

Scientific Note

Adaptation of *Mischocyttarus* sp. (Hymenoptera: Vespidae) to anthropized environments: Nesting on ornamental plants

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Abstract. Social wasps are essential components of ecosystems, acting as pollinators, predators of herbivorous insects, and bioindicators of environmental quality. Their nesting behavior is influenced by substrate availability, structural characteristics, thermal conditions, and predator avoidance. In urban areas, ornamental plants are widespread and may provide suitable microhabitats for wasp colonies, especially when combined with artificial supports such as pots. However, little is known about how these ornamental plant-pot systems influence nest site selection by social wasps. This study investigates the occurrence and nesting behavior of *Mischocyttarus* sp. (Hymenoptera: Vespidae) in ornamental plants in a residential urban environment in southeastern Brazil. We evaluated plant architecture, substrate stability, and nest positioning to explore factors that may influence nesting decisions. Special attention was given to structural and microclimatic features, such as thermal regulation and camouflage potential, which could enhance colony establishment and survival in anthropized landscapes. By focusing on the interactions between wasps and common ornamental plants, this study offers insights into the behavioral plasticity of *Mischocyttarus* sp. and highlights the often-overlooked ecological role of urban vegetation. The findings contribute to a better understanding of insect adaptation to urban environments and raise important considerations for urban biodiversity conservation through landscaping choices.

Keywords: Microhabitat, Nesting behavior, Nest camouflage, Social wasp.

Social wasps play crucial roles in ecosystems, acting as pollinators, bioindicators, and natural controllers of herbivorous insects (Bueno et al. 2019; Brock et al. 2021). Their colonies are associated with various substrates, including plants (abaxial surfaces of leaves, branches, cavities in tree trunks), soil, and artificial structures (Silva et al. 2019; Barbosa et al. 2020; Brügger et al. 2024). These colonies can be established independently (Polistini and Mischocyttarini) or through swarming (Epiponini) (Jeanne 1975), with their success relying on food, water, and suitable nesting sites (Castro et al. 2014; Brügger et al. 2019).

To ensure colony survival, social wasps have developed multiple defensive strategies, including camouflage (Badejo et al. 2020; Milani et al. 2020; 2021; Brügger et al. 2024), associations with both invertebrates and vertebrates (Somavilla et al. 2013; Corbara et al. 2018; Servigne et al. 2020; Silva et al. 2024; Barbosa et al. 2025), aggressive behavior (Western & Starr 2019), chemical defense mechanisms (Abd El-Wahed et al. 2021), and specific nest architectures (Silveira 2008).

Urbanization has influenced the distribution and nesting behavior of social wasps. In anthropized areas of the Neotropical region, particularly in Brazil, independently founding species are often reported as dominant (Barbosa et al. 2017). Among them, species of the tribe Mischocyttarini are frequently recorded in disturbed environments and are widely distributed across the Neotropical region (Oliveira et al. 2017). Both natural substrates (ornamental and non-ornamental plants) and artificial ones (concrete, plastic, and metal) are widely used for nesting (Detoni et al. 2018; Pérez-Bote & Mora-Rubio 2020). Substrate selection is influenced by protection, thermal regulation, predator avoidance, resource availability, and microclimatic conditions (Virgínio et al. 2016; Silva et al. 2023; Maciel et al. 2024).

In Brazil, ornamental plants are widely used in residential areas, serving aesthetic and ecological functions. They provide microhabitats for urban biodiversity, including insects, while also enhancing landscapes, promoting human well-being, and contributing to environmental stability (Eichemberg et al. 2009; Althaus-Ottmann et

al. 2011; Junqueira & Peetz 2017; Francini et al. 2022). However, the loss of green areas in urban environments has increased nesting in artificial substrates (Detoni et al. 2018), making ornamental plants an essential refuge for social insects such as social wasp.

Recent changes in consumer habits have also influenced plant usage. Since 2020, the COVID-19 pandemic has heightened interest in home gardening, increasing the demand for ornamental plants (Pereira et al. 2022). Studies indicate a growing preference for potted plants, particularly orchids and succulents, with visual appeal and price as key purchasing factors (Pereira et al. 2022; Souza et al. 2022). In addition to their aesthetic appeal, the structural characteristics of these plants may also increase nesting opportunities for social wasps, providing suitable microhabitats in urban environments.

Despite the widespread use of ornamental plants in urban areas, little is known about their role as nesting substrates for social wasps. This study aimed to investigate the occurrence of *Mischocyttarus* sp. (Hymenoptera: Vespidae) nests in cacti, succulents, and orchids in an urban environment, analyzing their structural characteristics and colony presence. The findings contribute to understanding how these wasps adapt to anthropized environments and highlight the ecological importance of ornamental vegetation in urban landscapes.

