Grey pineapple mealybug, *Dysmicoccus neobrevipes* Beardsley (Pseudococcidae: Hemiptera): an emerging pest of tuberose in India

D. M. Firake[1,*,†], Sunil Joshi[2,†], P. Naveen Kumar[1,4], T. N. Saha[1], V. S. Raju Dantuluri[3] and K. V. Prasad[1]

[1]ICAR-Directorate of Floricultural Research, Pune 411 036, India
[2]ICAR-National Bureau of Agricultural Insect Resources, Bengaluru 560 024, India
[3]ICAR-Directorate of Floricultural Research, Regional Station, Vemagiri, Kadiyam 533 125, India
[4]ICAR-Indian Institute of Horticultural Research, Hessaraghatta, Bengaluru 560 089, India

Tuberose (*Agave amica*) is a highly valued flower crop in India, known for its consistently high returns and ability to thrive in various climatic conditions. Severe outbreaks of the grey pineapple mealybug, *Dysmicoccus neobrevipes* Beardsley (Hemiptera: Pseudococcidae), have been observed in several villages of Pune district, Maharashtra (India), since 2021, leading to significant economic losses. The present study provides an illustrative morphological diagnosis of *D. neobrevipes* and basic information on its field establishment, impact on tuberose crop, nature of the damage and field symptoms, etc. Surveys conducted in major tuberose-growing areas of Pune district (Maharashtra) revealed that the mealybug primarily infests the underground and basal portion of tuberose plants, causing stunted growth, drooping and ultimately death of the plants. *D. neobrevipes* produces honeydew, fostering sooty mould growth that impairs photosynthesis and reduces flower yield. It also infests tuberose bulbs, spoiling them in storage. Based on primary scientific literature, the present study represents a scientifically confirmed record of *D. neobrevipes* as a new pest of tuberose in India. The ant species *Solenopsis geminata* was found attending to mealybug colonies, aiding their spread and creating a nuisance for farmers during routine field activities. A total of 87.09% of the surveyed fields (n = 62) showed mealybug infestation, ranging from 68% to 97%. Raising awareness among the farmers and implementing regular monitoring in tuberose-growing areas are crucial steps for developing effective management practices and preventing the further spread of this pest to other regions.

Keywords: *Dysmicoccus brevipes*, Gulchhadi, *Polianthes tuberosa*, Rajanigandha, *Solenopsis geminate*, Sungandharaja.

TUBEROSE *Agave amica* (Medikus) Thiede and Govaerts (Syn: *Polianthus tuberosa*; Asparagaceae) is widely cultivated across various Indian states for its loose flowers and floral spikes. Tuberose, popularly known as Rajanigandha or Sungandharaja or Gulchhadi, is considered as the most popular flower crop by small and marginal farmers as it provides consistent and high returns throughout the year[1]. It is a hardy crop, capable of withstanding several biotic stresses, and adaptable to a wide range of soils and climatic conditions[2]. Severe incidence of mealybugs were observed in 2021 in the tuberose fields of ICAR-Directorate of Floricultural Research, Pune, in Yavat and the surrounding areas of Pune district, Maharashtra. Mealybug colonies were found developing on underground parts and basal regions of tuberose plants. The affected plants were observed to be completely dried out and drooping, with the infestation being so severe (up to 100%) that farmers were compelled to destroy their entire fields. This mealybug species, including its field characteristics, appeared to differ from the striped mealybug, *Ferrisia virgata* Cockerell (Hemiptera: Pseudococcidae), which is known to damage tuberose crop in India[3,4]. To confirm its identity, adult female specimens were preserved in 70% ethanol and slide-mounted in Canada balsam, following the procedure described by Watson and Chandler[5]. The terminology for morphological description is presented as per Williams and Granara de Willink[6]. The morphology of the slide-mounted adult female was examined in 30 specimens at the Division of Germplasm Characterization, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, India. Morphological measurements were recorded using an eyepiece reticle on an Olympus BX 51 microscope, calibrated with a stage micrometer. These measurements represent maximum dimensions, with setal lengths including the base. Slide-mounted adult females were also examined using a Nikon Digital Sight DSVI-1 on a Nikon Eclipse 80i microscope, with measurements obtained from digital images using the M205 A Leica Application Suite.

