



E-ISSN: 2320-7078  
P-ISSN: 2349-6800  
JEZS 2020; 8(1): 1365-1369  
© 2020 JEZS  
Received: 16-11-2019  
Accepted: 23-12-2019

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## New records of Typhlocybinae leafhoppers (Hemiptera: Cicadellidae: Empoascini) Associated with Red gram ecosystem from north coastal districts of Andhra Pradesh, India

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### Abstract

Three new records of the typhlocybinae leafhoppers under the subgenus *Empoasca* (*Distantasca*) were identified and reported for the first time on redgram ecosystem from the north coastal Andhra Pradesh during, 2017-19. The three species were identified based on the shape of head, pronotum and length, serrations and number of macro and micro setae on the sub genital plates of the male genitalia structures. The descriptions of the species were clearly depicted with neat illustrations and also simple keys were prepared for easy identification.

**Keywords:** typhlocybinae leafhoppers, *Subgenus Empoasca (Distantasca)* New records, red gram ecosystem, Andhra Pradesh, India

### 1. Introduction

Leafhoppers are small wedge shaped insects with two or more rows of spines on the hind tibiae and pronotum not extending back over the abdomen. These are belongs to the family Cicadellidae of the order Hemiptera. Cicadellidae is one of the largest family in the exopterygota Hexapoda comprising more than 22,600 described species<sup>[1]</sup>. Typhlocybinae is the second largest subfamily, comprises of 470 genera with 5,200 species under six tribes all over the world<sup>[2]</sup>. The leafhoppers of the subfamily Typhlocybinae is mostly tiny, delicate and feeds on the contents of leaf parenchyma cells of their host plants. Their size ranges from 2.5 mm to 5.5 mm. The species of this subfamily differ from the other leafhoppers in lacking closed pre apical cells in the forewing and in having the acutely protruded hind basitarsus. The leafhoppers tribe Empoascini consists of 89 described genera and more than 1000 described species worldwide, is a large group within the subfamily<sup>[3]</sup>.

The tribe Empoascini is a diverse group and differs from other leafhoppers in the subfamily Typhlocybinae in lacking an appendix in the forewing and in having a sub marginal vein at the apex of the hind wing and veins RP, MP' confluent distally<sup>[1]</sup>. The members of the genus *Empoasca* are polyphagous pests and causing considerable damage to pulses, oilseeds and vegetable crop ecosystems and some of the *Empoasca* act as vectors in transmitting the plant diseases like potato leaf roll, witches broom diseases of potato (*Alebroides nigroscutellatus* Distant) and bunchy top disease of papaya (*Empoasca papayae* Oman)<sup>[3]</sup>. The leafhopper subgenus *Empoasca (Distantasca)* was first described as a separate genus, with *Empoasca terminalis* as its type species<sup>[4]</sup>. The subgenus *Distantasca* has the same structure and wings venation as in *Empoasca Walsh*, but male genital segments are different as described by<sup>[5,6]</sup>. Though the leafhopper fauna of different parts of the world are well known, but the taxonomic studies of them in Indian subcontinent is very much limited further, with the altering climatic conditions and agronomic practices, the pest status and population of the Typhlocybinae is likely to change. Hence, quick and accurate identification of these species is the important step in dealing with them. The present investigation provides an account of the population distribution of the *Empoasca* genus in red gram ecosystem in North coastal Districts of Andhra Pradesh and also it will be useful to the farming community for initiate the necessary management strategies to contest the leafhopper pests in this region.

## 2. Materials and Methods

The present study was conducted at Department of Entomology, Agricultural College, Naira, Srikakulam, and Andhra Pradesh during 2017-19.

### 2.1. Collection, killing, drying and preservation of the specimens

The leafhoppers were collected on red gram crop by net sweeping method. Insects trapped in the sweep nets were collected by using aspirator and killed with a cotton swab dipped in ethyl acetate. The killed leafhopper specimens are transferred into petri dishes by using camel hair brush and kept in hot air oven at 45-50°C for about 5-6 hours for drying. The dried specimens were preserved in the homeopathic vials.

#### 2.1.1 Processing of the material for study

The procedure advocated by [7] was followed for mounting and preparation of genitalia. The collected leafhoppers were brought to the laboratory, processed, mounted on the thick chart triangular mounts and labelled with collection details, viz., name of the collector, collection date, location of collection and host.

