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New records of leafhoppers from Gujarat

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Abstract
Leafhoppers (Hemiptera: Cicadellidae) represents one of the most diverse groups of phytophagous insects, many of which are important agricultural pests and vectors of plant pathogens. Despite their ecological and economic importance, the diversity of leafhoppers in Gujarat remains poorly documented. The present study reports the first systematic survey of leafhopper fauna from Anand Agricultural University (AAU), Anand in central Gujarat. Specimens were collected using sweep nets and light traps across multiple sites within the AAU campus and identified using standard taxonomic keys and databases. A total of thirteen leafhopper specimens were recorded, belonging to different genera and tribes, of which six species are documented for the first time from Gujarat *i.e*., *Balclutha incisa* (Matsumura), *Balclutha rubrostriata* (Melichar), *Cicadulina* sp., *Exitianus indicus* (Distant), *Hecalus* sp. and *Erythroneura* sp. Detailed redescriptions, diagnostic characters, host plants, seasonal occurrence, and distributional data are provided for each species. The findings highlight the rich but underexplored diversity of leafhoppers in Gujarat and underscore the need for continued faunistic surveys to better understand their host associations, pest potential, and role in agroecosystems.

Keywords: Leafhopper, diversity, sweep net, light trap, grass leafhopper, maize leafhopper

Introduction
Leafhoppers, belonging to the family Cicadellidae under the superfamily Membracoidea, represent one of the most diverse and ecologically significant groups of sap-sucking herbivorous insects within the infraorder Cicadomorpha of the order Hemiptera (Dietrich, 2005; Zhang, 2011) [5, 15]. With approximately 20,000 known species globally, Cicadellidae is a dominant and distinctly phytophagous insects feeding on nearly all vascular plant families (Deitz & Dietrich, 1993; Dietrich, 2013) [4, 6]. They are characterized by unique morphological traits, such as an enlarged post-clypeus, aristiform antennae and specialized wing venation patterns (Dietrich, 2005) [5]. Leafhoppers cause significant damage to agricultural crops through both direct feeding and indirect transmission of plant pathogens like viruses, bacteria and phytoplasmas, with only 1% of species currently recognized as vectors, reflecting a limited understanding of their ecological roles (Nault & Ammar, 1989; Dietrich, 2013) [10, 6]. Notable vector-borne diseases include peach yellow and little leaf of brinjal, caused by *Macropsis trimaculata* (Fitch) and *Hishimonas phycitis* (Distant), respectively (Bennett, 1967; Kumar *et al*., 2017) [2, 9]. As part of the "Big Five" insect orders, hemipterans such as leafhoppers are integral to biodiversity and ecosystem functioning in agricultural systems (Schuh & Slater, 1995; Kremen *et al*., 1993) [12, 8]. Their diversity study is crucial for knowing their host range, pest prediction, pest status, monitoring and the development of sustainable agricultural practices.

Leafhopper species have been documented in various regions of India, including Andhra Pradesh, Assam, Karnataka, Tamil Nadu and Gujarat. However, the leafhopper fauna of Gujarat remains largely unexplored. With this in view, an attempt was made to document leafhoppers from Anand Agricultural University, Anand located in central Gujarat. Anand is bordered to the north by Mahisagar district, to the south by the Gulf of Cambay (Khambhat), to the east by Panchmahal district, to the southeast by Vadodara district, and to the west by Kheda district (Anand Collectorate, 2025) [1]. The campus of Anand Agricultural University supports a diverse range of vegetation, including cultivated agricultural and horticultural crops, medicinal plants, and a diverse of weed and tree species. This study involved leafhopper collection across multiple sites in the Anand campus. Specimens were primarily collected from vegetation and by using light traps.

This represents the first systematic survey of its kind in the region and lays the groundwork for future research on local leafhopper diversity.

Materials and Methods

Leafhopper specimens were systematically collected from multiple sites within the AAU campus. Sampling was conducted using standard entomological techniques, including sweeping vegetation with a muslin sweep net during *kharif-rabi*, 2024-25 and deploying light traps at nocturnal hours during *rabi*-summer, 2024-25. Specimens were euthanized using potassium cyanide in a killing jar and subsequently pinned on a triangular card and also preserved in 70% ethanol which was sent to taxonomist *viz*., Yashwanth H. M., Bangalore and Naresh Meshram, Nagpur for identification. Attempt was made to identify leafhoppers using taxonomic keys given by Dietrich, 2005 and also from website, Auchenorrhyncha database (https://hoppers.speciesfile.org/). Each specimen was labeled with data, including locality, collection date, collector's name and host plant (when identifiable). Microscopic examination was performed for morphological analysis and high-resolution images were captured for documentation and comparative study.