The mealybug species infesting tuberose plants was determined as grey pineapple mealybug, *Dysmicoccus neobrevipes* Beardsley (Hemiptera: Pseudococcidae). Diagnostic characters of *D. neobrevipes* are shown in Figure 1. Morphological characters indicated in Figure 1 were adapted from Williams and Granara de Willink[6] and Beardsley[7]. *D. neobrevipes* is taxonomically close to the pink pineapple mealybug, *D. brevipes*[6], and several morphological traits of both species closely resemble each other. Recently, Choudhary *et al.*[8] described the morphological characteristics of *D. brevipes* specimens collected from garden pea fields, which show a significant similarity to some of the characters observed in *D. neobrevipes* females collected from tuberose (Figure 1 *a*–*m*). These characters include the shape of the adult female's body, which is oval to broadly oval in shape, with 17 pairs of cerarii (Figure 1 *a*). The ventral surface of each lobe with a quadrate sclerotised area (Figure 1 *b*). Each antenna typically consists of 8 segments (Figure 1 *c*). Legs are well developed, with a stout claw that lacks a denticle (Figure 1 *d*).

*For correspondence. (e-mail: dfirake@gmail.com)
†Equally contributed.

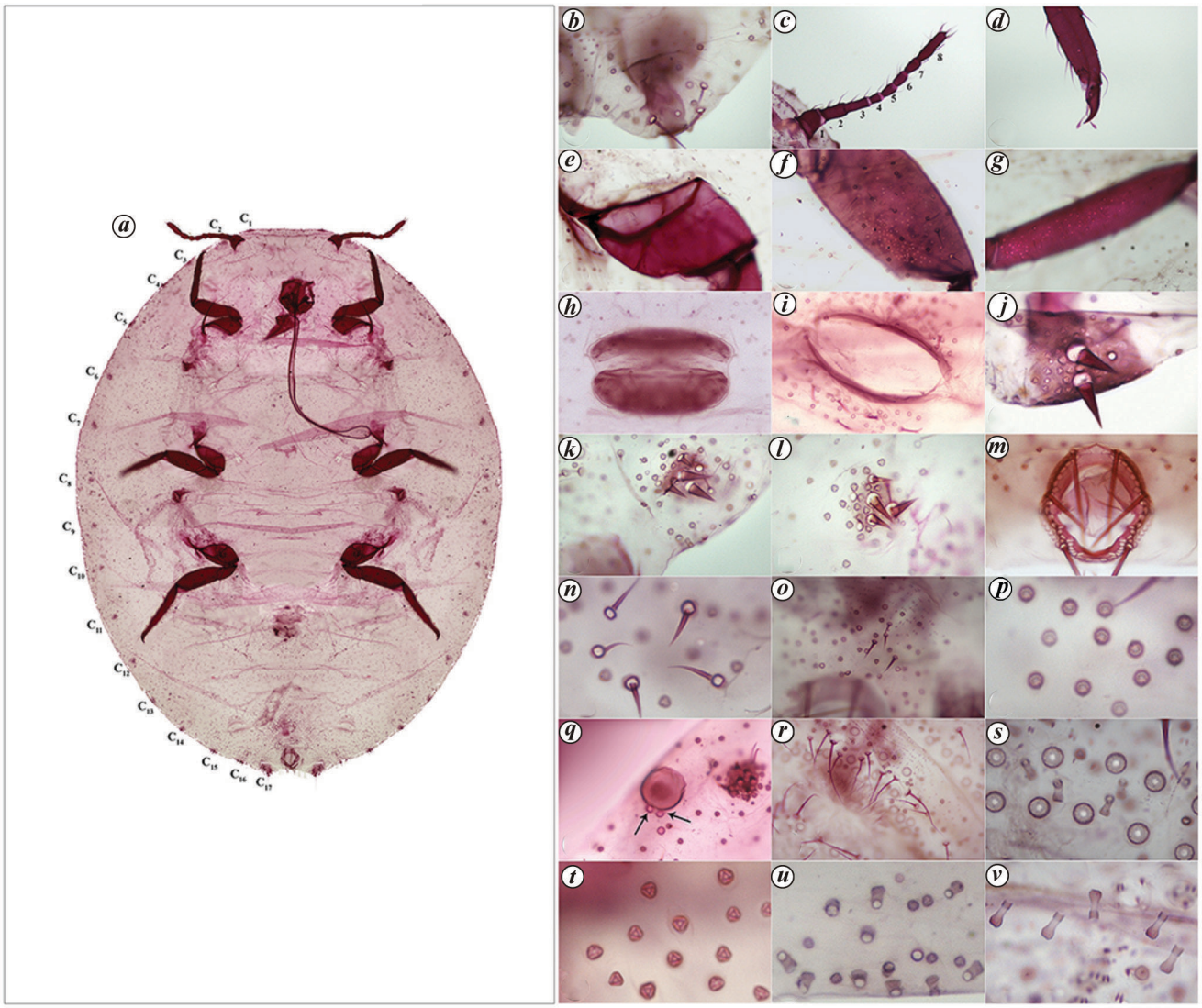

Figure 1. Taxonomic characters of slide-mounted female of *Dysmicoccus neobrevipes* Beardsley. Body derm showing 17 cerarii marked as (***a***) C1–C17; (***b***) ventral surface of anal lobe; (***c***) antenna; (***d***) claw; (***e***) coxa without translucent pores; (***f***) femur with translucent pores; (***g***) Tibia with translucent pores; (***h***) circulus; (***i***) ostiole; (***j***) anal lobe cerarius; (***k***) penultimate cerarius; (***l***) cerarius on head; (***m***) anal ring; (***n***) dorsal setae; (***o***) dorsal setae on abdominal segment VIII anterior to anal ring; (***p***) dorsal discoidal pores; (***q***) discoidal pores near eye; (***r***) ventral setae around vulva; (***s***) multilocular pores; (***t***) trilocular pores; (***u***) smaller oral collar tubular ducts; (***v***) larger tubular ducts.

