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Leafhopper (Cicadellidae: Hemiptera) Fauna Associated with Groundnut Ecosystem in Coastal Andhra Pradesh

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***Abstract*:** Twenty species of leafhoppers (Cicadellidae) were recorded in association with groundnut ecosystem. Among them, *Sophonia linearis* (Distant) is identified and reported for the first time in Andhra Pradesh during 2023-2025 representing a new record for the region. This species is identified based on the shape and length of the head, length of the pronotum. Adequate description of the species was provided supported with illustrations for quick identification. For the remaining species, an identification key with illustrations was developed.

***Keywords*:** Cicadellidae leafhopper, *Sophonia linearis* (Distant), Subgenital plates, Male genitalia

Leafhoppers belong to the family Cicadellidae of superfamily Membracoidea under the Infraorder Cicadomorpha of the suborder Auchenorrhyncha in the order Hemiptera, are considered insects of economic importance. They are distinguished from planthoppers by the absence of the “Y”-shaped cross vein in the forewings which in planthoppers is formed by the fusion of anal veins, 1a and 2a. Around 22,637 recognized species from 2445 genera were described worldwide, of which 1350 species from 340 genera are known to exist in India (Viraktamath 2006) and are arranged in almost 40 subfamilies and 98 tribes. They are small, agile and wedge-shaped insects. Many leafhoppers are important pests of crop plants, particularly because they are vectors of virus, bacteria and phytoplasma diseases (Wilson and Turner 2010).

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop cultivated extensively in Andhra Pradesh. During 2023-2024, was cultivated in 3.11 lakh hectares producing 3.23 lakh tonnes with a productivity of 1038 kg/ha (Department of Agriculture and Farmers Welfare 2025). *Empoasca (Empoasca) kerri* has already attained pest status in groundnut causing losses to the crop. Moreover, under changing climatic conditions, minor and less important pests are emerging as major ones, a trend exacerbated by indiscriminate pesticide use and altered agronomic practices. Although descriptions of numerous leafhopper species and genera are available in scattered literature, reliable identification remains a challenge. Taxonomic keys particularly those accompanied by illustrations and photographs, are vital for accurate species identification and are of great utility for both researchers and field entomologists. Rao (1998) reported 36 species of leafhoppers in rice, sugarcane, cotton and vegetable ecosystems and provided "key" for identification of these economically important species. Jacob et al. (2000) documented forty species belong to 20 genera associated with oilseed crops from Andhra Pradesh and provided illustrated key for their identification. Jacob et al. (2002) reported 41 species of leafhoppers including twelve new records associated with pulse crop ecosystems in Andhra Pradesh. Reddy and Rao (2001) reported 17 leafhopper species on different vegetable crops in Andhra Pradesh. Sangeetha et al. (2020) reported three new records of the Typhlocybinae leafhoppers on redgram ecosystem from the north coastal Andhra Pradesh and provided key for their identification with illustrations. Dhatri et al. (2021) reported nine leafhopper species associated with groundnut in Chittoor district of Andhra Pradesh and provided illustrated key for easy identification. Considering the economic significance of groundnut and the paucity of consolidated information on leafhoppers in its ecosystems, the present study aims to provide a comprehensive account of leafhopper species commonly found in groundnut in coastal Andhra Pradesh. Diagnostic features supported with illustrations are presented to facilitate accurate identification.

MATERIAL AND METHODS

The present investigation was conducted on leafhopper fauna associated with groundnut (*Arachis hypogea*) in coastal districts of Andhra Pradesh *viz*., Srikakulam, Vizianagaram, Visakhapatnam, Anakapalli, Kakinada, East Godavari, West Godavari, Krishna, NTR, Palnadu, Bapatla and SPSR Nellore during 2023-2025 (Table 1).

