

Morphological and molecular confirmation of occurrence of neotropical invasive Bondar's Nesting Whitefly, *Paraleyrodes bondari* Peracchi (Hemiptera, Aleyrodidae) in sugarcane and its seasonal dynamics

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Abstract

Aim: The present study was undertaken to identify and confirm the neotropical invasive whitefly species infesting sugarcane through morphological and molecular characterization, and to assess its seasonal incidence and associated natural enemies.

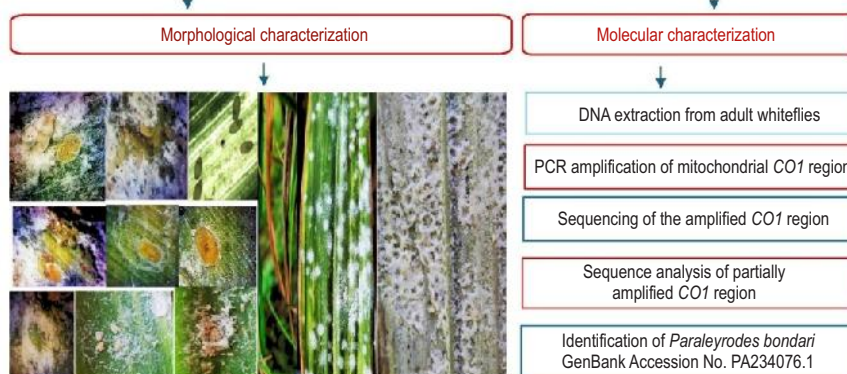
Methodology: The invasive whitefly infesting the sugarcane leaves was identified and confirmed through morphological and molecular characterization. Field and laboratory studies were undertaken to document its biology, seasonal incidence in relation to prevailing weather conditions, and associated natural enemies.

Results: The present study confirms the occurrence of the neotropical invasive whitefly, Bondar's Nesting Whitefly (BNW), *Paraleyrodes bondari* Peracchi (Hemiptera: Aleyrodidae), on sugarcane representing the first documented report of *P. bondari* infesting sugarcane in Andhra Pradesh. Adults formed characteristic woolly wax nests on the underside of sugarcane leaves and exhibited oblique greyish wing bands arranged in an 'X' pattern. Molecular characterization of partial mitochondrial *COI* gene revealed 100% nucleotide identity with *P. bondari* sequences previously reported from coconut, and the sequence was deposited in NCBI GenBank under Accession No. PA234076.1.

Interpretation: Detection of BNW on sugarcane in North Coastal Andhra Pradesh is a potential emerging threat for sugarcane cultivation due to its wide host range and rapid spread; understanding its biology and impact is essential for effective management.

Key words: Bondar's nesting whitefly, Molecular characterization, *Paraleyrodes bondari*, Sugarcane

Morphological and Molecular Confirmation of BNW, *Paraleyrodes bondari* in sugarcane



Introduction

Sugarcane (*Saccharum officinarum*) is an important commercial crop in Andhra Pradesh and plays a vital role in supporting the state's agricultural economy. However, its productivity and quality are frequently challenged by different pests. In recent years, despite quarantine regulations, several invasive insect species have successfully entered India and established themselves across diverse cropping systems, leading to considerable economic losses. Within a span of five years, notably, between 2016 and 2020, seven new whitefly species were reported from the tropical regions of Southern India (Selvaraj et al., 2020a). Among these, the rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*, first detected in India in 2016, rapidly spread across coconut plantations in Tamil Nadu (Srinivasan et al., 2016), Kerala (Shanas et al., 2016), Karnataka (Selvaraj et al., 2017). It was subsequently reported infesting coconut, banana, oil palm, and other horticultural crops (Chalapathi Rao et al., 2018), as well as sugarcane cultivated adjacent to coconut in Andhra Pradesh (Bhavani et al., 2020).

More recently, another invasive whitefly, Bondar's nesting whitefly (BNW), *Paraleyrodes bondari* Peracchi, originally described from Brazil (Peracchi, 1971), has also emerged as a serious pest of coconut in India. It was first noticed in the Andaman and Nicobar Islands in May 2017 (Vindya et al., 2019) and subsequently, reached mainland Kerala by December 2018 (Josephraj Kumar et al., 2019). It is closely associated with the RSW in numerous districts across Kerala, Tamil Nadu, Andhra Pradesh and the Lakshadweep Islands. Although *P. bondari* was initially confined to coconut and oil palm plantations in the southern states, favourable coastal climatic conditions and human-mediated dispersal have facilitated its spread into new regions of South India. In addition to coconut and oil palm, BNW has been reported infesting several other crops in India, such as citrus, guava, cassava, custard apple, jackfruit, bell pepper, cinnamon, Indian mulberry, mango, teak, and banana (Vindya et al., 2019), and more recently cotton (Sadhana et al., 2021). Although *P. bondari* has been recorded on horticultural crops such as coconut, guava, banana and oil palm in Andhra Pradesh (Chalapathi Rao et al., 2023), its occurrence on sugarcane has not been previously reported. Therefore, this study provides the first documented evidence of *Paraleyrodes bondari* infestation on sugarcane in Andhra Pradesh. This novel finding fills a critical knowledge gap in the host-range of this invasive whitefly and provides a baseline for developing targeted integrated pest-management (IPM) strategies in sugarcane cultivation. Accordingly, the present study was undertaken to identify the species infesting sugarcane and to investigate its seasonal incidence and associated natural enemies.