Translucent pores are absent from the hind coxa (Figure 1 *e*), but are abundant on the posterior surfaces of the hind femur (Figure 1 *f*) and hind tibia (Figure 1 *g*). The circulus is irregular or coffee bean-shaped, divided by an intersegmental line (Figure 1 *h*). Ostioles are well developed, featuring sclerotised inner lips along with small, stout setae and trilocular pores around the periphery (Figure 1 *i*). Each anal lobe cerarius contains 2 enlarged conical setae and 1 or 2 auxiliary setae (Figure 1 *j*), along with a compact group of trilocular pores, all located on a more or less circular sclerotised area. Penultimate cerarii (Figure 1 *k*) are slightly smaller than those on the anal lobes, each comprising 2–4 conical setae, 3–7 auxiliary setae, and a compact group of trilocular pores. Cerarii on the head (Figure 1 *l*) each have 3–6 conical setae. The anal ring has 6 setae (Figure 1 *m*). Other characteristics of female *D. neobrevipes* collected from tuberose are detailed in Figure 1 *n* to Figure 1 *v*. The dorsal surface is scattered with short, stiff setae throughout the surface (Figure 1 *n*). Similar short stiff setae are present on the surface anterolateral to the anal ring (Figure 1 *o*). Large discoidal pores, each larger than a trilocular pore, present conspicuously medially on the dorsum of the abdomen, particularly on segments VI–VIII (Figure 1 *p*), each with a reticulated surface. Smaller discoidal pores (1–3 numbers) with the plain surfaces are always present adjacent to each eye (Figure 1 *q*). Ventral surface with long flagellate setae around the vulva (Figure 1 *r*) and normal shorter flagellate setae are present throughout the venter. Multilocular disc pores (Figure 1 *s*) are present around the vulva, at the