Collection and preservation of the specimens: The leafhoppers were collected intensively on groundnut with about 15-20 to and fro insect net sweepings per sampling occasion. The leafhoppers were aspirated from the net, killed with ethyl acetate swabs and transferred to small glass vials, labelled, brought to the laboratory and dried in an oven at 45 - 50^{0}C for about 2-3 hours. Dried specimens were preserved in

the glass vials. The vials were properly labelled with collection details, *viz*., name of the collector, collection date, location of collection and host. The procedure advocated by Knight (1965) was adopted for mounting and preparation of genitalia. The collected leafhoppers were taken to the lab, they were processed, mounted on thick card triangle mounts and were labelled with the information about the collection, including the host, location, date, and name of the collector.

Preparation of male genitalia: Male genitalia were dissected using a Stereoscopic Zoom Binocular Microscope (CSM2, LABOMED). The abdomen was separated from the thorax with minutons (micro-needles) by applying gentle pressure at the junction of thorax and abdomen. The abdomen was then placed in a cavity block containing 10% KOH solution and left overnight at room temperature to digest soft tissues. After several washes in distilled water, the abdomen was transferred to a glass cavity slide containing a drop of glycerine, where the genital capsule was dissected and the genitalia separated under the stereomicroscope. The line diagrams of male genitalia were drawn after dissection using Olympus Research Microscope with camera lucida attachment. Whole insect specimens were photographed using Leica S-9 Optical Stereo Zoom Microscope attached with digital analyzer at 10X magnification and micro photographs of genital structures were taken with Olympus Trinocular Research Microscope fitted with photographic attachments and digital analyzer at 40X magnification. Confirmation of the species was done by comparing the observed male genitalia parts with available keys and published literature.

RESULTS AND DISCUSSION

Leafhopper diversity in groundnut ecosystem: In the present study, 20 species of leafhoppers belonging to 9 genera were collected and identified (Table 2). A perusal of literature indicated that one of the leafhopper species *Sophonia linearis* (Distant) was recorded for the first time on groundnut in Andhra Pradesh, thereby constituting a new record for the region.

Description of *Sophonia linearis* (Distant): Body is yellow. Vertex with two piceous (=nearly black), apical, elongate, fused spots from which longitudinal, piceous lines traverse posteriorly meeting posterior margin of vertex, lateral margin often with orange-yellow stripe confined to ocelli or extending anteriorly. Pronotum and scutellum with median, longitudinal, piceous line often interrupted before apex of scutellum. Claval margin of forewing piceous with piceous stripe bent obliquely near claval apex and reaching claval suture; spot on second apical cell and two oblique lines from costa in apical half piceous. Head about as wide as pronotum. Vertex nearly twice as long as wide in female, lateral margin raised. Scutellum longer than pronotum. Second apical cell of forewing narrowed apically. Hind margin of seventh sternum straight with median protuberance.

Measurements (mm): Total length including forewings 4.94 mm, width of the body 1.17 mm. length of the head 0.98 mm,

Table 1. Areas surveyed for the collection of leafhoppers on oilseed crops in coastal Andhra Pradesh

District	Place	Latitude	Longitude
Srikakulam	Ragole	18.344974°N	83.889959°E
Vizianagaram	Gajularega	18.12387°N	83.398816°E
Visakhapatnam	Thimmapuram	17.814677°N	83.408232°E
Anakapalli	L.Singavaram	17.800593°N	82.836389°E
Kakinada	Peddapuram	17.087922°N	82.114751°E
East Godavari	Rajamahendravaram	17.004393°N	81.783325°E
West Godavari	Marellamudi	16.913670°N	81.389418°E
Krishna	Gopuvanipalem	16.214436°N	81.191024°E
	Gollamudi	16.77805°N	80.29955°E
	Chopparametla	16.700051°N	80.814717°E
N.T.R	Nandigama	16.783956°N	80.314224°E
Palnadu	Gurazala	16.558004°N	79.637006°E
Bapatla	Bapatla	15.904370°N	80.467500°E
	Cherukupalle	16.049566°N	80.680954°E
	Chinaganjam	15.698071°N	80.237709°E
	Ipurupalem	15.844389°N	80.402395°E
SPSR Nellore	Damavaram	14.697951°N	79.969249°E

width across the compound eyes 0.65 mm. Length of the pronotum 0.39 mm, length of the scutellum 0.52 mm, length of the wing 3.38 mm and width of the wing 0.83 mm.