#### 2.1.2 Preparation of male genitalia

The male genitalia was dissected out under Stereozoom Binocular Microscope following the technique given by [7], for accurate identification of leafhopper species, for studying the male genitalia, the leafhopper specimens were firmly supported by a China clay block on its back, and the abdomen was detached from the thoracic region with the help of minutons (sharp micro needles) under the Stereo zoom Binocular Microscope by pressing at the junction of thorax and abdomen. The detached abdomen was kept for digestion in the cavity block containing a few millilitres of freshly prepared 10% KOH and left for overnight at room temperature. After the digestion, the digested soft tissues of the abdomen was transferred to a glass cavity dish containing distilled water were gently pressed out by using the fine needles. The KOH remnants are removed by washing the abdomen thrice in water. After the above treatment, the entire abdomen becomes completely transparent and allows the clear examination of the male genitalia. For male genitalia dissection, the abdomen was transferred to a microscopic slide containing one or two drops of glycerol after repeated washings in distilled water and which was done under the Luxeo 4D Stereo zoom Binocular Microscope by using minutons.

### 2.1.3 Illustrations

The illustrations made with the help of Labomed Trinocular Research Microscope using micap 3.6 digital camera attachment using the software under 10X magnification. Photographs of adults were made with stereo zoom microscope under 35X magnification.

## 3. Results and Discussions

### 1. *Empoasca (Distantasca) bulbosa* (Dworakowska) (Figures: a-d & 1-7)

*Empoasca (Distantasca) bulbosa* Dworakowska, 1994 [8]. Folia Entomologica Hungarica. 55: 93-215; Qin & Zhang, 2007 [9]. The Pan- Pacific Entomologist. 83(3): 185-192.

*Empoasca (Distantasca) bulbosa* Dworakowska earlier reported in Sikkim and it was reported for the first time from Andhra Pradesh.

#### Specimens examined

1♂, Redgram, Naira, 10. X.2018, Sangeetha. L.

#### Measurements

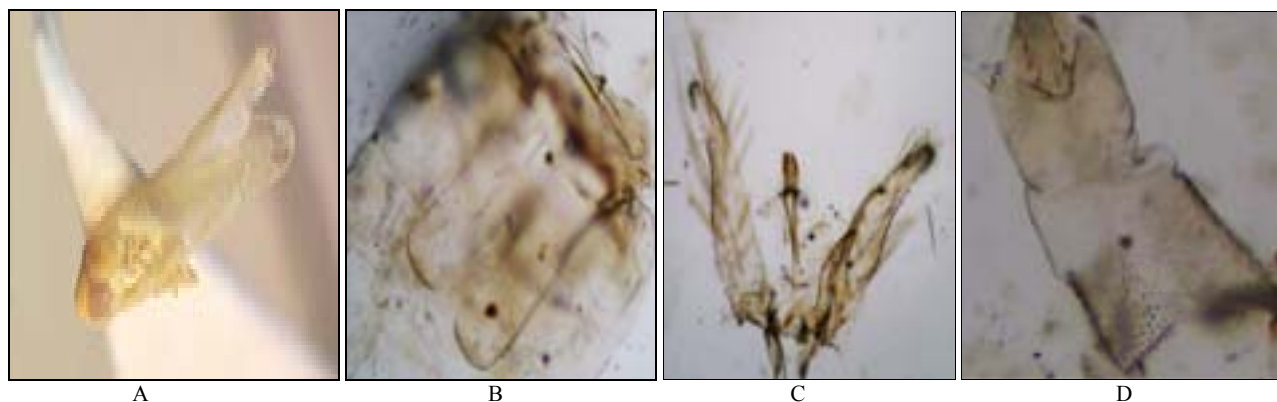
Total body length: 3.30 mm; Length of the wings: 2.52mm; Ocular distance: 0.75 mm; Length of the abdominal apodemes: 0.0040mm; Length of the subgenital plates: 0.0045mm; Length of the styles: 0.0023mm; Length of the pygofer process: 0.006mm.

