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Srinivasa NDivision of Entomology, ICAR-
Indian Agricultural Research
Institute, New Delhi, India**Naresh Meshram M**Division of Entomology, ICAR-
Indian Agricultural Research
Institute, New Delhi, India**PR Shashank**Division of Entomology, ICAR-
Indian Agricultural Research
Institute, New Delhi, India

Diagnostic studies of mango leafhoppers (Hemiptera: Cicadellidae) from India

Srinivasa N, Naresh Meshram M and PR Shashank

Abstract

Mango leafhoppers were causing main threat to yield of mangoes. Lack of sophisticated and well-illustrated photographs to identify them is creating the problems to identify a species. The study was conducted to survey and collection of mango leafhoppers from major mango growing areas in India during the period of 2013-15 to develop diagnostic keys to identify them. Twelve species of mango leafhoppers were found in survey and collection they belongs to family Cicadellidae with two subfamily Idiocerinae and Typhlocybinae were studied. The characters were studied are head, thorax and abdomen where colour, shape, spot and wing venation variations were studied along with emphasis was laid on male genitalia variation for the development of diagnostic keys with well-illustrated photographs were provided for easy identification.

Keywords: Cicadellidae, Idiocerinae, Typhlocybinae, Genitalia

1. Introduction

Mango *Mangifera indica* L. is the national fruit of India, infested by number of insect pests, among these leafhoppers are economically most important ^[1]. Adults and nymphs of mango hopper suck sap from inflorescence, young shoots and tender leaves of mango. The affected florets turn brown, become dehydrated and ultimately fruit set does not occur in heavily infested plant parts ^[2]. They excrete massive quantities of honeydew which imparts sugary shine to leaves and fruits and other plant parts and encourages growth of sooty mould fungi *Capnodium mangiferum* (Cooke & Broome) and *Meliola mangiferae* Earle that reduces photosynthetic efficiency of leaves and market quality of fruits ^[3].

Leafhoppers belong to the family Cicadellidae of the order, Hemiptera. These are small wedge shaped insects of various form, colour and size and distinguished in having one or more rows of small spines extending the length of hind tibia. These are widely distributed and many are serious pests and vectors of diseases of many crops ^[4]. Recent world estimates range between 35,000-45,000 species over 22,600 species are now described ^[5]. The leafhopper species of the subfamily Idiocerinae feed and breed on trees and some are serious pests of mango, in the Indian subcontinent out of 10 genera and 43 species are recorded. Idiocerinae is a small subfamily of the Cicadellidae recognized by: Head wider than pronotum, ocelli on face, facial sutures extending beyond the antennal pits almost to the ocelli, distance between antennal bases greater than that between ocelli; fore wing with wide appendix ^[6].

There are twelve leafhopper species reported on mango. Das *et al.* ^[7] recorded *Amrasca splendens* Ghauri from Kerala causing severe damage to mango plantation. Viraktamath and Viraktamath ^[8] described three new species of mango hoppers namely, *Busonomimus manjunathi*, *Idioscopus anasuyae* and *I. jayashriae* on mango in Karnataka. Nearly eighteen species of leafhoppers have been reported as pests of mango in the world ^[9]. Among these, five species belonging to the subfamily Idiocerinae; *Idioscopus clypealis* (Lethierry), *I. nitidulus* (Walker), *I. nagpurensis* (Pruthi), *Amritodus atkinsoni* (Lethierry) and *Amritodus brevistylus* Viraktamath are the most important leafhopper pests of mango ^[9-10]. Others include, *Amrasca splendens*, *Busonomimus manjunathi*, *Idioscopus decoratus*, *I. dworakowskiae* and *I. spectabilis* which have been reported to feed on mango ^[11]. The effective management of pest species damaging the mango, cannot be undertaken without accurate identification. Therefore the present study were undertaken to develop, descriptions and illustrated simple keys to these economically important leafhoppers for use by entomologists who are dealing with crop protection strategies.