The detailed description of the other nineteen leafhopper species recorded are available in the literature. However, a key is prepared for all the 20 leafhopper species, for their easy identification.

Identification Key of Leafhopper Fauna Associated with Groundnut Crop Ecosystems

1. Forewings with anteapical cells…….....2

-Forewings without anteapical cells (Fig. 2)...……..…16

2. Forewings with two anteapical cells……..……..…...3

-Forewings with three anteapical cells……..……6

3. Yellowish orange coloured insects; dorsal side of the abdomen black in colour. Vertex with a pair of round black spots; pygofer with a curved, bifid process and a robust subapical spine; aedeagus shafts cylindrical, short and 'C' shaped (Plate 2a)... ……..……..…….***Cicadulina bipunctata*** **(Melichar)**

-Vertex without such round black spots and pygofer process and aedeagus not as above……..……...……4

4.Vertex subacute; styles with apophyses claw like; pygofer with a distinct serrated comb like structure on posteroventral margin; subgenital plates triangular, shorter than Pygofer (Fig. 3)……..…….. ***Aconurella neosolana*** **Rao and Ramakrishnan**

–Vertex more or less rounded, styles and pygofer not as above……..……..…5

5. Aedeagus with 3 pairs of basal processes or projections (Fig. 4-5)……. ……..….***Balclutha incisa*** **(Matsumura)**

-Aedeagus without such processes. Pygofer without

Table 2. Leafopper species identified in the study

Leafhopper species
Austroagallia bifurcata Sawai Singh and Gill
Aconurella neosolana (Rao and Ramakrishnan)
Chiasmus niger Pruthi
Exitianus indicus (Distant)
Exitianus nanus (Distant)
Nephotettix virescens (Distant)
Cofana unimaculata (Signoret)
Amrasca biguttula (Ishida)
Empoasca (*Empoasca*) *kerri* Pruthi
Empoascanara maculifrons (Motschulsky)
Seriana jaina (Distant)
Balclutha incisa (Matsumura)
Balclutha saltuella (Kirschbaum)
Cicadulina bipunctata (Melichar)
Nirvana pallida Melichar
Sophonia linearis (Distant)
Hishimonus phycitis (Distant)
Doratulina indra (Distant)
Doratulina rubrolineata (Distant)
Doratulina speciosum (Distant)

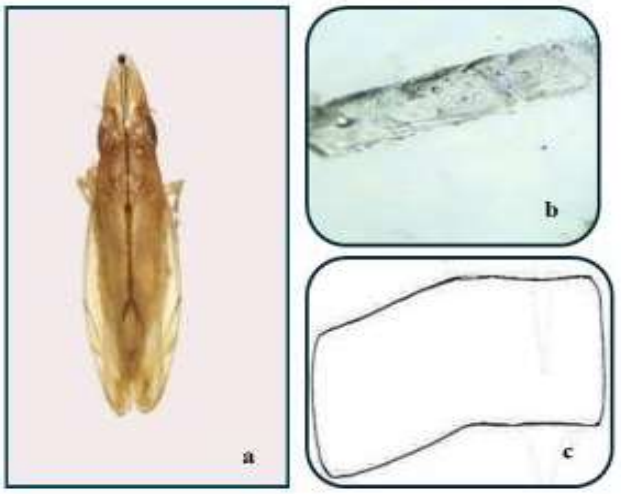

Plate 1. *Sophonia linearis* (Distant) a. Adult dorsal view; b. Female seventh abdominal sternal plate; c. abdominal sternal plate line drawing