To carry out the study, vases containing ornamental plants, 9 cacti (*Cleistocactus winteri* D.Hunt), 12 succulents (*Sedum morganianum* E. Walther.), and 15 orchids (*Phalaenopsis* sp.), located on balconies in southeastern Minas Gerais, Brazil (21°21'33"S, 43°14'45"W), were inspected. A rapid survey of *Mischocyttarus* sp. nests was conducted between January 3 and January 25, 2025 (n = 23 days). Each nest was observed for ten minutes between 7:00 and 9:00 a.m., following a standardized protocol for short-term sampling aimed at checking if the nest was active.

During the survey, the following data were counted visually using a handheld counter and recorded: number of nests found, totaling the colonies of *Mischocyttarus* sp. present in each plant type; number of wasps, cells, eggs, larvae, and pupae present in each nest. Specimens

were identified to the genus level using the identification key proposed by Souza & Zanuncio (2012). Differences between plant types were assessed using the Wilcoxon rank-sum test, due to the small sample size and non-normal data distribution. All statistical analyses and graphical visualizations were conducted in R 4.5.0 (R Core Team 2025) using the packages ggplot2 (Wickham 2016), dplyr (Wickham et al. 2023), tidyr (Wickham et al. 2025), and ggh4x (van den Brand 2025).

Twelve nests of *Mischocyttarus* sp. were found: seven in cactus pots and five in succulents, while none were observed in orchid pots. The colonies varied in size and composition, with average colonies having 9 cells, 2 adults, 3 eggs, 3 larvae, and 1 pupae, indicating an early developmental stage with low adult numbers and limited reproductive output. No significant differences were observed between nests in cactus pots and succulents for any parameter (Wilcoxon rank-sum test; Cells: $p = 0.37$; Eggs: $p = 0.39$; Larvae: $p = 0.80$; Pupae: $p = 0.26$; Individuals: $p = 0.48$), suggesting that both substrates provide similar conditions for colony establishment (Fig. 1).

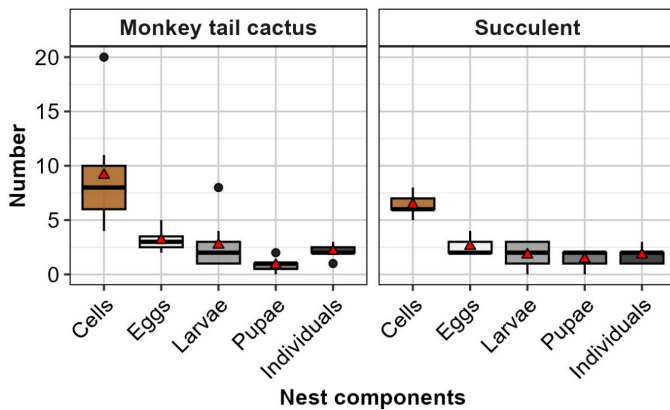


Figure 1. Nest characteristics of *Mischocyttarus* sp. (Hymenoptera: Vespidae) recorded on two plant types: Monkey tail cactus and Succulent. Boxplots represent the distribution of the number of cells (light brown), eggs (light gray), larvae (medium gray), pupae (dark gray), and individuals (near black) in the nest. The central line in each box indicates the median, the box limits represent the interquartile range, and whiskers indicate data variability. Red diamonds represent mean values, and black dots indicate outliers. Both panels share the same y-axis scale, allowing direct comparison between plant types.

These findings are consistent with previous studies on *Mischocyttarus* Saussure, 1853 species. For example, research on *Mischocyttarus cerberus* Ducke, 1918 shows that while colony size and life cycle duration may not vary significantly, the species tends to achieve high success in establishing viable nests in urban environments (Penna et al. 2007). This suggests that a small initial colony size may not

limit long-term success in some *Mischocyttarus* species.

The preference for nesting cacti and succulents may be attributed to their structural characteristics, such as hanging stems, which provide protection and consequently camouflage the nest, favoring nest attachment. In contrast, orchids grow vertically, offering less suitable support for nest protection. Thus, the presence of cacti and succulents in urban environments can provide important microhabitats for insects and other invertebrates (Barbosa et al. 2017; Mayorga-Pérez et al. 2020). Additionally, *Mischocyttarus* sp. workers may benefit from the increased availability of prey associated with these ornamental plants, as they often attract a greater diversity and abundance of herbivorous insects (Marquardt et al. 2021).