#### Description

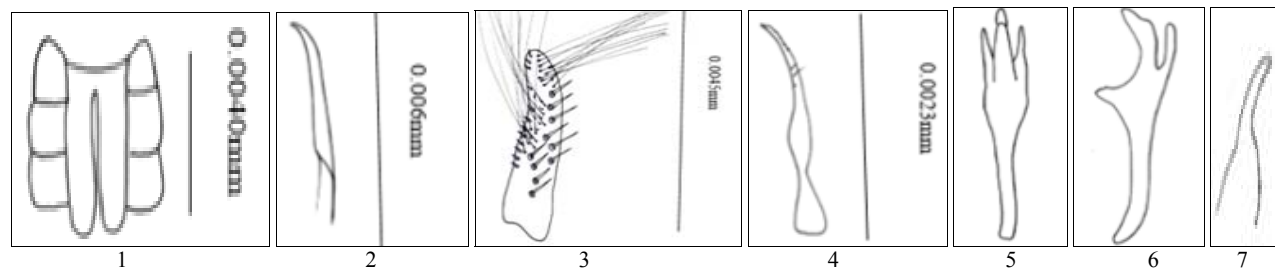
Body is light yellow in colour. Head is not broader having sharp frons. Both the wings are semi transparent and the intensity of the yellow colour reduced towards the tip. Frons with well developed brown colour compound eyes, ocelli are away from the compound eyes. Abdominal apodemes are well developed, longer, broad and reaching upto middle of the 4<sup>th</sup> abdominal segment. The aedeagus shaft is long, narrow at base and broader at the apex produced with one pair of appendages. The anal tube appendages smooth, without small teeth. Subgenital plates are long, with numerous fine hairs, macro setae are distributed all over the surface. Styles are broader at the base, narrower at the tip with serrated apex.

#### Diagnosis

*Empoasca (Distantasca) bulbosa* (Dworakowska) is similar to *Empoasca (Distantasca) terminalis* Distant external coloration. But it can be different from later in having small teeth on the anal tube appendages.



**Fig 1:** A-d *Empoasca (Distantasca) bulbosa* Dworakowska a. Adult lateral view (35X); b. Abdominal apodemes (10X); c. Male genitalia (10X); d. Anal tube (10X).



**Fig 2:** 1-7 *Empoasca (Distantasca) bulbosa* (Dworakowska) 1. Abdominal apogees; 2. Pygofer process; 3. Styles; 4. Subgenital plates; 5. Aedeagus (ventral view); 6. Aedeagus (lateral view); 7. Anal tube appendages.

## 2. *Empoasca (Distantasca) latava* Dworakowska (Figures: e-i; 8-14)

*Empoasca (Distantasca) latava* Dworakowska, 1981<sup>[10]</sup> *Entomologische Abhandlungen und Berichte aus dem Staatlichen Museum für Tierkunde in Dresden*. 44 (8):153–202.

Qin & Zhang, 2007<sup>[9]</sup> *The Pan-Pacific Entomologist*. 83(3): 185-192.

This species was already reported from Sikkim in India and it is reported for the first time from Andhra Pradesh.

### Specimens examined

5♂, 4♀, Redgram, S.S.valasa, 19. IX. 2018, Sangeetha.L; 2♂, Redgram, Naira, 8. IX. 2018, Sangeetha. L.

### Measurements

Total body length: 3.43 mm; Length of the wings: 2.53 mm; Ocular distance: 0.7mm; Length of the abdominal apodemes: 0.0042mm; Length of the subgenital plates: 0.0048mm;

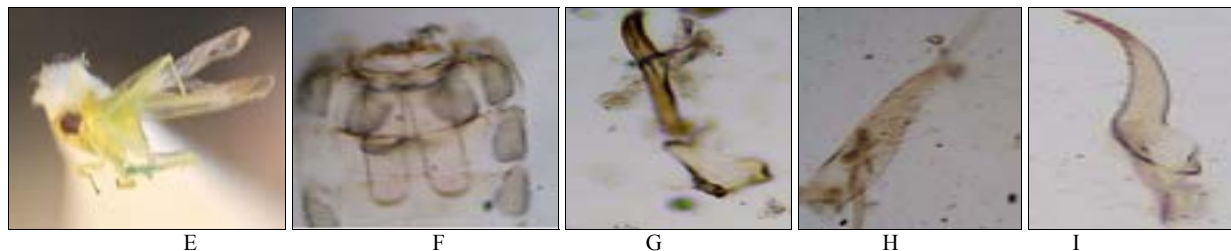
Length of the styles: 0.0031mm; Length of the pygofer process: 0.0029mm.