Materials and Methods

The study was conducted at the Regional Agricultural Research Station (RARS), Anakapalle, Andhra Pradesh, India, under the AICRP on Sugarcane, Department of Entomology

during 2024- 2025. The study was focused on identifying a newly observed invasive whitefly species infesting the underside of sugarcane leaves of variety CoA 14321 during the cane maturity stage. The pest was first detected in December 2024 and was since spread across sugarcane fields surrounding research farm of RARS, Anakapalle. Infested sugarcane plants exhibited white waxy nests on the underside of the leaves, followed by leaf yellowing and drying. Identification was based on systematic field observations and detailed morphological and molecular analyses. The identification of *P. bondari* is difficult because of its cryptic morphology and its co-existence with other whitefly species, particularly in immature stages, requiring careful morphological characterization and specialized diagnostic methods. Therefore, the infested sugarcane leaves containing all developmental stages were collected in paper envelopes (Dubey and David, 2012), and the adults were preserved in 70% ethanol along with relevant collection data for subsequent laboratory identification and documentation.

Morphological characterization: Morphological identification of invasive whitefly was performed by preparing mounted slides following the procedure described by Hodges and Evans (2005). The pseudo-pupal stage specimens were mounted and examined under a Stereo zoom Microscope equipped with an inbuilt camera and Capture Pro software (version 4.6). Microscopic images were captured and compared with Martin (2004) standard key characteristics. The detailed morphological features of eggs, nymphs, and puparia were studied using a compound microscope (NIKON Eclipse E 200), with images digitally recorded through VImage software. Permanent mounts of puparia were prepared to aid in species confirmation based on morphological traits. Generic classification was guided by the key provided by Sundararaj et al. (2020), while species-level identification was validated by cross-referencing descriptions from authoritative taxonomic literature (Wosula et al., 2018; Selvaraj et al., 2024). Following the initial detection of *P. bondari*, a roving survey was conducted to study its incidence patterns. The whitefly was found colonizing coconut and guava plants in the Anakapalle district of Andhra Pradesh since December 2024. Specimens collected from these infested hosts were subjected to morphological analysis for species confirmation. Given that host plant specificity is not a determining factor for identifying this invasive whitefly species, this study focused on assessing the incidence, severity, and molecular characterization of invasive whitefly on sugarcane in Andhra Pradesh. Concurrently, infested sugarcane leaf samples were sent to the National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru, for independent species verification and confirmation through morphological identification.

Molecular characterization: For molecular confirmation, adult whiteflies were used for DNA analysis. Genomic DNA was extracted from individual adult specimens following standard protocol (Sambrook and Russel, 2001). The partial mitochondrial cytochrome c oxidase subunit I (*mtCOI*) gene, approximately 658 base pairs in length, was amplified using polymerase chain

reaction (PCR). The amplified PCR product was subsequently sequenced, and the resulting sequence was compared against reference sequences available in the NCBI GenBank database using BLAST analysis to confirm species identity.

DNA Extraction: Adult invasive whiteflies collected from infested sugarcane leaves were maintained under controlled laboratory conditions ($26 \pm 2^\circ\text{C}$, $70 \pm 5\%$ RH, 12:12 h light : dark) and reared on sugarcane leaves. Genomic DNA was extracted from five adults using a modified CTAB method (Sambrook and Russell, 2001) in combination with the Qiagen DNase kit. The insects were homogenized in liquid nitrogen, and the homogenate was mixed with 600 μl of pre-heated (60°C) 2 \times CTAB extraction buffer (2% w/v CTAB, 100 mM Tris-HCl pH 8.0, 1.4 M NaCl, 20 mM EDTA). After incubation at 60°C for 1 hour, DNA was purified using repeated phenol:chloroform:isoamyl alcohol (25:24:1) extraction, followed by isopropanol precipitation and ethanol washing. DNA pellet was air-dried and resuspended in 70 μl TE buffer, then stored at -20°C . DNA integrity was confirmed by 1.2% agarose gel electrophoresis and the concentration and purity were measured spectrophotometrically.

PCR amplification of mitochondrial cytochrome c oxidase-1 (COI) region: To complement morphological identification, molecular analysis targeting the COI gene was conducted to confirm the identity of the invasive whitefly species. The COI gene was amplified using universal primers: Forward primer (LCO 1490): 5'-GGTCAACAAATCATAAAGATATTGG-3', Reverse primer (HCO 2198): 5'-TAAACTTCAGGGTGACCAAAAATCA-3' (Folmer et al., 1994). Polymerase Chain Reaction (PCR) was performed in 200 μl flat-capped PCR tubes (Tarsons, Kolkata, India), in a 20 μl reaction mixture consisting of 1X reaction buffer (with 25 mM Mg Cl₂), 0.01 mM dNTPs, 0.001 M of each primer, 1 U Taq DNA polymerase (Genei), 100 ng template DNA.

PCR amplifications were carried out in an Eppendorf DNA thermocycler using the following thermal profile: Initial denaturation at 97°C for 6 min followed by 35 cycles of denaturation at 94°C for 1 min, annealing at 55°C for 1 min, extension at 72°C for 2 min, final extension at 72°C for 10 min (Josephraj Kumar et al., 2020). The amplified PCR products were separated by electrophoresis on a 1.2% agarose gel at 80 volts for 45 min. The quality and concentration of DNA was evaluated using a spectrophotometer. Positive amplification confirmed the presence of the target COI gene region.

Sequencing of the amplified mtCOI region: PCR-amplified products were resolved on a 1.2% agarose gel and visualized using a gel documentation system. A 100 bp DNA ladder was included for size estimation. Amplicons of approximately 500–600 bp, corresponding to the mtCOI region, were selected for downstream sequencing. The 5' terminus of the COI gene was amplified using universal primers. The quality and integrity of the PCR products were verified by agarose gel electrophoresis, and purified amplicons were submitted for Sanger sequencing at Chromous Biotech Pvt. Ltd., Bangalore.