The positioning of the nests further highlights specific adaptations of *Mischocyttarus* sp. to urban environments, particularly regarding plant structure and substrate stability. All nests were located on the back of plant branches and attached to the surfaces of polyethylene and clay pots (Fig. 2), rather than directly to the plants themselves. This behavior may reflect a strategic response to the structural fragility of the host plants. Succulents have leaves and branches that detach easily when handled or exposed to strong winds, increasing the risk of colony loss (Smith 2004). Similarly, the fine and soft trichomes of the monkey tail cactus provide limited support, hindering effective nest adhesion.

Such substrate selection is consistent with patterns observed in other *Mischocyttarus* species. Castro et al. (2014) reported that more than 90.9% of *Mischocyttarus cassununga* (von Ihering, 1903) nests are constructed on artificial substrates. In a broader assessment, Oliveira et al. (2017) found similarly high frequencies for other species, including *M. cerberus* (98%), *Mischocyttarus drewseni* Saussure, 1857 (100%), and *Mischocyttarus rotundicollis* (Cameron, 1912) (88.88%), predominantly using artificial structures such as windows, metal surfaces, walls, and roofs. This preference suggests that structural stability is a key factor influencing nest-site selection in urban habitats, where artificial elements may offer more reliable anchorage than fragile plant surfaces.

Another critical factor influencing nest-site selection in *Mischocyttarus* sp. is thermal regulation, which plays a fundamental role in the foundation, development, and long-term survival of social wasp colonies (Jeanne & Morgan 1992; Virginio et al. 2016; Stabentheiner et al. 2022). The use of pots with ornamental plants contributes significantly to the creation of microhabitats that buffer temperature fluctuations. Frequent watering of these plants helps lower surface temperatures of the pots, promoting thermal stability and favoring colony maintenance (Klingner et al. 2005; Mayorga-Pérez et al. 2020; Maciel et al. 2024; Schaefer et al. 2025). This microclimatic buffering, combined with the structural stability of the pots and the camouflage offered by the plant foliage, reduces nest visibility to

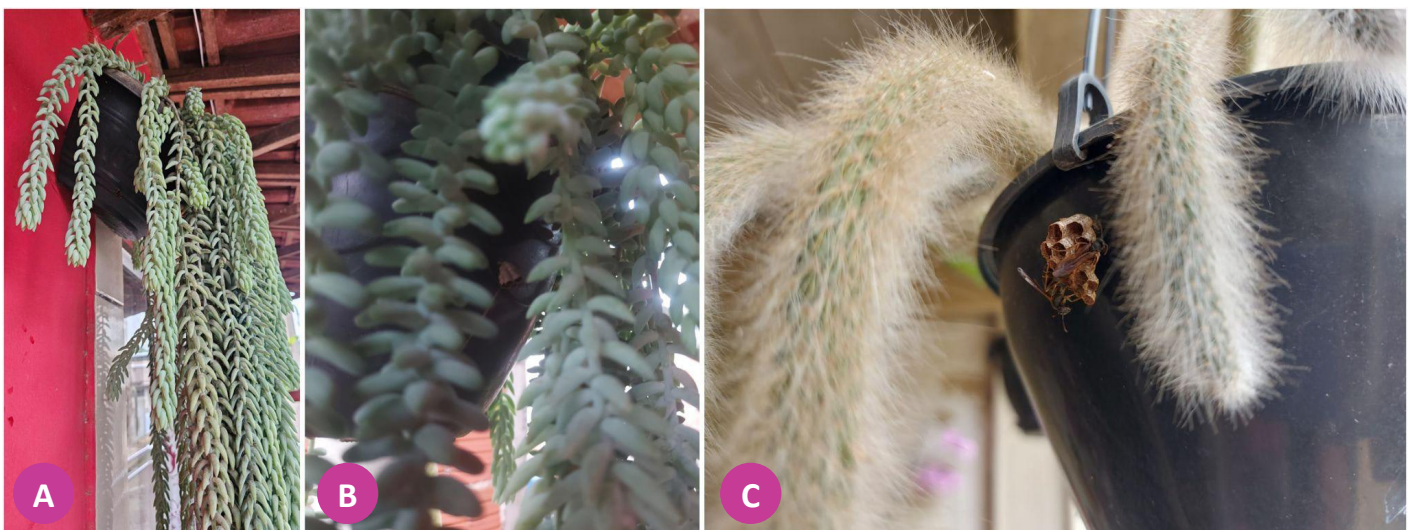


Figure 2. Ornamental plants used by *Mischocyttarus* sp. (Hymenoptera: Vespidae) for nesting in an urban environment. From left to right: (A) succulent *Sedum morganianum* with pendant stems; (B) close-up of succulent architecture providing potential camouflage; (C) monkey tail cactus (*Cleistocactus winteri*) showing a *Mischocyttarus* sp. nest attached to the pot rather than to the plant surface, illustrating the preference for stable artificial substrates.