Correspondence

Srinivasa NDivision of Entomology, ICAR-
Indian Agricultural Research
Institute, New Delhi, India

2. Materials and methods

Mango leafhoppers were collected from mango orchards through sweep net and light trap from various parts of the country during the period of 2013-15, were processed by series of steps like sorting, cleaning, mounting, selection of specimens for study the following characters are below

I. Head: Crown, Face, Compound eyes, Ocelli, Frontal suture, Subgenal suture, Clypeus.

II. Thorax: Pronotum, Scutellum, Proepisternum, Hind tarsi, Hind tibial spinulation, forewing appendix, venation.

III. Abdomen: a. Male genitalia: Pygofer, Subgenital plate, style, Connective, Aedeagus.

2.1 Male genitalia dissection

Male genitalia dissections will be carried out as described by

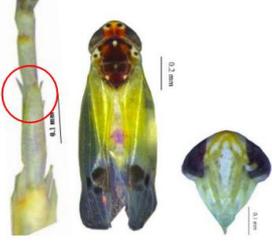
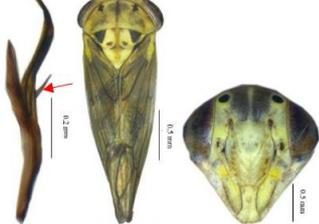
Oman ^[12] and Knight ^[13]. The abdomen will be removed by inserting a sharp pin between the abdomen and thorax and with gentle piercing. The abdomen will be treated in 10 % KOH for 2- 4 h to remove unsclerotized material by gently prodding the abdomen with the head of a pin. Afterwards, the abdomen will be rinsed thoroughly in water. The internal structures will be then removed by a hooked pin, before being stored in glycerol vials for study. The photographs of male, female (habitus, lateral, face and thorax) and genitalia structures at different magnification were taken with Leica DFC 425C digital camera on the Leica 19205FA stereozoom automontage microscope. The photographs and illustrations were processed by using Adobe Photoshop CS3.

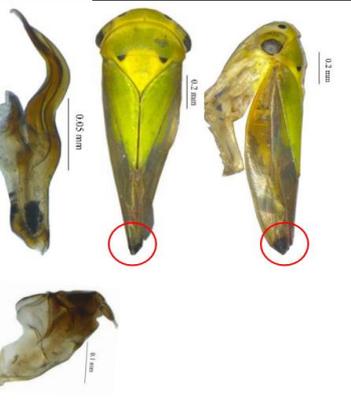
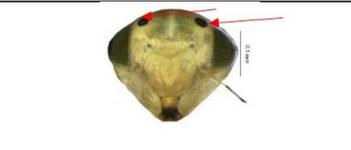
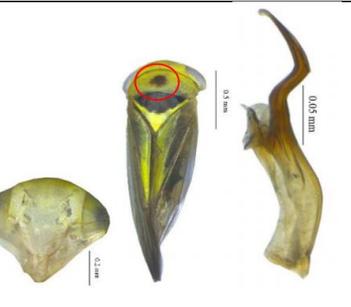
2. Results

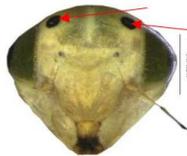
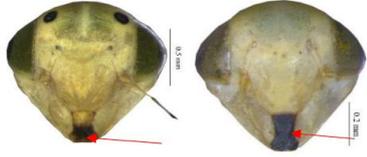
3.1 Check list for leafhopper species associated with mango from India

<i>Amrasca</i> Ghauri, 1967: 159. Type-species: <i>Amrasca splendens</i> Hyrcinal by original designation.		
1. <i>splendens</i> Ghauri, 1967: 161	Karnataka	Minor
<i>Amritodus</i> Anufriev 1970: 376. Type- species: <i>Idiocerus atkinsoni</i> Lethierry, by original designation		
2. <i>atkinsoni</i> (Lethierry), 1889:252 <i>Idiocerus atkinsoni</i> (Lethierry) 1889: 252 <i>I. quinquepunctatus</i> (Melichar) 1903: 146	Gujarat, Karnataka, Maharashtra, Orissa, Punjab, Uttaranchal, Uttar Pradesh, West Bengal	Major
3. <i>brevistylus</i> Viraktamath 1976: 234	Karnataka, Tamil Nadu	Major
<i>Busoniomimus</i> Maldonado-Capriles 1977: 491. Type-species: <i>Idiocerus minor</i> Bierman, by original designation		
4. <i>manjunathi</i> Viraktamath and Viraktamath 1985: 305	Karnataka, Kerala	Minor
Genus <i>Idioscopus</i> Baker 1915; 320. Type-species: <i>Idiocerus clypealis</i> Lethierry, by original designation		
5. <i>anasuyae</i> Viraktamath and Viraktamath 1985: 307	Karnataka	Minor
6. <i>clypealis</i> (Lethierry) 1903: 48 <i>I. nigroclypeatus</i> (Melichar) 1903: 48 <i>I. scutellatus</i> (Distant) 1908	Wide spread in India	Major
7. <i>decoratus</i> Viraktamath 1976:236	Karnataka	Minor
8. <i>dworakowskiae</i> Viraktamath 1979: 25	Karnataka	Minor
9. <i>jayashriae</i> Viraktamath and Viraktamath 1985: 308	Karnataka	Minor
10. <i>nagpurensis</i> (Pruthi) (<i>Idiocerus</i>) 1930: 17	Karnataka, Tamil Nadu, Kerala, West Bengal, Maharashtra, Bihar	Major
11. <i>nitidulus</i> (Walker) 1870: 252 <i>I. niveosparsus</i> (Lethierry) 1889: 252 <i>I. incertus</i> Baker 1924: 367 <i>I. freytagi</i> Ahmed, Naheed & Ahmed 1980 <i>I.karachiensis</i> Ahmed, Naheed & Ahmed 1980	throughout India	Major
12. <i>spectabilis</i> Viraktamath 1979:23	Karnataka	Minor