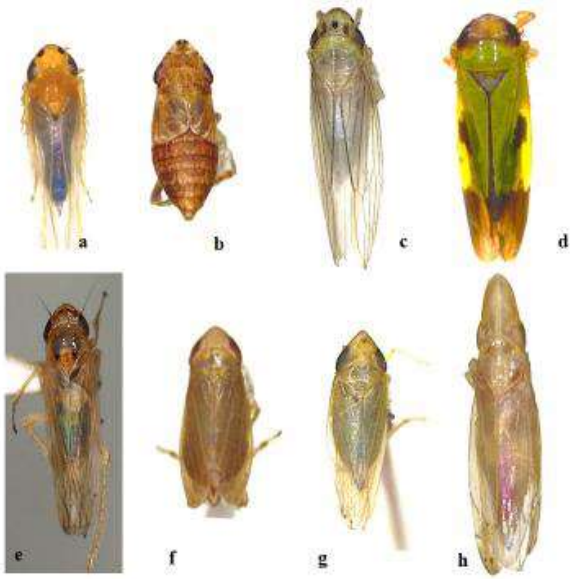

Plate. 2. a. *Cicadulina bipunctata* (Melichar): Adult dorsal view; **b.** *Chiasmus niger* Pruthi: Adult dorsal view; **c.** *Cofana unimaculata* (Signoret): Adult dorsal view; **d.** *Nephotettix virescens* (Distant): Adult dorsal view; **e.** *Exitianus nanus* (Distant): Adult dorsal view; **f.** *Doratulina speciosum* (Distant): Adult dorsal view; **g.** *Doratulina rubrolineata* (Distant): Adult dorsal view; **h.** *Nirvana pallida* Melichar: Adult dorsal view

processes; Connective stem approximately as long as the arms (Fig. 6)……...***Balclutha saltuella*** **(Kirschbaum)** 6. Tegmina bracypterous, apical margin of forewing and exposed terga of abdomen reddish brown (Fig. 7-8 and Plate 2b)…….....…***Chiasmus niger*** **Pruthi**

- Insects variedly coloured; tegmina complete 7

7. Clypeus and clypellus swollen; mostly larger insects, head distinctly green in colour and forewings pale yellowish white, vertex with a black spot at the centre, distinct ocelli on either sides. (Fig. 9-10 and Plate 2c)….....***Cofana unimaculata*** **(Signoret)**

- Clypeus and clypellus not swollen; mostly smaller to medium sized insects.....……...8

8. Aedeagus with two shafts. Head and pronotum lemon yellow, forewings with pale reddish mottling all over; Aedeagus shafts broad, apex with lateral mesal margins curved anteriorly, apex acutely rounded in posterior view, with curved processes from lateral margins and turned ventrally.....***Hishimonus phycitis*** **(Distant)**

- Aedeagus with single shaft and is not fused with connective ……..……9

9. Vertex round, very much narrower, its length is shorter by two or two and half times or even more the length of pronotum with two prominent black spots; aedeagus split into two unequal branches, with a well-developed aedeagal apodemes; connective broad, extremely short, without clear distinction of stem and arms……..***Austroagallia bifurcata*** **Sawai Singh and Gill**

- Vertex not much narrower in its length than pronotum…….....10

10. Connective 'Y' shaped; aedeagus simple, not long with slight curvature...……..…….11

- Connective 'U' shaped; aedeagal shaft very long, strongly curved dorsocephalad...13

11. Colour opaque green, vertex free of any black marks; in males, the apical third of the wings black, but the black patch does not extend to the claval area; aedeagus with a pair of lateral paraphyses, dorsal surface elongate, sclerotized with five pairs of spines laterally and directed towards apex (Fig. 11 and Plate 2d)…... ……..…***Nephotettix virescens*** **(Distant)**

- Colour dull brown with various patterns of dark brown or black markings, aedeagus without spines…….....…12

12. Vertex with a conspicuous black band between compound eyes; pygofer with two prominent dark brown or black spines extending to the apical margin, the upper spine is broader and longer than the lower; aedeagus is simple, curved having an articulation between the base and the shaft (Fig. 12-13)...***Exitianus indicus*** **(Distant)**