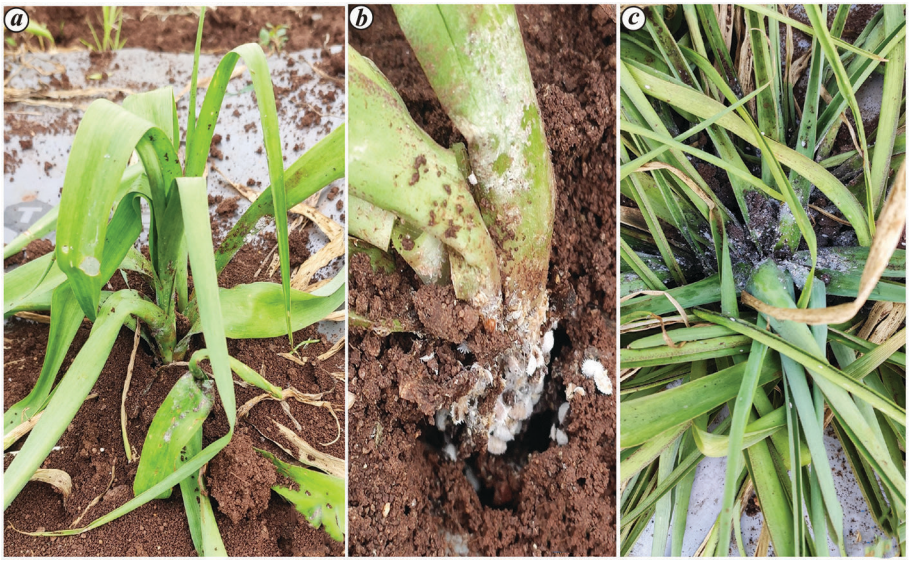

Figure 2. Symptoms of mealybug, *D. neobrevipes* infestation to tuberose plants. ***a***, Damage symptoms at initial phase of *D. neobrevipes* infestation include a loss of vigour, downward drooping of leaves, and drying of leaf tips. ***b***, *D. neobrevipes* colonies developed on underground parts of the tuberose plants along with large number of ants, *Solenopsis geminata* attending mealybugs. ***c***, *D. neobrevipes* infestation started developing on basal portion and above ground plant parts and excessive honeydew excretion by *D. neobrevipes* leading to blackening of leaves and shoots.

Figure 3. (***a***) Colonies of mealybug (*D. neobrevipes*) forming on newly emerging shoots, beginning at the underground parts and spreading upward to the shoots and leaves. (***b***) *D. neobrevipes* colonies developing on freshly harvested bulbs and (***c***) entirely damaged buds unsuitable for planting.

anterior edge of abdominal segment VII, and the posterior edge of segment VI, in the median areas only. Trilocular pores (Figure 1 *t*) are evenly distributed, and less numerous on the venter than on the dorsum. Oral collar tubular ducts come in two sizes: a small type (Figure 1 *u*) is sparsely distributed across the abdominal segments and median area of the thorax, and the larger type (Figure 1 *v*) is found in groups along the margins of the posterior abdominal segments.

D. neobrevipes was first described from Hawaii, USA by Dr. J. W. Beardsley in 1959 (ref. 7). *D. neobrevipes* is reported to be a polyphagous species associated with plant

species across 67 genera in 40 plant families[9]. Although various main host plants of this species have been documented in different countries, pineapple, banana[10], and sisal (*Agave sisalana*)[11] are recognised as major hosts. In these crops, *D. neobrevipes* has established itself in the fields and caused significant economic damage. *D. neobrevipes* has been reported in many countries across the Americas, Africa, Europe, Asia and Oceania. This species is frequently intercepted on various hosts at US ports of entry, including tuberose from Taiwan, and originating from different countries[12]. In Asia, severe outbreaks of *D. neobrevipes* have been observed on various crops in Malaysia, the Philippines, Thailand[13–15] and China[11].

Due to the dearth of information on the nature of the damage of this mealybug and its impact on the tuberose yield, an intense field study was undertaken. Extensive surveys were conducted in major tuberose-growing localities of Maharashtra during August 2022. Observations on the incidence of *D. neobrevipes* and infested plants (%) were recorded by counting the number of damaged plants in relation to the total number of plants in a 100 m^2 area in each field. *D. neobrevipes* infestation was examined in 62 tuberose fields in Yavat and 10 adjoining villages in the Pune district of Maharashtra. *D. neobrevipes* incidence was observed in 54 tuberose fields and the infestation levels (mean infested plants) ranged from 68% to 97% (Supplementary Table 1). *D. neobrevipes* remains concealed underground during the early stages of infestation.