predators and supports colony fitness (Barbosa et al. 2020). Moreover, the ability of social wasps to engage in behavioral thermoregulation, such as fanning or water spreading, further contributes to maintaining optimal conditions for brood development (Stabentheiner et al. 2022; Amstrup et al. 2024).

Together, these findings underscore the adaptive flexibility of *Mischocyttarus* sp. to anthropized environments. The combination of ornamental plants, such as cacti and succulents, and artificial substrates

like pots creates microhabitats that offer structural support, thermal stability, and camouflage from predators. This reflects behavioral adaptations that enhance colony survival and reproductive success in urban landscapes. However, ongoing climate change may disrupt these dynamics by altering the availability and suitability of nesting sites. Urban landscaping, therefore, plays a critical role in sustaining social wasp biodiversity, highlighting the ecological value of such elements in human-modified habitats (Fig. 3).

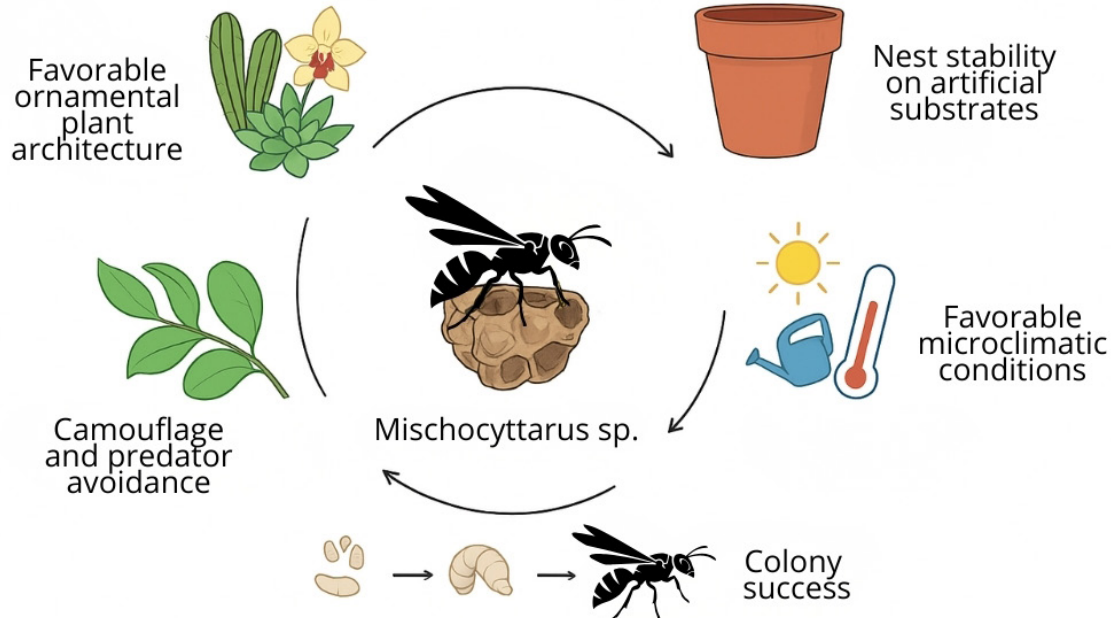


Figure 3. Conceptual model illustrating the main factors influencing nest-site selection of *Mischocyttarus* sp. (Hymenoptera: Vespidae) in ornamental plant-pot systems within urban environments. Plant architecture (especially cacti and succulents), substrate stability provided by pots, microclimatic buffering through shade and watering, and camouflage potential interact to enhance nest establishment and early colony development.

Conflict of Interest Statement

The author declares no conflict of interest.

Ethical Approval

Not applicable.

Data Availability

The data that support the findings of this study are available on request from the corresponding author.

Generative AI Statement

During the preparation of this manuscript, the author used SciSpace for reference searches and literature review, Google Translate, QuillBot, and ChatGPT to assist in improving the English of the text. ChatGPT and Canva were used to improve the illustrated conceptual model in Figure 3. After using these tools, the author carefully revised and edited the manuscript as needed and assumes full responsibility for the content of this publication.

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