- A pair of conspicuous black spots are present at the base of scutellum slightly below the posterior margin of pronotum; pygofer with 3-7 brown or black spines, all are more or less uniform in thickness (Fig. 14-15 and Plate 2e).....…***Exitianus nanus*** **Distant**

13. Vertex with two prominent black spots between the anterior margins of eyes and two large black spots present on face……...***Doratulina indra*** **(Distant)**

- Vertex and face without any black spots…….....17

14. Aedeagus very long, deeply bent dorsocephalad and the shaft with distinct sinuation in the center (Fig. 16)……..…***Doratulina speciosum*** **(Distant)**

- Aedeagus very long, deeply bent dorsocephalad and the shaft without distinct sinuation in the center (Fig. 17 and Plate 2g)……***Doratulina rubrolineata*** **(Distant)**

15. Vertex 1.5 to 2.0 times as long as width between eyes.....16

-Vertex not long as above…….....17

16. Vertex with median white stripe and lateral, orange or lemon yellow, submarginal stripe; forewing with a black dot near the apex (Plate 2h).….***Nirvana pallida*** **Melichar**

- Vertex with two piceous, apical, elongate, fused spots from

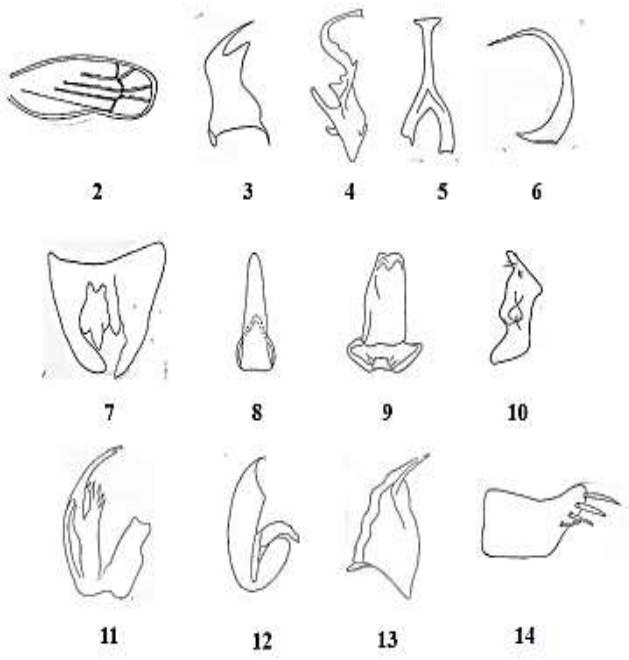

Fig. 2. Fore wing without anteapical cells; 3. *Aconurella neosolana* (Ramasubbarao and Ramakrishnan) Style; 4.-5: *Balclutha incisa* (Matsumura) Aedeagus dorsal view and Connective; 6. *Balclutha saltuella* (Kirschbaum) Aedeagus lateral view; 7-8: *Chiasmus niger* Pruthi Pygofer dorsal view and Aedeagus dorsal view; 9-10: *Cofana unimaculata* (Signoret) Ardeagus dorsal view and Style; 11. *Nephotettix virescens* (Distant) Aedeagus lateral view; 12-13: *Exitianus indicus* (Distant) Aedeagus lateral view and Style; 14. *Exitianus nanus* (Distant) Pygofer

which longitudinal, piceous lines traverse posteriorly meeting posterior margin of vertex. Pronotum and scutellum with median, longitudinal, piceous line often interrupted before apex of scutellum. Claval margin of forewing piceous with piceous stripe bent obliquely near claval apex and reaching claval suture (Fig. 1 and Plate 1a)..... .....***Sophonia linearis*** **(Distant)**

17. Vannal veins fused in the hindwings (Tribe Erythroneurini)…….…..20

- Vannal veins in the hindwings separate apically (Tribe Empoascini)……..……21

18. Aedeagus with two leaf like symmetrical processes, extending to posterior side; a large black spot at the margin of vertex and face; two black spots on scutellum visible through the posterior pronotal region (Fig. 18-19)…….....***Seriana Jaina*** **(Distant)**