Identification of whitefly species through partially amplified mtCOI sequence analysis: Molecular identification of invasive whitefly was conducted using the partial amplified nucleotide sequences of the mtCOI gene. The resulting sequences were subjected to homology analysis using the BLAST (Basic Local Alignment Search Tool) program available at the National Centre for Biotechnology Information (NCBI). Sequence similarity was assessed by comparing the obtained mtCOI sequences with those in the NCBI GenBank database to confirm species-level identity.

Assessment of severity of the infestation and its association with weather parameters: An observational plot (0.5 acre) naturally infested with invasive whitefly was selected for the study. Sampling was carried out at 10 locations within the plot, following a uniform protocol. Pest incidence was assessed visually, and infestation levels were graded based on the presence of all active life stages (eggs, nymphs, and adults). Population density was recorded weekly from 50 randomly selected sugarcane plants at each location. Observations were taken throughout the infestation period and correlated with prevailing weather parameters to analyze environmental influences on pest dynamics. Infestation severity per plant was evaluated using the grading scale of Chalapathi Rao et al. (2023).

Results and Discussion

In December 2024, four years after the first detection of the neotropical invasive whitefly, *Aleurodicus rugioperculatus* (RSW) at the research farm of the Regional Agricultural Research Station, Anakapalle (Andhra Pradesh, India), a second neotropical invasive whitefly species was recorded infesting sugarcane. Detailed morphological assessment identified the species as *Paraleyrodes bondari* Peracchi (Hemiptera: Aleyrodidae), commonly called Bondar's Nesting Whitefly (BNW). It was primarily observed colonising the abaxial (underside) surfaces of sugarcane leaves of multiple varieties. Initially, in December 2024, infestation was detected on sugarcane variety CoA 14321 (8–10-month-old crop) over a 0.5 acre area, where 68% of plants exhibited symptoms consistent with BNW infestation. Subsequently, by the end of February 2025 the pest incidence had expanded to other varieties including CoA 92081, CoA 99082 and CoA 14323. Infestation intensity across surveyed fields ranged from low to high.

Both nymphs and adults of BNW were found residing within the characteristic woolly wax nests on the underside of leaves (Fig. 1a–d). Adult BNW were identified by a distinctive “X”-shaped marking on the wings along with a fine powdery coating on wings and body (Fig. 2i). These whiteflies appeared to feed by inserting piercing-sucking mouthparts into the phloem tissue and extracting sap rich in sugars and amino acids (as described by Martin et al., 2000). Colonised leaves exhibited typical symptoms like formation of circular waxy nests, progressive yellowing and chlorosis, sooty mold development on the upper surfaces, and eventual desiccation and drying (Fig. 1e–f). Prolonged feeding by