### Description

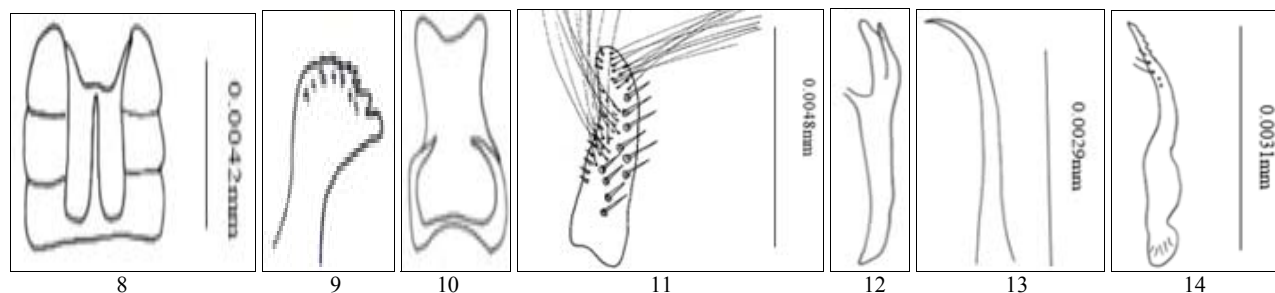
Body is yellowish green in colour. Head as broad as the pronotum. Eyes are brown in colour. The transparency is gradually increases towards the tip of the both the wings. Abdominal apodemes are elongated and reaching upto the 4<sup>th</sup> abdominal segment. The aedeagus shaft produced with one pair of appendages which are tapering and curved at the tip in lateral view. The anal tube appendages ornamented with small teeth apically. Subgenital plate is sinuate, with numerous fine hairs and 13-16 macro setae scattered irregularly on the surface. Styles are long, slender and serrated at the apex.

### Diagnosis

*Empoasca (Distantasca) latava* (Dworakowska) is easily distinguished by the presence of more than 16 macro setae at the tip of the elongated sub genital plate.



**Fig 3:** e-i. *Empoasca (Distantasca) latava* (Dworakowska) e. Adult lateral view (35X); f. Abdominal apodemes (10X); g. Aedeagus (10X)(lateral view); h. Subgenital plates (10X); i. Pygofer process (10X).



**Fig 4:** 8-14 *Empoasca (Distantasca) latava* (Dworakowska) 8. Abdominal apodemes; 9. Anal tube appendages; 10. Connective; 11. Subgenital plates; 12. Aedeagus (lateral view); 13. Styles; 14. Pygofer process.

## 1. *Empoasca (Distantasca) tna* (Dworakowska) (Figures j-m; 15-20)

*Empoasca (Distantasca) tna* Dworakowska, 1980<sup>[11]</sup> *Entomologische Abhandlungen*. 43 (8): 151–201.

*Empoasca (Distantasca) tna* Dworakowska reported for the first time in Andhra Pradesh.

### Specimens studied

3♂, 2♀, Redgram, S.S.Valasa, 19. XI.2018, Sangeetha. L.

### Measurements

Total body length: 3.30 mm; Length of the wings: 2.03 mm; Ocular distance: 0.55-0.60mm; Length of the abdominal apodemes: 0.0041; Length of the subgenital plates:

0.0048mm; Length of the styles: 0.0031mm; Length of the pygofer process: 0.0029mm.

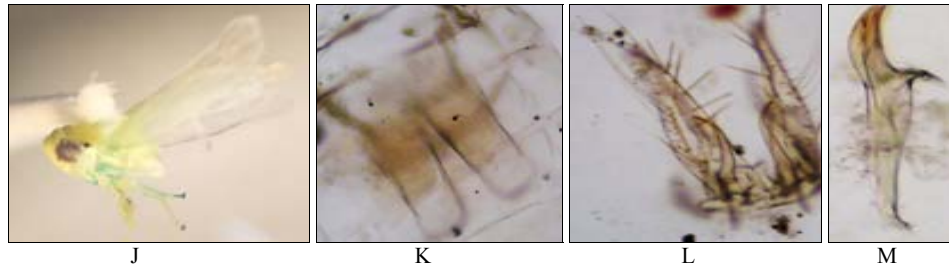
### Description

The body is light yellowish green in colour. Pronotum is not broader than the head and its width is more than the length. The compound eyes are brownish, the wings are transparent and light green in colour. The abdominal apodemes are elongated and reaching upto middle of the 4<sup>th</sup> segment. The aedeagal appendages are curved mesad at about 1/3 of their length from the tip. The anal tube appendages not smooth, but