- Aedeagus with one pair of asymmetrical apical processes, but not leaf like, longer one arising from the shaft and the shorter one deriving from the base of the longer one rather than from the shaft; vertex with large black spot on the margin of vertex and face (Fig. 22-23)….....***Empoascanara maculifrons*** **(Motschulsky)**

19. Vertex with two distinct black spots, tegmina also with a large black spot on the apical part; subgenital plates significantly elongated with numerous numbers of macro, micro, and hair like setae; aedeagus short, shaft tube like, slightly curves at apex (Fig. 24-25) ……....***Amrasca biguttula biguttula*** **(Ishida)**

- Vertex and forewings without distinct black spots; subgenital plates short, not elongated; aedeagus without any processes, tubular, notched apically, broader apically with middle extensions on both sides and gradually narrowed towards the proximal end; pygofer process elongated, inner surface serrated apically (Fig. 26-27)…….. ……....***Empoasca (Empoasca) kerri*** **Pruthi**

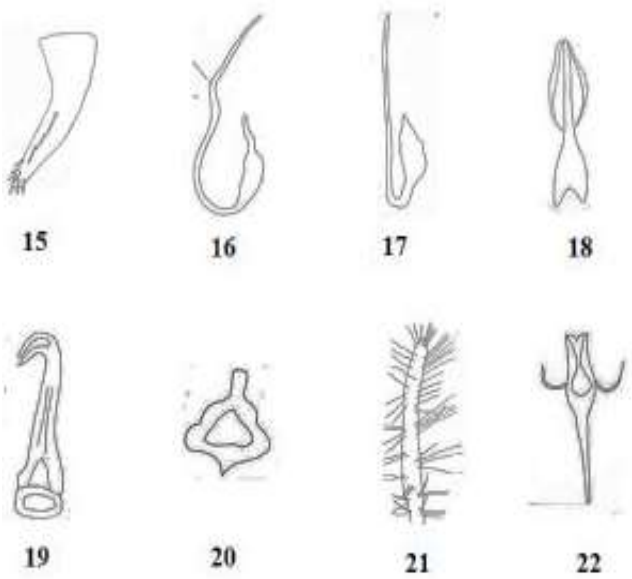

Fig. 15. *Exitianus nanus* (Distant) Subgenital plate; 16. *Doratulina speciosum* (Distant) Aedeagus lateral view; 17. *Doratulina rubrolineata* (Distant) Aedeagus lateral view; 18. *Seriana jaina* (Distant) Aedeagus dorsal view; 19-20: *Empoascanara maculifrons* (Motschulsky) Aedeagus and Connective; 21. *Amrasca biguttula* (Ishida) Subgenital plate; 22. *Empoasca* (*Empoasca*) *kerri* Pruthi Aedeagus dorsal view

Changes in the leafhopper diversity in groundnut crop ecosystem: In the present study 20 leafhopper species were associated with groundnut ecosystem in coastal Andhra Pradesh. Earlier, Jacob et al. (2000) reported 40 species of leafhoppers associated with oilseed crops of which 33 species are recorded on groundnut crop from Andhra Pradesh (undivided state). In the present six species are reported for the first time from groundnut crop ecosystem *viz., Austroagallia bifurcata* Sawai Singh and Gill, *Chiasmus niger* Pruthi, *Doratulina indra* (Distant), *Empoascanara maculifrons* (Motschulsky), *Nirvana pallida* Melichar and *Sophonia linearis* (Distant) apart from the earlier 33 species. Among these species, *Sophonia linearis* (Distant) is being reported for the first time as a new distributional record from Andhra Pradesh whereas other species of leafhoppers are reported on other crops but not from the groundnut crop ecosystem. Dhatri *et al.,* (2021) also reported nine species from groundnut in Chittoor district, but, the earlier mentioned species were not reported. Compared with the earlier studies, the present faunal composition appears richer, possibly due to intensive sampling across multiple coastal districts and extended survey duration (2023-2025). The occurrence of *Sophonia linearis* and other leafhoppers on groundnut for the first time suggests that shifts in species composition may be underway, potentially influenced by changing climatic conditions and cropping patterns.