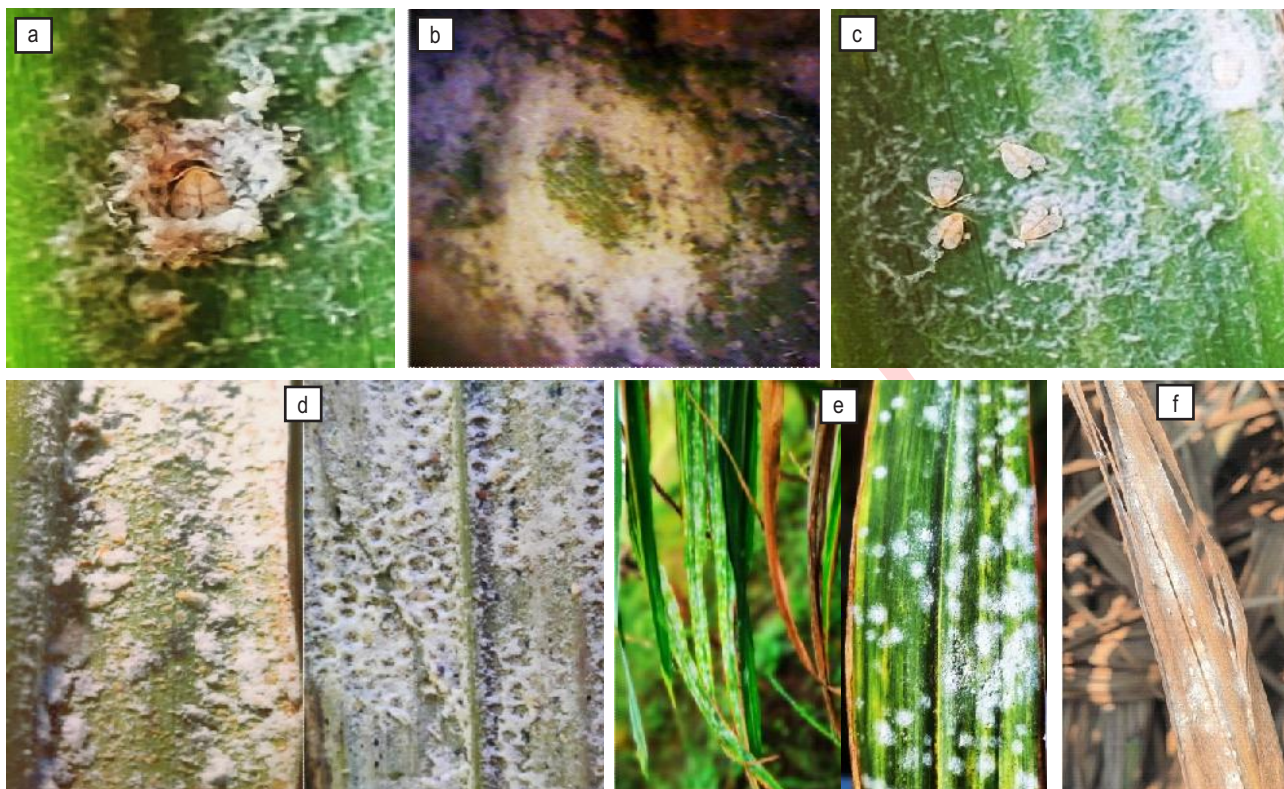


Fig.1: *P. bondari*-Damage symptoms in sugarcane (a-e): (a) Adult in woolly wax nest; (b) Empty nest; (c) Adults on sugarcane leaf; (d) Woolly waxy nests on the underside of sugarcane leaf; (e) Chlorotic patches on infested sugarcane leaves; (f) Drying of the leaf.

BNW led to yellowing, chlorosis, and eventual drying of sugarcane leaves (Fig. 1e-f). Although BNW appeared to excrete less honeydew than RSW, direct feeding damage by BNW produced more pronounced yellowing and leaf drying in the surveyed fields. Such physiological stress can adversely affect the cane yield and juice quality, particularly by reducing sucrose content and sugar recovery. Infestation levels exhibited a range from low to severe across various fields, with certain locations demonstrating extensive colonization.

Morphological Identification: The newly invasive whitefly species infesting sugarcane was identified as Bondar's Nesting Whitefly, *Paraleyrodes bondari* Peracchi (Hemiptera: Aleyrodidae), based on the morphological characteristic of adult male reproductive structure. The adults of *P. bondari* were smaller in size compared to those of the rugose spiralling whitefly. BNW forms small, irregular, waxy colonies on the ventral surface of sugarcane leaves and constructs distinctive nest-like structures resembling bird nests (Fig. 1a-e).

Biology: On the undersides of leaves, the adult *P. bondari* laid stalked eggs in circular clusters, commonly referred to as "nests," composed of fuzzy wax. Each nest contained approximately 20 to 66 eggs. Newly laid eggs were rectangular, pale yellowish in colour, and possessed a short pedicel (Fig. 2 a-d). As the eggs

matured, they turned orange or dark yellow and developed a longer pedicel before hatching (Fig. 2 d-e). The eggs hatched into first-instar crawlers (Fig. 2 e-f), which dispersed to locate suitable feeding sites and then settled. The nymphs (Fig. 2 g) were flat, creamy yellow, and transparent, characterized by marginal hairs and fibrous, glass-like dorsal projections. They also had small setae along the body margins and secreted a ring of white, waxy, filamentous threads from well-developed compound pores. The pupal stage was flat and encircled by a distinctive wax pattern (Fig. 2 h). The puparium exhibited long, shiny wax threads and contained a well-developed lingula and vasiform orifice. It typically had five or six compound pores; the anterior one or two pairs were notably smaller than the remaining abdominal and cephalic pairs. The thoracic region bore two pairs of cicatrices and a pair of submedian setae, while the outer sub margin was lined with 14 pairs of hair-like setae. The adult was a small insect, measuring approximately 1.0 mm in length. The adults had powdery white forewings marked by a distinct "X"-shaped oblique grey band and were covered with a fine, waxy coating (Fig. 2 i). A key diagnostic feature of the male was the rod-shaped aedeagus (Fig. 2 j-l), which bore both anterior and posterior horns. Females had four articulated antennal segments, whereas males had three. During oviposition, females secreted abundant wax, forming characteristic nest-like structures that gave rise to the common name "nesting whiteflies". The adults had unbranched

