualistic system that underpins their ecological success (Currie et al. 1999; Mueller et al. 2005).

Foraging behavior in leaf-cutting ants is strongly influenced by plant nutritional quality, water content, and secondary metabolites, which can affect both substrate selection and colony performance (Howard 1987; Rockwood & Hubbell 1987). In this context, plant chemical defenses play a key role in mediating ant-plant interactions, potentially altering foraging strategies and resource use (Hubbell et al. 1983; Lanan et al. 2011).

Previous studies have demonstrated that neem-derived compounds, particularly azadirachtin, can negatively affect leaf-cutting ants by reducing worker survival, impairing queen oviposition, and inhibiting the development of the symbiotic fungus (Amaral et al. 2018; 2019; 2020). However, no records are currently available documenting the interaction between *Atta opaciceps* Borgmeier, 1939 (Hymenoptera: Formicidae: Myrmicinae) and neem trees.

Therefore, this study reports the first published record of *At. opaciceps* attacking *Az. indica* in Brazil, in the municipality of Bom Jesus, Piauí, and describes a foraging pattern associated with this interaction previously documented for other *Atta* species.

Field observations were conducted between January 20 and 28, 2026, through daily monitoring of a leaf-cutting ant colony in a continuous afforestation transect (72 × 12 m) located at the Universidade Federal do Piauí, Campus Professora Cinobelina Elvas (CPCE/UFPI), Bom Jesus, Piauí, Brazil (09°05'02" S, 44°19'45" W to 09°05'04" S, 44°19'45" W). The climate is tropical with dry winter (Aw) with mean annual temperature of 24.9°C and rainfall concentrated between November and April (Alvares et al. 2013).

The vegetation consisted predominantly of 12 neem individuals (*Az. indica* A.Juss.), along with other tree species, including *Jacaranda mimosifolia* D.Don, *Licania tomentosa* (Benth.) Fritsch, *Syzygium* sp., and *Mangifera indica* L., distributed in an area covered by *Zoysia japonica* Steud. grass and patches of exposed soil with the presence of *Evolvulus nummularius* (L.) L. Neem trees were established in 2008.

Attacked trees were recorded, and workers and soldiers ants were collected from different nest entrances and preserved in 70% ethanol. Specimens were subsequently mounted, labeled, and identified based on external morphological characters through comparison with reference material from the CPCE/UFPI entomological collection, previously validated by a specialist (J.H.C. Delabie, personal communication). Voucher specimens were deposited in the same collection.

The collected workers and soldiers were identified as *At. opaciceps*, commonly known as the "saúva-do-sertão" (Fig. 1A-C).

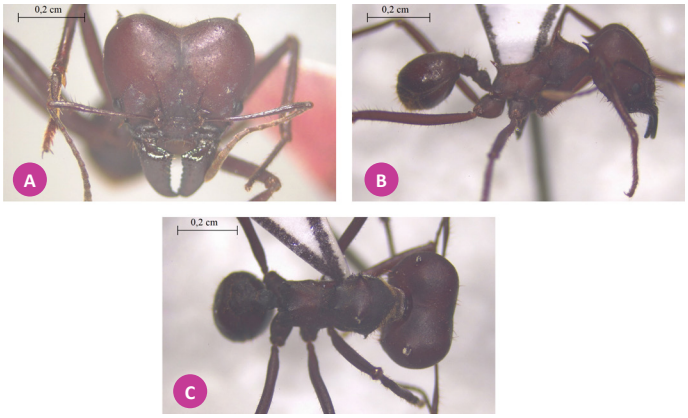

Figure 1. Soldier of *Atta opaciceps* Borgmeier, 1939 (Hymenoptera: Formicidae) collected from a colony in Bom Jesus, Piauí, Brazil, January 2026. (A) Head in dorsal view; (B) body in lateral view; (C) body in dorsal view.

During the observation period, foraging activity was exclusively restricted to neem trees. The colony exhibited intense activity (Fig. 2A-D), with 26 active nest openings distributed beneath the tree canopy. Progressive defoliation was observed, initially affecting a single tree, expanding to a second tree on the third day, and reaching a third individual by the end of the observation period (Fig. 2A-B).

In addition to a central mound, several satellite mounds were observed, all showing active cutting activity around nest entrances (Fig. 2C-D).

These observations constitute the first published record of *At. opaciceps* attacking *Az. indica* in Brazil. Although neem is widely recognized for its insecticidal and repellent properties, herbivory by leaf-cutting ants on this species has been previously reported for other taxa. For example, *Atta sexdens* (Linnaeus, 1758) has been shown to cause significant defoliation of neem under field conditions (Souza et al. 2009b). Similarly, other insect groups, including Coleoptera (*Apate terebrans* Pallas, 1772, Bostrichidae) and hemipterans from the families Cydnidae and Diaspididae, have been reported overcoming neem chemical defenses (Souza et al. 2009a; Matias et al. 2011; Costa et al. 2013; Castro et al. 2020). These findings indicate that the effectiveness of neem bioactive compounds may vary depending on herbivore identity and ecological context, as widely observed in plant-insect interactions (Hubbell et al. 1983; Lanan et al. 2011).