CONCLUSION

The present study documented 20 species of leafhoppers associated with groundnut ecosystems in Coastal Andhra Pradesh. Among these, *Sophonia linearis* (Distant) is reported for the first time from the state, constituting a new distributional record. A detailed description of this species, along with diagnostic features and illustration of female seventh abdominal sternal plate has been provided to facilitate accurate identification. In addition, an illustrated key for all recorded species is also presented to assist entomologists and extension personnel in species recognition, which is essential for effective pest surveillance and management in groundnut cultivation.

AUTHOR'S CONTRIBUTION

S. Madhurika performed specimen collection, conducted morphological examination, and species identification, curated and analyzed the data, and prepared the original manuscript draft. Dr. P. Sudha Jacob contributed to conceptualization and investigation, validated the taxonomic descriptions, oversaw project administration, and reviewed and edited the manuscript. Dr. S. R. Koteswara Rao provided supervision, participated in validation, and contributed to manuscript review and editing. Dr. V. Prasanna Kumari offered supervision, assisted in validation, and contributed to the writing.

REFERENCES

Department of Agriculture and Farmers Welfare, 2025 Retrieved from https://upag.gov.in/dashreports/statewiseapy?rtab=Area%2C+Production+%26+Yield&rtype=reports on 11.09.2025.

Dhatri KS, Chalam MSV, Rajesh A, Ramana Murthy B and Venkateswarlu NC 2021. Leafhopper fauna associated with groundnut crop ecosystem In Rayalaseema region of Chittoor district in Andhra Pradesh. *Andhra Pradesh Journal of Agricultural Sciences* **7**(1): 1-8.

Jacob PS, Ramasubbarao V and Punnaiah KC 2000. Leafhopper fauna associated with oilseed crops in Andhra. Pradesh, India. *Pest Management and Economic Zoology* **8**(1): 11-27.

Jacob PS, Ramasubbarao V and Punnaiah KC 2002. New record of leafhoppers (Cicadellidae: Homoptera) associated with pulse crop- ecosystems in Andhra Pradesh. *The Andhra Agricultural Journal* **49**(3&4): 256-261.

Knight WJ 1965. Techniques for use in the identification of leafhoppers (Homoptera: Cicadellidae). *Entomologist's Gazette* **16**(4): 129-136.

Rao VRS 1998. *Bio-Systematics of leafhopper fauna of economic importance in Andhra Pradesh.* Final Report of ICAR Ad-hoc Research Scheme, ICAR, New Delhi.

Reddy P and Ramasubbarao V 2001. Leafhopper fauna associated with vegetable crops of Andhra Pradesh in India. *Entomon* **26**(2): 121-130.

Sangeetha L, Seetharamu P, Dhurua S and Suresh M 2020. New records of Typlocybinae leafhoppers (Hemiptera: Cicadellidae: Empoascini) Associated with Red gram ecosystem from north coastal districts of Andhra Pradesh, India. *Journal of Entomology and zoology Studies* **8:** 1365-1369.

Viraktamath CA 1983. Genera to be revised on a priority basis. **In**: *Proceedings of the First international workshop on Leafhoppers and Planthoppers of Economic importance.* WJ Knight, NC Pant, TS Robertson and MR Wilson (eds.). *Commonwealth Institute of Entomology*, London. 471-492.

Viraktamath CA 2006. Final report of emeritus scientist project on "*Taxonomic studies on the economically important leafhoppers (Hemiptera: Cicadellidae) of the Indian subcontinent*". Department of Entomology, University of Agricultural Sciences, GKVK, Bangalore. 65-70.

Wilson MR and Turner JA 2010. *Leafhopper, Planthopper and Psyllid Vectors of Plant Disease*. Amgueddfa Cymru - National Museum Wales. http://naturalhistory.museumwales.ac.uk/Vectors on 11 November 2025.

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