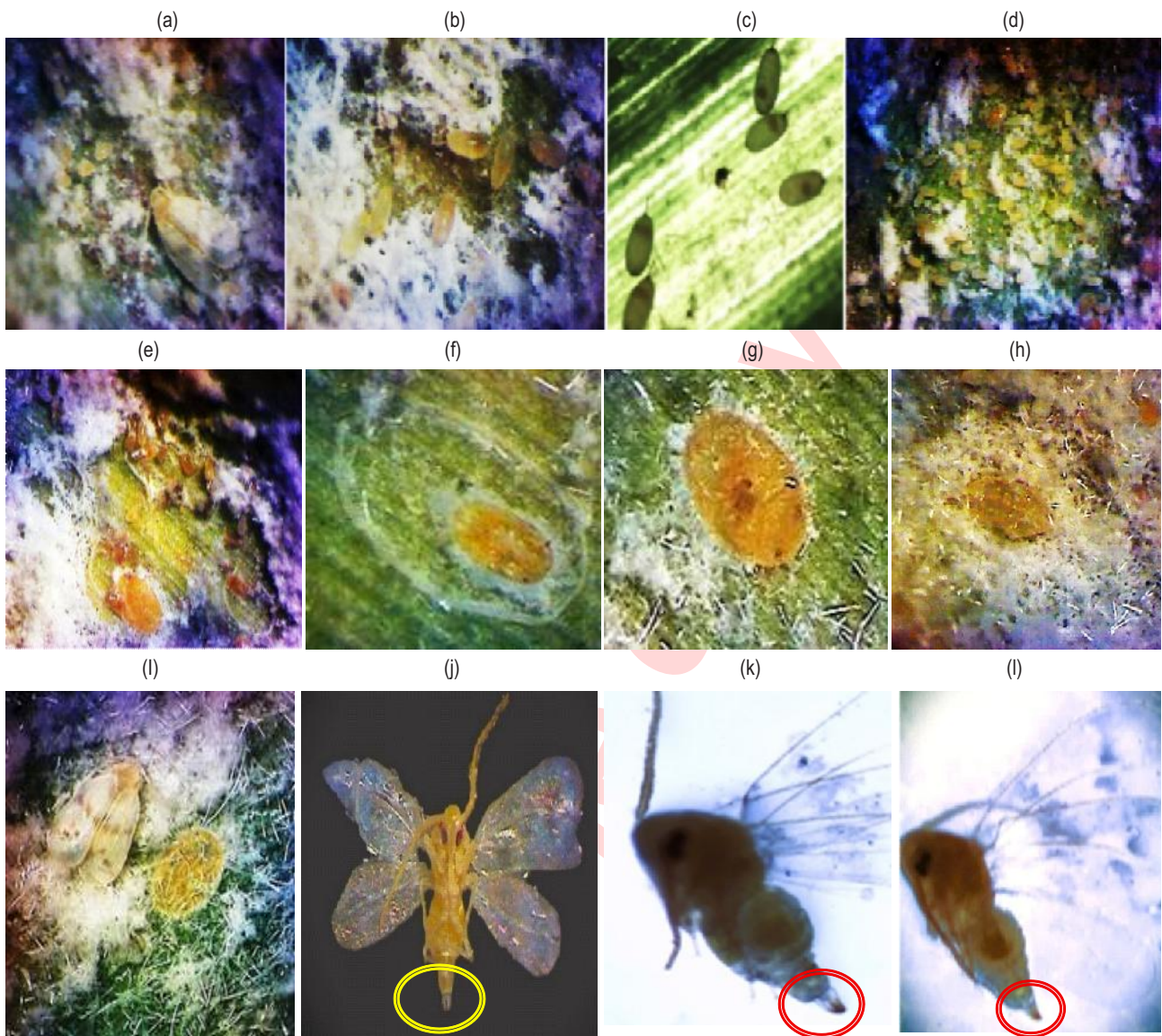


Fig. 2 (a-l): Life stages of *P. bondari*. (a-d) Stalked eggs laid by female adult on underside of the sugarcane leaf); (e) Tanned eggs and crawler; (f-h) Different instars of nymphs; (i) Adult and Pupa; (j) Male adult; (k-l) Male genitalia and Unbranched wings.

wing veins (Fig. 2 k-l) and generally remained within the woolly waxy nests (Fig. 1 a-d). The complete life cycle of *P. bondari* is completed within approximately 20–28 days. The life-stage descriptions of *P. bondari* are consistent with those reported by Martin (2004), Vidya et al. (2019) and Suriya et al. (2023).

The morphometric analysis of *P. bondari* across different developmental stages revealed that the eggs measured $154.4 \pm 0.29 \mu\text{m}$ in length and $83.8 \pm 0.15 \mu\text{m}$ in breadth. The first to fourth instar nymphs ranged from $244.6 \pm 0.31 \mu\text{m}$ to $587.0 \pm 0.28 \mu\text{m}$ in length and $163.9 \pm 0.17 \mu\text{m}$ to $414.3 \pm 0.20 \mu\text{m}$ in breadth. Adults measured $1009.1 \pm 0.34 \mu\text{m}$ in length and $527.1 \pm 0.20 \mu\text{m}$ in breadth. These morphometric values for eggs,

nymphal instars, and adults (Table 1) are in close agreement with the observations of Suriya et al. (2023). Minor variations in measurements may be attributed to differences in host plants, environmental conditions, or geographical location, which are known to influence the size and development of whitefly species.

Further, *P. bondari* was authoritatively identified by Dr. Selvaraj Krishnan from ICAR-NBARI, Bengaluru based on the following diagnostic characters: shape of male aedeagus; structure of cephalic and abdominal compound pores of puparium. Taken together, these results confirm the presence and establishment of *P. bondari* in India on sugarcane, and this plant species represent a new host for this whitefly.

Table 1: Measurements of the body length and breadth of different life stages of *P. bondari*

Life stages	Body measurements	
	Length (µm)	Breadth (µm)
Eggs	154.4 ± 0.29	83.8 ± 0.15
1 st nymphal instar/Crawler	244.6 ± 0.31	163.9 ± 0.17
2 nd nymphal instar	349.1 ± 0.32	247.3 ± 0.74
3 rd nymphal instar	451.9 ± 0.24	357.7 ± 0.48
4 th nymphal instar/Puparium	587.0 ± 0.28	414.3 ± 0.25
Adult	1009.1 ± 0.34	527.1 ± 0.20

Values are mean ± S.D.

Table 2: Incidence and intensity of *P. bondari* in sugarcane (Dec 2024 to Mar 2025)

Standard week / Year	Incidence of <i>P. bondari</i> (infested leaves/plant) (%)	No. of live nests/leaf	Severity	Rainfall (mm)	Temperature °C		Relative humidity (%)	
					Max	Min	A.N	F.N
2024-25								
51SW	4.0	0.2	Low	41.2	27.4	19.1	95.0	74.9
52SW	10.0	0.6	Low	3.8	28.0	18.4	91.3	57.1
2025-26								
1SW	16.0	1.2	Low	0.0	28.0	18.4	91.3	57.1
2SW	24.0	10.6	Moderate	0.0	29.3	17.0	93.6	51.0
3SW	27.0	12.2	Moderate	0.0	28.9	16.1	95.1	48.4
4SW	34.0	20.8	High	4.8	29.5	15.8	95.9	45.6
5SW	42.0	22.1	High	0.0	31.7	15.3	97.3	51.1
6SW	46.0	25.4	High	0.0	32.8	18.0	95.0	51.0
7SW	53.0	22.6	High	0.0	34.0	20.1	94.9	47.7
8SW	62.0	21.8	High	0.0	34.1	19.4	92.9	47.3
9SW	68.0	13.6	Moderate	0.0	33.7	20.7	92.6	45.7
10SW	68.0	8.8	Low	0.0	35.7	20.3	94.1	41.3

(Low: 0-10 live adult nests /leaf; Moderate: 10.1-20 live adult nests/leaf; Severe: >20 live adult nests /leaf (Chalapathi Rao et al., 2023).

