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Scientific Note

High infestation of *Cecropia pachystachya* (Urticaceae) by the scarab beetle *Macrodactylus pumilio* Burm., 1855 (Coleoptera: Scarabaeidae)

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Abstract. Population outbreaks, although rare, hold significant ecological implications, particularly in short-lived organisms. These outbreaks are often triggered by changes in population control factors such as food availability, absence or reduction of natural enemies, diseases, or favourable climatic conditions. This study documents an infestation event where the scarab beetle *Macrodactylus pumilio* Burm., 1855 (Coleoptera: Scarabaeidae) heavily infested a specimen of *Cecropia pachystachya* Trécul. in, Serra do Cipó, Minas Gerais, Brazil. The infestation took place at the onset of the rainy season, which corresponded with the annual emergence of the beetles from the soil. We searched another nine fruiting trees within 100 m radius, none of which were infested. The estimated abundance of *M. pumilio* beetles on the infested tree reached 45,825 insect individuals. The insect is a known agricultural pest, affecting citrus, passion fruit, coffee plantations, and ornamental flowers. *C. pachystachya*, a pioneer tree commonly found in secondary forests of Latin America, may represent a potential alternative host for the beetles in the face of increasing pesticide use. This event may have significant implications for the population dynamics of *C. pachystachya* and highlights the importance of understanding the life cycle and behaviour of species of the genus *Macrodactylus* Dejean, 1821. Similar outbreaks have been reported in agricultural systems, emphasizing the need for precise knowledge to plan effective management strategies in both natural and agricultural environments.

Keywords: Agricultural pests, Frugivory, Insect predation, Plant-insect interactions, Population fluctuations.

Population outbreaks are relatively rare phenomena of high ecological relevance, primarily observed in short-lived organisms (Barbosa et al. 2012). These outbreaks occur due to various factors, usually triggered by changes in population control mechanisms, such as the availability of food (Rossiter 1992), the absence or reduction of natural enemies (predators and parasitoids), and disease (Price 1987; Alalouni et al. 2013; Hood et al. 2019), or favourable climate conditions (Kurz et al. 2008; Jactel et al. 2019). Sometimes, population dynamics factors and a combination of these triggers contribute to the occurrence of outbreaks (Wallner 1987; Barbosa et al. 2012; Alalouni et al. 2013).

Several variables, both dependent and independent of population density, have been extensively studied to understand the specific reasons for population outbreaks (Wallner 1987; Barbosa et al. 2012). However, not all invertebrates can experience population outbreaks, as this occurrence is influenced by intrinsic factors such as life cycle characteristics, sensitivity to weather changes, host quality, and the strength of linkage to natural enemies (Wallner 1987; Hunter 1991). These outbreaks hold significant ecological importance due to their substantial impact on the communities in which they take place.

The scarab beetle *Macrodactylus pumilio* Burm., 1855 (Coleoptera: Scarabaeidae: Melolonthinae), commonly known as the rose-chafer (referred to as "vaquinha-amarela" or "besouro-amarelo" in Brazil; see Fig. 1), primarily feed on flowers and buds, with a preference for pale-coloured flowers, but instances of attacks on leaves, shoots, and ripe fruit have been documented (Williams et al. 1990). They are commonly recognized as agricultural pests, particularly in citrus plantations (especially oranges), passion fruit farms, coffee plantations, and ornamental flower gardens. The genus *Macrodactylus* Dejean, 1821 comprises 116 reported species, and their eggs are typically deposited in the soil in relatively small quantities, ranging from six to thirty eggs per clutch, depending on the species (Junqueira 1953; Sousa et al. 2016). The adult beetles emerge from the soil at the onset of the rainy season, typically spanning from September to November, resulting in highly seasonal population dynamics for this organism. Considering the growing challenges posed by pesticides in agricultural fields, *Cecropia pachystachya* Trécul (Urticaceae) may serve as a native alternative host for *Macrodactylus* beetles.

Cecropia pachystachya, commonly referred to as *embaúba* in Brazil, is a dioecious pioneer tree (10-15 m tall) prevalent in secondary forests across Latin America (Berg 1978). These trees exhibit a remarkable ability to withstand fluctuations in soil moisture levels, enabling their establishment in diverse soil conditions (Vicentini et al. 2008). *Cecropia pachystachya* undergo extended flowering periods, with the peak occurring between August and November. The tree species is particularly abundant in degraded areas and secondary vegetation. It is widely regarded as an effective colonizer of open fields due to its rapid growth rate and strong reliance on light exposure for germination (Sato et al. 2008). The primary dispersers of this species encompass bats and birds, which play a vital role in propagating the seeds across substantial distances (Sato et al. 2008). Notably, despite its prevalence in humid regions, *C. pachystachya* has been observed colonizing the arid *campo rupestres*, a type of mountaintop rocky grassland in Brazil, originating from disturbed sites adjacent to highways (Carvalho et al. 2020).