Results and Discussion

In the current study, out of thirteen leafhoppers collected, three leafhopper species were first report from Gujarat. Their morphological characters which can be shown are provided in plates and redescribed from previous researches. Their taxonomic hierarchy also provided with their distribution, host plants and season of collection.

Systematic Position

Order: HEMIPTERA, Linnaeus 1758

Suborder: AUCHENORRHYNCHA, Duméril 1806

I) Subfamily: DELTOCEPHALINAE, Fieber 1869

A) Tribe: MACROSTELINI, Kirkaldy 1906

i) Genus: *Balclutha*, Kirkaldy 1900

1. *Balclutha incisa* (Matsumura, 1902) [Fig. 1]
Common name: Grass leafhopper

Redescription: Yellowish green to brownish in overall appearance. Pronotum and vertex without orange-red to brownish longitudinal markings. The head is as wide as the pronotum. The crown is short with a weakly angulate anterior margin. Ocelli are situated at the anterior margin of the crown and are visible from above. The pronotum is significantly longer than the crown, with short and divergent lateral margins that may sometimes be longer; carina is absent. The posterior margin is either straight (transverse) or slightly concave. Forewing elongated possessing two subapical cells and four apical cells (Shah *et al*., 2023) [13].

Distribution: Worldwide distribution including India. In India, it is recorded from various locations including Tamil Nadu, Tripura and Assam.

Host plant(s): Mainly grasses and rice (*Oryza sativa* L.).

Season of collection: Throughout study period, *kharif* (2024)

Method of collection: Sweep net

Collected from plants: Rice, soyabean, cowpea, redgram

2. *Balclutha rubrostriata* (Melichar, 1903) [Fig. 2]
Common name: Grass leafhopper

Redescription: Head equal in width to pronotum. Pronotum bears longitudinal stripes that extend to the posterior margins of the vertex and scutellum (Shah *et al*., 2023) [13].

Distribution: It is basically native to Sri Lanka and India later rapidly spread to Australia, various Asian islands, Southeast Asia, Japan, the eastern Mediterranean, and several African nations in the Old World. In the New World, it has been recorded in Puerto Rico, the U.S. Virgin Islands, Central America, Hawaii, and more recently, in Texas, USA.

Host plant(s): Mainly grasses

Season of collection: November to February *i.e*., *rabi* (2024-25)

Method of collection: Light trap

ii) Genus: *Cicadulina*, China 1926 (Fig. 3)
Common name: Maize leafhopper

Redescription: Body coloration ranges from pale yellow to a more intense golden yellow hue. Certain species exhibit black markings on the forewings, pronotum and ventral surface. The dorsal abdominal region typically presents a brown pigmentation. The majority of species exhibit a pair of circular brown spots located on the anterior margin of the crown. Sexual dimorphism is evident, with the female *Cicadulina* characterized by an elongated ovipositor distinguishing it from the male (Bosque-Perez and Alam, 1992) [3].

Distribution: Found in India, Iran, South Africa, Kazakisthan, Sweden, Namibia, Tanzenia, Yemen, Ethiopia, Ukraine. It is found throughout India.

Host plant(s): Bajra [*Pennisetum glaucum* (L.)] and maize (*Zea mays* L.)

Season of collection: July to September, *kharif* (2024)

Method of collection: Sweep net

Collected from plants: Bajra, maize, wheat and okra

B) Tribe: CHIASMINI, Distant 1908

i) Genus: *Exitianus*, Ball 1929

***Exitianus indicus* (Distant, 1908) [Fig. 4]**
Common name: Grassland leafhopper

Redescription: Yellow-brown in color with a variable anterior margin of pronotum with a series of black spots arranged in an arc, frontoclypeus shows faint brown lateral arcs. Scutellum marked with faint brown basal triangles (Naveed *et al*., 2021) [11].

Distribution: India, China, Australia, Nepal, Pakistan, Philippines and Taiwan. In India, it is found in Tamil Nadu, Andhra Pradesh, Maharashtra and Kashmir.

Host plant(s): Mainly grasses

Season of collection: November to March, *rabi*-summer (2024-25)

Method of collection: Light trap

C) Tribe: HECALINI, Distant 1908

i) Genus: *Hecalus*, Stal 1864 (Fig. 5)
Common name: Grey lawn leafhopper

Redescription: Crown lacks any orange or yellow coloration pattern, tegmina are unmarked (Naveed *et al*., 2021) [11].