At molecular level, the partial cytochrome c oxidase subunit-I (*COI*) region of the tested whiteflies was sequenced, and homology comparisons were conducted. The test sequence was compared with available database sequences in NCBI and BOLD database. The sequence-based homology confirmed the population as *Paraleyrodes bondari* Peracchi (Hemiptera; Aleyrodidae). The *COI* region sequence was deposited in NCBI database with an accession number, PA234076.1. Barcode of life (BOLD) database specimen identification results showed 100 per cent identity with Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi on coconut (GenBank accession MK343480.1; MW041899.1; MW488198.1), which was reported as a new invasive species in Kerala (Josephraj Kumar et al., 2019), Karnataka in 2020 (Shivaji Thube et al., 2020) and in Tamil Nadu (Banumathi et al., 2021). The sequence of the tested whitefly and *P. bondari* were highly homologous, and the sequence similarity reached 100%. A phylogenetic tree was constructed by using neighbor-joining (NJ) method in MEGA software (ver. 10.0.5)

considering most relevant sequences from NCBI database along with sequence data of our investigation. Separate grouping was obtained through *COI* region sequences where in *Paraleyrodes bondari* Peracchi sequences were clustered in one clade as depicted in Fig. 3.

The Bondar's nesting whitefly (*Paraleyrodes bondari*) was observed actively feeding on sugarcane leaves. In December 2024, the infestation level was approximately 4.0%; however, by the end of February 2025, it had sharply increased to 68% in the observational plot. Initially, the population density was low, with an average of 0.2 live nests per leaf during the 52nd standard week (SW) of 2024. This increased dramatically to 25.4 live nests per leaf (High) by the 6th SW (second week of February 2025). By the 10th SW (second week of March 2025), the population density declined to 8.8 live nests per leaf. These findings highlight the rapid buildup of BNW populations and emphasize the importance of continuous monitoring and timely

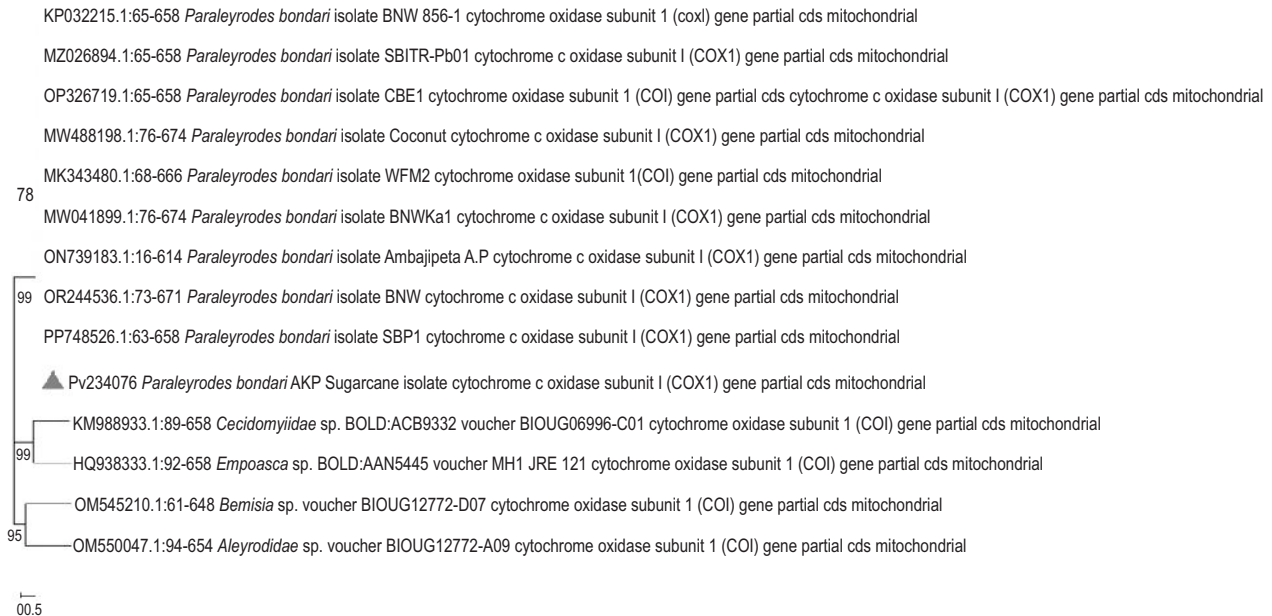


Fig. 3: Phylogenetic tree of BNW constructed based on the neighbor-joining (NJ) method and Bootstrap values are displayed at each node.

Table 3: Association between incidence of BNW and weather parameters

Weather parameter	Correlation Coefficient (r)
Max. Temp. (°C)	0.50*
Minimum Temp. (°C)	-0.26*
Afternoon RH(%)	0.59*
Forenoon RH (%)	-0.05
Rainfall (mm)	-0.44*

*Significant at 5% level

management interventions to minimize their potential impact on sugarcane productivity (Table 2). The present study on the correlation between abiotic factors and the population of Bondar's Nesting Whitefly (*Paraleyrodes bondari*) revealed significant relationships with several environmental variables. Maximum temperature ($r = 0.50$) and evening relative humidity ($r = 0.59$) exhibited strong positive correlations with the population density. Conversely, rainfall ($r = -0.44$) showed significant negative correlations (Table 3).