The present note aims to document an infestation of a specimen of *C. pachystachya* by an extremely large number of individuals of *M. pumilio* actively feeding on the ripe infructescence of the plants (Fig. 1). The individual of *C. pachystachya* described in this note was approximately 10 m tall and was located within the Reserva Vellozia, a privately-owned property situated in Serra do Cipó, Minas Gerais, Brazil (19°16'45" S, 43°35'27" W). This area is characterized by *campo rupestre* vegetation and is within the Cerrado Biome. The episode was observed on October 28, 2013, and lasted for a single day. During this period, beetles were observed preying on the infructescence, leading to a significant loss in their numbers. In total, we inspected 10 fruiting female individuals of the same species within a 100 m radius.

No attacks were observed on any of them, except for the lone female specimen of *C. pachystachya*.

To estimate the magnitude of the insect infestation on the tree, we conducted a thorough assessment. First, we recorded the number of terminal branches and estimated the average quantity of infructescence borne by each branch. Subsequently, we determined the proportion of infructescence that had been predated on a per-branch basis. The subject tree exhibited a total of 39 terminal branches, each carrying an average of nine infructescence, out of which two were found to be affected by insect predation. Furthermore, we quantified the mean number of *M. pumilio* individuals attacking each infructescence to estimate the overall insect abundance on the tree. Our findings revealed an average of 587.5 scarabs per infructescence, amounting to an estimated total of 45,825 insects on the tree individual. Samples of the insects were collected and later identified by Sérgio Vanin, a beetle specialist at the Museum of the University of São Paulo, in Brazil.

It is highly probable that there was a substantial reproductive loss for the affected individuals of *C. pachystachya* in that particular year. If the attack extended to other individuals of the plant species, it may have had a significant impact on the population of these trees within the region. The high density of insects also attracted certain species of birds that fed on the scarabs during the infestation period. Similar events, caused by *Macrodactylus* species, have been previously documented in agricultural systems, such as the passion fruit crop, resulting in a significant impact on production (Sousa et al. 2016). These findings indicate the importance of understanding the dynamics and precise characteristics of the life cycle of *Macrodactylus* insects to comprehend drastic variations in their abundance and patterns of attack. This knowledge holds great relevance in the planning of actions, both in natural environments and in the agricultural sector.

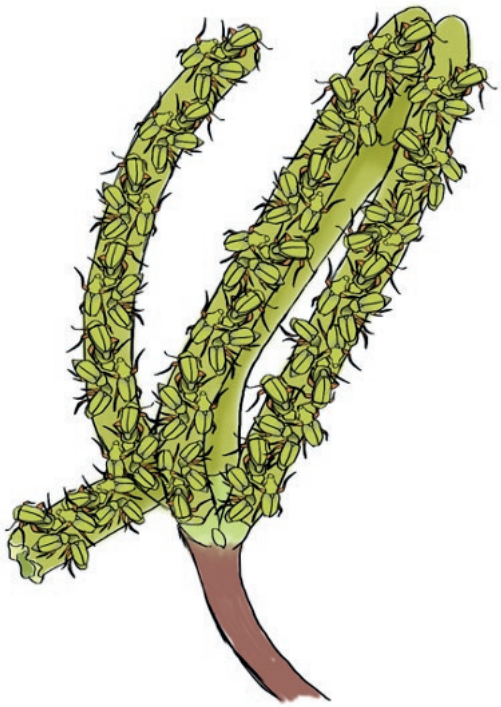

Figure 1. Infructescence of *Cecropia pachystachya* Trécul (Urticaceae) being eaten by a large number of individuals of the scarab beetle *Macrodactylus pumilio* Burm. (Melolonthinae) in Serra do Cipó, Brazil. Illustration by Helena Negrão.

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Authors' Contributions

Conceptualization: GWF; Methodology: GWF and MB; Formal analysis and investigation: MB; Writing - original draft preparation: HN; Writing - review and editing: MB, GWF; Funding acquisition: GWF, MB; Resources: GWF; Supervision: MB, GWF.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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