Numerous mealybug nymphs were observed feeding primarily on the sap of underground parts, leaves and shoots of the basal region, which led to stunted plant growth. Severely infested plants showed symptoms of drooping, and complete blackening of leaves and shoots and eventually died (Figure 2 *a*–*c*). *D. neobrevipes* impaired the plant's photosynthetic capacity by excretion of honeydews on the plant surface which resulted in the growth of sooty mould. This mould blocked sunlight and air from reaching the leaves and further hindered photosynthesis. Further, mealybug colonies were found on the spikes of infested plants, leading to poor-quality flowers and reduced yield. Damaged plants often appeared drooped, with rotting underground portions. *D. neobrevipes* attacked newly emerging shoots, starting from the underground parts and progressing upward until the shoots die (Figure 3 *a*). In addition to field infestation, *D. neobrevipes* was carried over to the storage through infested bulbs after harvesting. In stored tuberose bulbs, mealybugs thrive on these bulbs thereby making them unsuitable for planting (Figure 3 *b* and *c*). In infested tuberose fields, large numbers of fire ants *Solenopsis geminata* (Fabricius) were observed attending mealybug colonies in nearly all surveyed locations both in fields and stored bulbs. Mealybug damage was found to be more devastating in fields than in storage. Less often *Camponotus compressus* Fabricius was also observed attending colonies of *D. neobrevipes* in few locations. These ants not only protect *D. neobrevipes* from natural enemies but also facilitate its spread by transporting the young mealybugs to new plants[16].

D. neobrevipes reproduces sexually[13] and are known to cause wilt disease in pineapple in Hawaii. One closely related mealybug species *D. brevipes*, is distinct from *D. neobrevipes* by the morphological differences. *D. neobrevipes* mainly colonises the aerial parts of plants, while *D. brevipes* inhabits the roots and basal portions of the host plants as per the earlier reports[7]. On the contrary, in this study, *D. neobrevipes* infestations initially started in the underground portions of tuberose plants, and the mealybug colonies were predominantly found on the basal parts. These colonies were on the aerial parts of the plant, including the shoots, leaves, and even spikes during the flowering and post-flowering stages. Even while infesting aerial parts, *D. neobrevipes* tend to conceal themselves in protected areas of the pineapple, such as under bracts, making visual detection challenging[17]. *D. neobrevipes* preference to inhabit concealed areas of plant structures may be attributed to the basal portion being the only resource for feeding before spike formation. The present study is the scientific report of *D. neobrevipes* as an important emerging pest of tuberose.

Detection of mealybug in the early stage of the crop is difficult because of concealed feeding habits. *D. neobrevipes* can spread through infested bulbs and ants. Therefore, it is essential to thoroughly wash harvested bulbs with a 1% detergent solution and allow them to dry in the shade before storage. Stored bulbs should be regularly inspected for mealybug colonies and washed with 1% detergent before planting to prevent initial field infestations. Awareness among farmers should be created about concealed feeding habits and related management, in-depth studies on its field bio-ecology and natural enemies to develop effective management measures to curtail the infestation and damage of *D. neobrevipes* in tuberose.

Conflicts of interest statement: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

1. Singh, K. P., Tiwari, A. K. and Saha, T. N., AICRP on Floriculture, ICAR Database on Tuberose (*Polianthes tuberosa* Linn.) (2010–11 to 2013–14). ICAR-DFR Technical Bulletin No. 17. ICAR-Directorate of Floricultural Research, College of Agriculture Campus, Pune, India, 2015.
2. Sadhukhan, R., Chowdhuri, T. K. and Datta, S. K., Tuberose (*Polyanthes tuberosa* Linn./*Agave amica*). In *Floriculture and Ornamental Plants*, Springer Singapore, Singapore, 2021, pp. 1–52; https://doi.org/10.1007/978-981-15-3518-5_17.
3. Mani, M. and Krishnamoorthy, A., Field efficacy of Australian ladybird beetle, *Cryptolaemus montrouzieri* Mulsant in the suppression of stripped mealybug *Ferrisia virgata* (Cockerell) on tuberose. *J. Biol. Control*., 2007, **21** (Special Issue), 129–131.
4. Shanthi, M., Nalini, R., Rajavel, D. S. and Murali Baskaran, R. K., Occurrence of mealybug, *Ferrisia virgata* Cock on tuberose in Madurai, Tamil Nadu. *Insect Environ*., 2008, **13**(4), 149.