These findings align with the previous research indicating that whitefly populations are particularly sensitive to wet seasons and periods of heavy rainfall, with population surges often linked to temperature increase of over 2°C during the summer months. Dickey et al. (2015) reported that temperature and rainfall are critical environmental factors that influence the diversity and distribution of Aleyrodids, especially whiteflies. Optimal conditions for whitefly activity and development are generally found at elevated temperatures between 15°C to 35°C, which

support all life stages including oviposition, larval growth, nymphal development, and adult emergence. Singh et al. (2017) emphasized that regional rainfall patterns directly affect whitefly species composition, highlighting the complex interplay between climatic variables and population dynamics. Chandrika et al. (2019) reported that reduced rainfall, increased temperature, and lower humidity contribute to the outbreak and rapid spread of the RSW. Similarly, Elango and Nelson (2020) identified prolonged dry spells as the primary factor for the proliferation and dispersal of this species in Tamil Nadu. In the case of *A. dispersus*, population density was positively correlated with maximum temperature and negatively correlated with relative humidity on guava (Mani and Krishnamoorthy, 2000). Aishwariya et al. (2007) reported that only maximum temperature had a significant impact with the whitefly population whereas other abiotic factors were not significantly influencing the population and noted that whiteflies are present year-round in South India, with population peaks during summer (March to June) and declines in winter (October to January).

In the present study, *P. bondari* was found to co-occur with the sugarcane whitefly, *Aleurolobus barodensis* (Fig. 4 a-b); with *Melanaphis sacchari* (sugarcane aphid) and *A. barodensis* (Fig. 4 c-d); with *Aleurodicus rugioperculatus* (Fig. 4 e-f) on sugarcane leaves across different locations. The coexistence of BNW with *A. barodensis* and *M. sacchari* was relatively high, accounting for about 70% compared with other associated species namely *A. barodensis* alone (20-25%), *A. rugioperculatus* alone (5%). While sugarcane yellow leaf disease is known to be aphid-vectored, the establishment of a new whitefly species on sugarcane opens the possibility of altered epidemiology; its vector potential needs to be investigated. The feeding damage of BNW was more than RSW with minimum