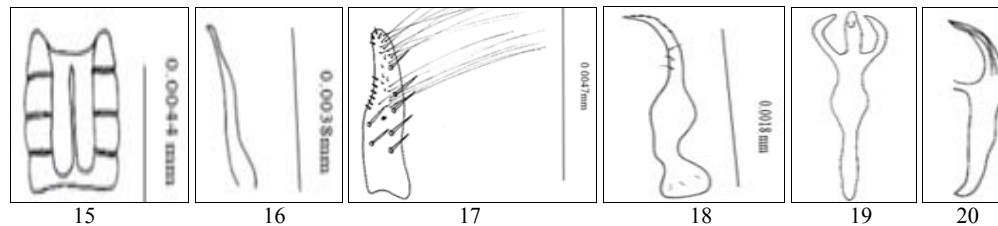
having small tooth. Subgenital plates sinuate, elongated with numerous long fine hairs and macro setae all over the surface. Styles are slender, broad at the base, tapering at the tip and apex is serrated. The connective is broad.

### Diagnosis

*Empoasca (Distantasca) tna* Dworakowska is easily distinguished from other species by the presence of elongated pygofer process and also aedeagus appendages curved mesad at 1/3<sup>rd</sup> of their length from the tip.



**Fig 5:** j-m *Empoasca (Distantasca) tna* (Dworakowska) j. Adult lateral view (35X); k. Abdominal apodemes (10X); l. Subgenital plates and styles (10X); m. Aedeagus (lateral view) (10X).



**Fig 6:** 15- 20 *Empoasca (Distantasca) tna* (Dworakowska) 15. Abdominal apodemes; 16. Pygofer process; 17. Subgenital plates 18. Styles; 19. Aedeagus (lateral view); 20. Aedeagus (Ventral view)

The present findings of the three newly recorded species of the subgenus *Empoasca (Distantasca)* are similar in external morphological characters but they are primarily distinguished by the well-developed anal tube appendages and the long subgenital plates with macro setae not reaching the tip and more number of fine hair-like setae and abdominal apodemes developed reaching to 4 the segment. All these described characters of the species are in accordance with the findings of Sohi and Dworakowska (1983)<sup>[12]</sup>, Thapa (1989)<sup>[13]</sup>, Quin and Zhang, 2008<sup>[14]</sup>, Zhang (2008)<sup>[15]</sup>, Zhang *et al.*, (2010)<sup>[16]</sup> and Xu *et al.*, (2017)<sup>[2]</sup> from India, Nepal and China.

### 3.1. Key to the species of new records belonging to the tribe Empoascini.

1. The aedeagal shaft with two pairs of appendages -----2  
---- The aedeagal shaft with one pair of appendages -----
2. The aedeagal shaft and appendages equally broad -----  
*Empoasca (Distantasca) faciata* (Dworakowska) ---- The aedeagal shaft without small teeth apically ----- 3
3. The anal tube appendages with large sub apical tooth ----- 4  
----- 4
- The anal tube appendages with small teeth apically (Fig. 9 & 11) ----- *Empoasca (Distantasca) latava* (Dworakowska)
4. The anal tube appendages smooth, without large tooth -----  
---- *Empoasca (Distantasca) bulbosa* (Dworakowska)
- The anal tube appendages not smooth with small tooth ----- 5
5. Pygofer process slightly curved without sinuation ---

*Empoasca (Empoasca) kerri* Pruthi --- Pygofer process elongated curved with sinuation ---- *Empoasca (Distantasca) tna*

### 2. Conclusion

Though the leafhopper fauna of different parts of the world are well known, but the taxonomic studies of them in Indian subcontinent is very much limited further, with the altering climatic conditions and agronomic practices especially in Andhra Pradesh the pest status and populations are likely to change in this region. The present study of the three new records of leafhoppers species distribution, identification, descriptions and keys will be helpful in these ecosystems in order to forecast their attack and develop strategies for proper management.

### 3. Acknowledgements

The senior author is highly thankful to Acharya N.G. Ranga Agricultural University, Lam, Guntur, and Andhra Pradesh for the financial assistance in the form of stipend and providing the facilities for conducting the research work.

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