5. Watson, G. W. and Chandler, L. R., *Identification of Mealybugs Important in the Caribbean Region*, CABI Bioscience, Egham, Surrey, UK, 2000, 2nd edn (revised), p. 40.
6. Williams, D. J. and Granara de Willink, M. C., *Mealybugs of Central and South America*, CAB International, UK, 1992, p. 644.
7. Beardsley, J. W., On the taxonomy of pineapple mealybugs in Hawaii, with a description of a previously unnamed species (Homoptera: Pseudococcidae). *Proc. Hawaii. Entomol. Soc*., 1959, **17**(1), 29–37.
8. Choudhary, J. S., Gotyal, B. S., Joshi, S., Ramya, R. S., Patil, J., Lekhana, N., Selvaraj, K. and Shivakumara, K. T., Pineapple mealybug, *Dysmicoccus brevipes* Cockerell (Hemiptera: Pseudococcidae): a new threat to garden pea, *Pisum sativum* L. in India, 8 June 2023, Preprint (version 1) available at Research Square, 2023; https://doi.org/10.21203/rs.3.rs-3028765/v1.
9. García Morales, M., Denno, B. D., Miller, D. R., Miller, G. L., Ben-Dov, Y. and Hardy, N. B., ScaleNet: a literature-based model of scale insect biology and systematics. *Database*, 2016, doi:10.1093/database/bav118; http://scalenet.info (accessed on 26 August 2024).
10. Curry, C., *Dysmicoccus neobrevipes* (grey pineapple mealybug). Available from CABI, Wallingford, UK Crop Protection Compendium, 2022; doi:10.1079/CPC.20251.20210102445.
11. Qin, Z., Wu, J., Qiu, B. L., Ren, S. and Ali, S., Effects of host plant on the development, survivorship and reproduction of *Dysmicoccus neobrevipes* Beardsley (Hemiptera: Pseudoccocidae). *Crop Protec*., 2011, **30**(9), 1124–1128.
12. Miller, D., Rung, A., Parikh, G., Venable, G., Redford, A. J., Evans, G. A. and Gill, R. J., ScaleNet Edition 2, 2014; https://idtools.org/tools/1044/index.cfm?packageID=1113&entityID=3400 (accessed on 7 August 2024).
13. Beardsley, J. W., Notes on the pineapple mealybug complex, with descriptions of two new species (Homoptera: Pseudococcidae). *Proc. Hawaii. Entomol. Soc*., 1965, **19**(1), 55–68.
14. Rohrbach, K. G., Beardsley, J. W., German, T. L., Reimer, N. and Sanford, W. G., Mealybug wilt, mealybugs and ants on pineapple. *Plant. Dis*., 1988, **72**, 558–565.
15. Williams, D. and Watson, G., The scale insects of the tropical South Pacific region. Part 2. The mealybugs (Pseudococcidae), CAB International Institute of Entomology, London, UK, 1988.
16. Beardsley, J. W., TH Su, F. L., McEwen, D. and Gerling, D., Field investigations on the inter relationships of the big-headed ant, the gray pineapple mealybug, and pineapple mealybug wilt disease in Hawaii. *Proc. Hawaii. Entomol. Soc*., 1982, **24**, 51–67.
17. Jahn, G. C., Beardsley, J. W. and González-Hernández, H., A review of the association of ants with mealybug wilt disease of pineapple. *Proc. Hawaii. Entomol. Soc*., 2003, **36**, 9–28.

ACKNOWLEDGEMENTS. The funding for the institute project ‘Eco-friendly Pest Management in Commercial Loose Flower Crops, Project code: 45/S/IPP/12’ by the Indian Council of Agricultural Research, New Delhi is duly acknowledged. We acknowledge Dr Himender Bharati (Professor, Punjabi University, Patiala (India)) for the identification of ant specimens associated with *D. neobrevipes.*

Received 27 September 2024; revised accepted 19 March 2025

doi: 10.18520/cs/v128/i9/946-950

Edited by S. K. Satheesh and printed & published by the Current Science Association, Bengaluru 560 080.
Typeset by WINTECS Typesetters, Bengaluru and Printed at Omkar Offset Printers (Ph. 80267 08186), Bengaluru