Distribution: India, China, Indonesia, Philippines, Malaysia, Thailand etc. In India, it is widely distributed across various states including Chhattisgarh, Karnataka, Mizoram, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal

Host plant(s): Mainly grasses

Season of collection: November to January, *rabi* (2024-25)

Method of collection: Light trap

II) Subfamily: Typhlocybinae, Kirschbaum 1868

A) Tribe: Empoascini, Distant 1908

i) Genus: ***Erythroneura*, Fitch 1851 (Fig. 6)**

Common name: Grape leafhopper

Redescription: The head is narrower than the pronotum when viewed from above, and the crown (top part of the head) is strongly extended forward, forming a sharp angle in the middle. The ocelli (simple eyes) are either absent or only vestigial. The face appears depressed in profile, slanting less than 45° from the horizontal, giving it a flattened appearance. The anteclypeus is narrow in both males and females. The front femur has a row of setae with one basal seta distinctly larger than the others, while the back ventral row lacks fine basal setae. In male genitalia, the pygofer apex does not reach the tip of the subgenital plate. The subgenital plates are free and have an angulate subbasal projection along the lateral margin. The section of the plate before the medial constriction is shorter than the section after it. Four basal macrosetae are arranged in a single row along the margin and there is a continuous row of small, rigid subbasal setae. Coloration is highly variable among species and even within species. Most are generally white or yellow, often marked with orange, reddish or brownish diagonal stripes (vittae) that either form a continuous zigzag pattern or appear as separated flecks. Some species have crossbands and the forewing frequently has dark spots on the costal margin, near the apex of the second apical cell and at the base of the inner apical cell (Dmitirv and Dietrich, 2007) [7].

Distribution: India, China, Indonesia, Philippines, Malaysia, Thailand etc. In India, it is distributed in Chhattisgarh, Tamil Nadu, Karnataka, West Bengal and Arunachal Pradesh.

Host plant(s): Apple (*Malus pumila* Mill.), potato (*S. tuberosum*), grapes (*Vitis vinifera* L.) and some other grasses *etc*.

Season of collection: November to February, *rabi* (2024-25)

Method of collection: Light trap

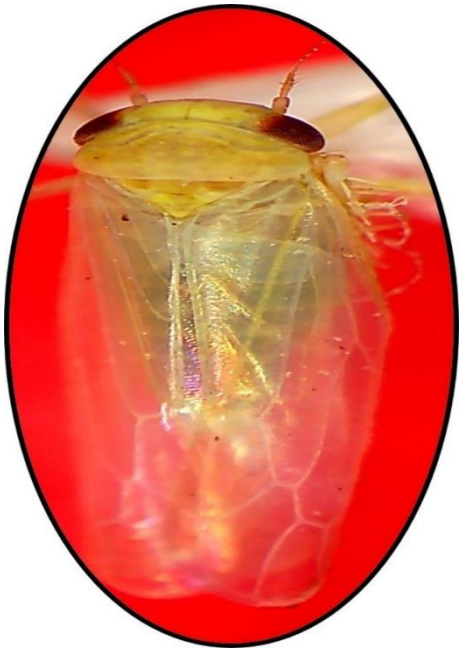

Fig 1: *Balclutha incisa* (Matsumura)

Fig 2: *Balclutha rubrostriata* (Melichar)

Fig 3: *Cicadulina* sp.

Fig 4: *Exitianus indicus* (Distant)

Fig 5: *Hecalus* sp.

Fig 6: *Erythroneura* sp.

Conclusion

The present survey represents the first systematic documentation of leafhopper diversity from Anand Agricultural University, Gujarat, contributing valuable baseline data on this ecologically and agriculturally important insect group. Out of the thirteen specimens collected, six species were recorded for the first time from the state, thereby expanding the known distribution of these taxa in India. The results revealed that leafhoppers in the region are closely associated with major crops such as rice, maize, bajra, soybean, cowpea and redgram indicating their potential impact on local agroecosystems. As several leafhopper species are known vectors of plant pathogens, documenting their diversity is essential for pest prediction, monitoring and the development of sustainable management strategies. Further systematic surveys across different agro-climatic zones of Gujarat, coupled with molecular identification and pathogen transmission studies, are recommended to build a comprehensive understanding of leafhopper biodiversity and their ecological significance.

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