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Insect infestation during sporadic flowering of *Dendrocalamus hamiltonii* in Meghalaya, India

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ABSTRACT

This study recorded occurrences of the sap sucking insects *Antonina pretiosa* and *Planococcus citri* on the inflorescence of *Dendrocalamus hamiltonii* during its sporadic flowering during the month of May and June, 2024 in Ri-Bhoi district of Meghalaya. The inflorescences where the insects occurred failed to form viable seeds.

1. Introduction

Bamboos have two main types of flowering, namely sporadic and gregarious. Sporadic flowering is characterized when part of a clump or a few clumps in the population flowers at irregular intervals, whereas gregarious flowering occurs when clumps spread out over a wide area flower simultaneously, followed by mass mortality and seed setting (Janzen, 1976; Biswas et al., 2016; Xie et al., 2016). The bamboo *Dendrocalamus hamiltonii* Nees & Arn. ex Munro (Poaceae) is distributed in Bhutan, India, Nepal, Myanmar and Thailand; and flowers when it reaches an age of 30–40 years (Sharma and Borthakur, 2018). This economically important species is distributed in all states of northeast India and its young shoots are edible (Sharma and Borthakur, 2018). In Meghalaya, it is used to construct cottages (Rao and Ramakrishnan, 1987; Das et al., 2018). The flowering of this species leads to the production of many seeds that germinate within 3–10 days (Banik, 2016) and the flowering clumps die within the following three years (Das et al., 2018). Generally, seeds of this species are rich in protein (3.19 g 100 g^{-1}) and starch (43.7 g 100 g^{-1}) (Kumawat et al., 2014). It is believed that the flowering of bamboo followed by the production of seeds causes an increase in the population of rodents which may then lead to famine (John and Nadgauda, 2002; Sridhara and Rajendran, 2010; Sharma et al., 2014). A study conducted in northeast India by Kumawat et al. (2014) supported the association of rodent outbreaks with the flowering of bamboo, including *D. hamiltonii*, but noted that flowering seasons do not always result in a rodent outbreak of the same severity.

From May to the middle of June in 2024 sporadic flowering of *D. hamiltonii* was observed along the Kling Road in the Baridua area of the Ri-Bhoi district of Meghalaya. It was associated with occurrences of multiple insect egg cases and with citrus mealybug. In India, the association of particular insects with different bamboos has been recorded by many workers (Beeson, 1941; Singh and Bhandari, 1988; Mathew and Varma, 1988; Varma and Sajeev, 1988; Nadgauda et al.,1993; Koshy et al., 2001; Revathi and Remadevi, 2011; Remadevi and Revathi, 2013; Chen et al., 2017; Mehmud et al., 2024). Three species of insects have been associated with inflorescences of different species of *Dendrocalamus* Nees, namely *Apis mellifera* L. and *Allodape marginata* Smith with *Dendrocalamus strictus* Nees. (Nadgauda et al., 1993) and *Apis cerana* Fab. with *Dendrocalamus membranaceus* Munro and *Dendrocalamus sinicus* L.C.Chia & J.L.Sun (Chen et al., 2017). Bamboo flowering is a rare phenomenon (Sharma and Borthakur, 2018), providing few opportunities to observe insect associations, and here we report the association of two mealybugs with *D. hamiltonii* inflorescences.

2. Material and methods

Field visits were conducted weekly in the study area (25°06'27''N; 092°59'59.9''E) and inflorescences with insects were collected. Literature-based identification of bamboo (Sharma and Borthakur, 2018) and insects (Ben-Dov, 1994; Tanwar et al., 2007; Gill et al., 2012; Ülgentürk et al., 2014) were conducted. Collected insects were immediately sorted and preserved in 70 % ethyl alcohol and were later

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identified using a stereo-zoom microscope (Olympus Model- MSZ-TR). The collected inflorescences with egg cases and nymphs of the insects was also examined under a dissecting microscope for measurement and photography. After being preserved in formalin, the samples were submitted to the Department of Zoology, University of Science and Technology Meghalaya while another sample was sent to Department of Zoology, Cotton University.

Fig. 1. A–B. Flowering of *Dendrocalamus hamiltonii*, C. Germinating seed, D–F. Egg cases of *Antonina pretiosa* on the inflorescence (arrow showing ants, anal tube and exudates), G. Nymph of *A. pretiosa*, H–K. *Planococcus citri*, L. *Apis mellifera*.