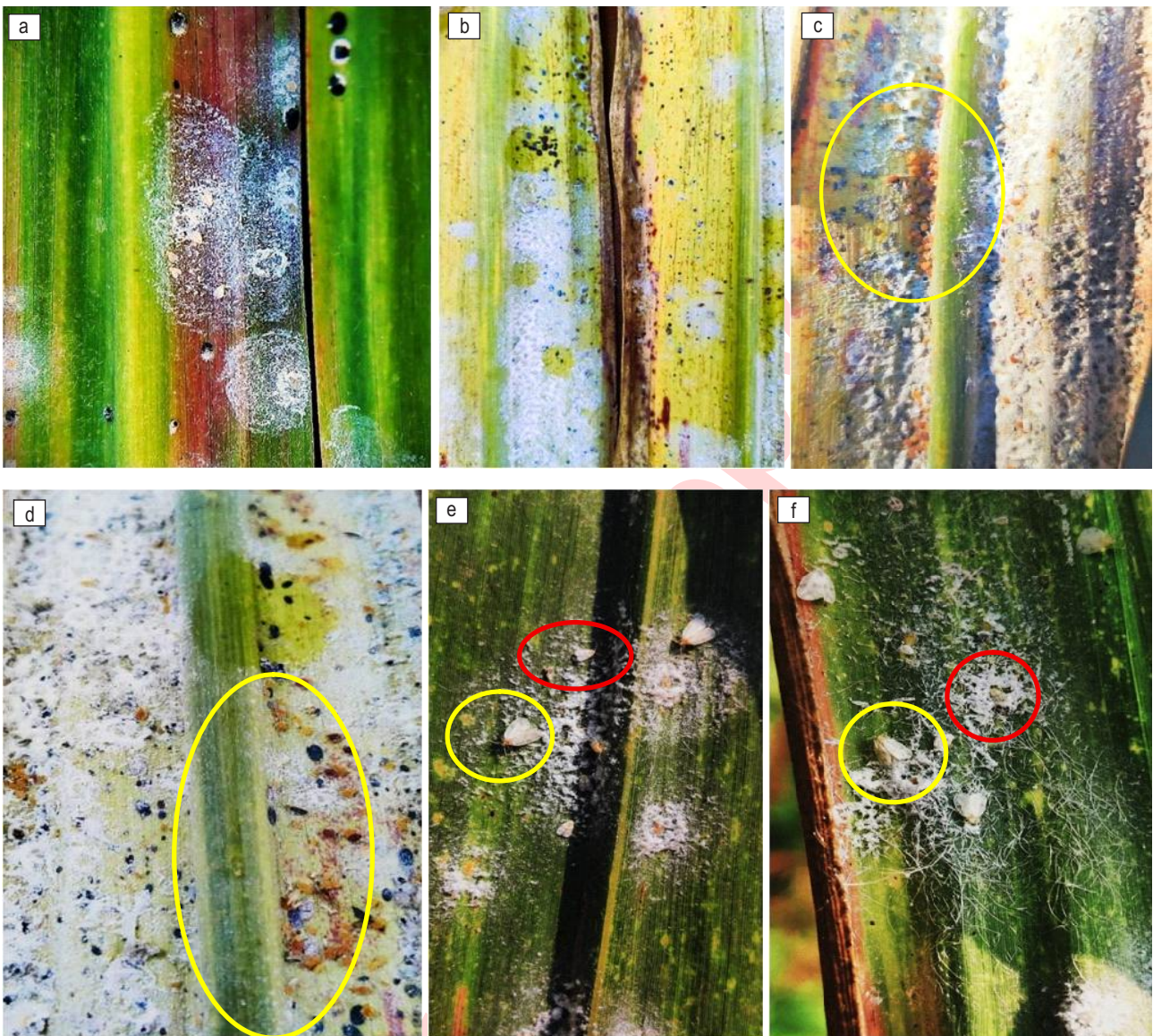


Fig. 4 (a-f): Co-existence of *P. bondari* with other insect pests in sugarcane. (a-b) *P. bondari* with *Aleurolobus barodensis*, (c-d) *P. bondari* with *Melanaphis sacchari* & *A. barodensis* (e-f) *P. bondari* with *A. rugioperculatus*.

honeydew and sooty mould deposits on sugarcane leaves. The co-occurrence of *A. rugioperculatus* and *P. bondari* on coconut palms was previously reported by Josephraj Kumar (2019) and Sundararaj *et al.* (2021), as well as on oil palm by Chalapathi Rao *et al.* (2023), suggesting a possible simultaneous introduction of these species from the New World.

Preliminary observations indicated that no parasitized nymphs or puparia of the BNW were found associated with the parasitoid *Encarsia guadeloupae* on sugarcane. However, general predators like *Chrysoperla carnea*, *Micromus* spp. (Fig. 5 a), coccinellids like *Micraspis univittata* Hope (Fig. 5 b) and *Anegleis cardoni* Weise (Fig. 5 c) were observed on the infested

leaves. Since these predators are not exclusive to BNW, their potential to effectively suppress whitefly populations appears limited. More targeted biological control strategies may be necessary to manage BNW infestations effectively. As of now, no specialized parasitoids of *P. bondari* have been documented globally (Daniel *et al.*, 2020) or in India (Sadhana *et al.*, 2023).

Nevertheless, certain predatory species belonging to Coccinellidae, Chrysopidae and Cecidomyiidae have been observed preying on *P. bondari* at different developmental stages (Sadhana *et al.*, 2022). These generalist predators, frequently reported in coconut ecosystems, may contribute to the natural suppression of *P. bondari* populations (Selvaraj *et al.*, 2020b).

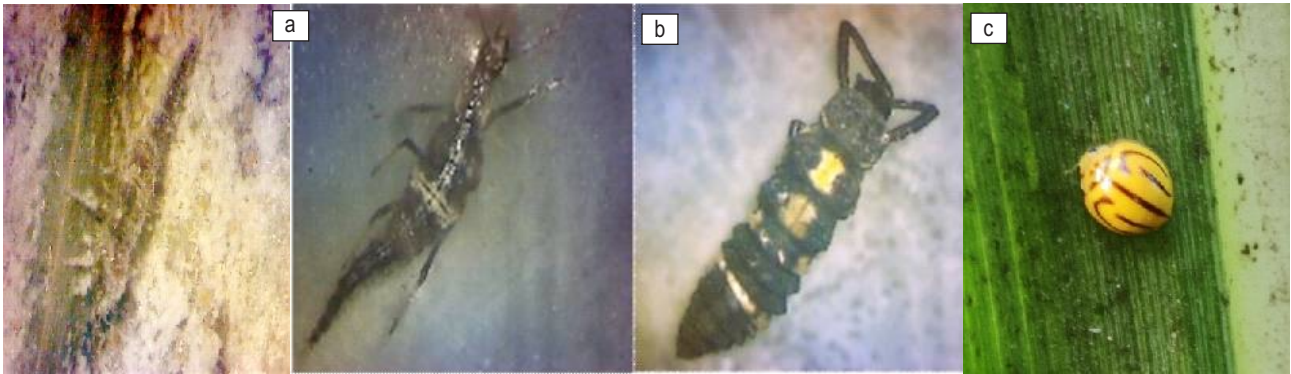


Fig. 5 (a-c): Natural predators observed in sugarcane (a) *Micromus* spp.; (b) Coccinellid-*Propylea dissecta* grub; (c) Adult of *Anegleis cardoni* (Weise).



Fig. 6 (a - b): Incidence of *P. bondari* on other host crops (a) Guava, (b) Coconut.

P. bondari has recently been observed in sugarcane-growing regions of Andhra Pradesh, although it has previously been reported on other crops such as guava, coconut, and banana. Until now, no records existed of its occurrence in the sugarcane agroecosystem in this region. Given its ability to cause economic damage to multiple horticultural crops, its establishment in sugarcane raises concern and may lead to significant yield losses if not managed promptly. Other crops namely Cassava (Omongo *et al.*, 2018), Citrus (Peracchi, 1971), Cotton (Sadhana *et al.*, 2021), Ficus (Stocks, 2012), Guava (Sundararaj *et al.*, 2021), Coconut (Josephraj Kumar *et al.*, 2019),

Banana and Subabul (Vidya *et al.*, 2019), Jasmine, Golden dew drop, rambutan, egg fruit, snake plant, red ginger (Suriya *et al.*, 2024) were also reported in different regions of India.

The present study confirms the occurrence of BNW (*Paraleyrodes bondari*) on sugarcane in Andhra Pradesh, posing a new threat to sugarcane cultivation. Its polyphagous nature and lack of natural enemies in newly affected areas heighten the risk of serious crop damage. Beyond dispersal through air and planting material, changing climatic conditions may facilitate its further spread. Hence, systematic surveys along with integrated

management strategies are essential to limit infestation and prevent further expansion.

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