In addition to the host record, *At. opaciceps* workers were observed severing leaflets at the petiolule, causing them to fall to the ground before subsequent retrieval and transport. Similar behavior has previously been reported for *At. sexdens* attacking neem trees (Souza et al. 2009b), and a two-stage foraging strategy involving petiole cutting followed by ground collection has been documented in *At. laevigata* on chemically defended hosts (Vasconcelos & Cherrett 1996). Although leaf-cutting ants of the genus *Atta* typically cut and directly transport fresh plant fragments to the nest (Hölldobler & Wilson 1990; Wirth et al. 2003), cutting behavior is known to be plastic and responsive to substrate properties (Römer et al. 2023; Viana-Bailez & Endringer 2016). Vasconcelos & Cherrett (1996) suggested that ground deposition may reduce the effectiveness of volatile repellent compounds, increasing leaf palatability, a mechanism potentially relevant in the context of neem foliage, which is rich in volatile bioactive compounds such as azadirachtin. The strategy observed in *At. opaciceps* is consistent with the opportunistic and flexible foraging behavior documented for this species in the Caatinga Dominion (Siqueira et al. 2018).

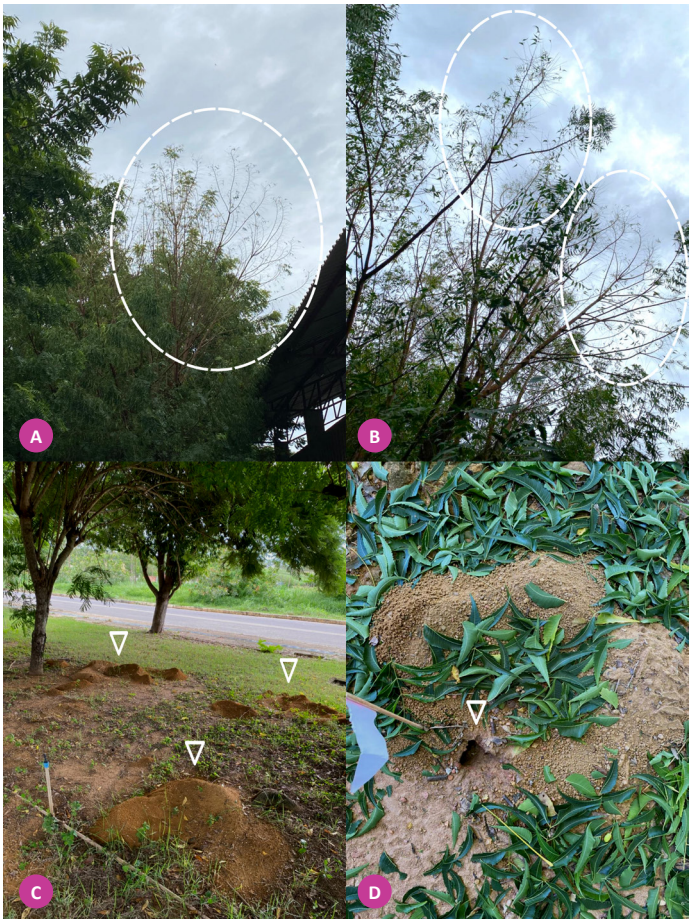

Figure 2. Record of *Atta opaciceps* attacking neem trees (*Azadirachta indica*) in Bom Jesus, Piauí, Brazil, January 2026. (A) first attacked tree; (B) second attacked tree; (C) epigeal nest mounds; (D) active nest entrance surrounded by neem leaflets cut by workers.

Previous studies have demonstrated that azadirachtin negatively affects leaf-cutting ants by impairing worker survival, queen reproduction, and symbiotic fungus development (Amaral et al. 2018; 2019; 2020). Given the central role of the fungal symbiont in colony nutrition, any disruption in this system can significantly influence foraging decisions and resource selection (Currie et al. 1999; Mueller et al. 2005). In this context, the observed behavior may represent a behavioral adjustment that allows the exploitation of chemically defended hosts while minimizing physiological costs.

The occurrence of this pattern suggests a high degree of behavioral plasticity in *At. opaciceps*, enabling the use of resources that are typically considered unfavorable. This plasticity may have important ecological implications, particularly in anthropized environments, where resource availability and plant composition can influence foraging dynamics.

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Authors' Contributions

DMP: Conceptualization, Investigation, Writing - original draft. RMS: Conceptualization, Investigation, Writing - original draft, Supervision. AR: Writing - review & editing, Validation. ACFF: Writing - review & editing, Validation. LBS: Writing - review & editing, Validation. All authors read and approved the final manuscript.

Conflict of Interest Statement

The authors declare that they have no competing interests.

Ethical Approval

Not applicable.

Data Availability

All data generated or analyzed during this study are included in this published article.

Generative AI Statement

AI tools (Consensus and SciSpace) were used exclusively to assist in literature search and retrieval of scientific articles. These tools were not used for writing the manuscript. All content was prepared by the authors, who assume full responsibility for the work.

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