3. Results and discussions

In the study area flowering of around 50–60 culms of *D. hamiltonii* was observed. The florets or flowers of the heads (inflorescence) produced viable seeds which were later germinated (Fig. 1 A–C). Multiple heads were found with an infestation of the sap-sucking insect *Antonina pretiosa* Ferris (Homoptera: Pseudococcidae). *A. pretiosa* laid multiple egg cases in the heads, with some having 30–65 cases. The cases were dark brown with black stripes, around 3 mm in diameter, and had a distinct 2–3 cm long anal tube (Fig. 1 D–F). The egg cases were filled with multiple ellipsoidal eggs. Due to the infestation, the inflorescences were covered with a white cottony substance. Large numbers of *A. pretiosa* nymphs ca. 0.5 × 0.2 cm (Fig. 1G) were observed in the first and second weeks of May whereas, adult females were observed in the last week of May to middle of June. The occurrence of *A. pretiosa* on the inflorescences of *Bambusa bambos* (L.) Voss was previously reported from the region by Mehmud et al. (2024), but this is the first record of *A. pretiosa* on *D. hamiltonii* inflorescences.

Interestingly, another mealybug was associated with the egg cases of *A. pretiosa* (Fig. 1H) on *D. hamiltonii,* and was identified as *Planococcus citri* Rissio (Homoptera: Pseudococcidae). The adult females were ca. 7.5 × 2.5 mm, elongate-oval, soft-bodied, covered with slightly curved waxy filaments and without wings (Fig. 1I–K). The adult male was larger than the female and bore functional wings and a posterior end with long waxy filaments. Although, *Planococcus ficus* Signoret has been reported on bamboo (García et al., 2018), this is the first reported occurrence of *P. citri* on the inflorescences of *D. hamiltonii*. In the inflorescence, *Apis mellifera* was attracted to the honeydew droplets released by *A. pretiosa* (Fig. 1L). Many studies (e.g., Venkatesh, 1984; Nadgauda et al., 1993), have mentioned the visitation of pollinators such as *A. mellifera* on the flowers of bamboo but they were only considered to be vectors of pollen (Nadgauda et al., 1993). However, studies by Chen et al. (2017) on *Dendrocalamus membranaceus* and *D. sinicus* have revealed that honeybees (*Apis cerana*) may be good pollinators of *Dendrocalamus* spp.

On bamboo, *A. pretiosa* is generally found beneath the leaf sheath, stem and nodes (Ülgentürk et al., 2014) but there have reports of its occurrence on the inflorescence, such as on *B. bambos* in Assam (Mehmud et al., 2024). The sporadic flowering of *D. hamiltonii* in the Ri-Bhoi district was recorded in 2017–2018 (Das et al., 2018), but no insect associations were reported. After a gap of 6–7 years, our study observed sporadic flowering again in the same district, but this time in association with *A. pretiosa* and *P. citri* on the inflorescence. Both these mealy bugs generally feed on sap from the stems, nodes and under the bracts of the bamboo and other host plants (Miller et al., 2014; García et al., 2018). The inflorescence infested with *A. pretiosa* did not have any blooming flowers or other developed organs such as anthers or ovules. The entire inflorescence was covered with a white cottony substance (Fig. 1D–F). The utilization of the inflorescence for feeding was not clearly observed. However, the egg cases on the inflorescences were associated with an absence of viable seeds. *Planococcus citri* also secrets honeydew, causing the growth of sooty moulds (Gill et al., 2012) in the inflorescence.

4. Conclusion

Bamboo flowering is an interesting event as the determination of exact time and age are unpredictable. Our study recorded sporadic flowering of *D. hamiltonii* in Meghalaya, with the presence of two mealy bugs i.e., *A. pretiosa* and *P. citri*. Generally, the habitat of *A. pretiosa* is restricted to the vegetative parts but we also recorded it on the inflorescences. Furthermore, we also found *P. citri* on the inflorescences of *D. hamiltonii*, which has not been recorded previously.

CRediT authorship contribution statement

Selim Mehmud: Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Sasanka Sekhar Ghosh:** Writing – review & editing, Investigation.

Author's contribution

SSG conducted identification of insects; SM conducted field survey, collection and plant identification; both authors equally contributed in the manuscript.

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Declaration of Competing Interest

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Data availability

Data will be made available on request.

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