3.2 Diagnostic keys for mango leaftoppers

<p>1. Hind tarsomere I acuminate...<i>Amrasca splendens</i></p>	
<p>- Hind tarsomere I truncate.....2</p>	
<p>2. Male pygofer with triangular projections on ventral margins.....<i>Busoniomimus manjunathi</i></p>	
<p>- Male pygofer not as above.....3</p>	
<p>3. Aedeagus with elongated preatrium, shaft comparatively short.....4</p>	
<p>- Aedeagus without preatrium, shaft elongate.....5</p>	
<p>4. Aedeagus with basal pair of spine like processes.....<i>Amritodus brevistylus</i></p>	

<p>- Aedeagus without basal pair of spine like processes.....<i>Amritodus atkinsoni</i></p>	
<p>5. Third apical cell of fore wing with black spot, clavus yellowish green, pygofer with ventral processes, aedeagal shaft sinuate.....<i>Idioscopus decoratus</i></p>	
<p>- Third apical cell of fore wing without black spot6</p>	
<p>6. Face and vertex uniformly ochraceous or lemon yellow, without black irregular spots.....7</p>	
<p>- Face and vertex with round black spots.....8</p>	
<p>7. Head, pronotum and scutellum, yellowish green a large discal spot on pronotum and basal half of scutellum black.....<i>Idioscopus spectabilis</i></p>	
<p>- Head pronotum immaculate, lemon yellow or shahgreen, scutellum with two dark brown basal triangular spots, anal collar processes broad, almost straight.....<i>Idioscopus dworakowskiae</i></p>	

<p>8. Face irregularly marked with brown or black patches without well-defined black spots, style with anterior portion longer than the posterior<i>Idioscopus nitidulus</i></p>	
<p>- Face with one or more small round black spots near upper margin.....9</p>	
<p>9. Clypellus entirely or partially black.....10</p>	
<p>- Clypellus without any black marking.....11</p>	

<p>11. Aedeagus strongly sinuate, shaft broad at base narrowed and strongly curved apical hook and has pair lateral sinuate curved processes arising mid length.....<i>Idioscopus anasuyae</i></p>	
<p>- Aedeagus shaft with caudal denticle slightly before gonopore.....<i>Idioscopus jayashriae</i></p>	

4. Discussion

The present investigation will support the existing literature for easy identification of mango leafhopper complex of India. Leafhoppers associated with mango belongs to two subfamily Typhlocybiinae and Idiocerinae of Cicadellidae. Since Lewis^[14] described the genus *Idiocerus*, about 13 species described under this genus from Indian subcontinent by Lethierry^[15], Melichar^[16], Distant^[17], Baker^[18] and Pruthi^[19]. Now position of these species changed to genera other than *Idiocerus* namely, *Amritodus* Anufriev, *Balocha* Distant, *Idiocerus* Baker and *Idioscopus* Kirkaldy. Most commonly found genus is *Idioscopus*, most of the species of which breeds on the plants of the family Anacardiaceae and most of them posing serious threat to mango *Mangifera indica* L^[9]. *Amritodus atinsoni* (Lethierry) was described under, *Idiocerus atkinsoni* by Lethierry^[15], later Malnado- capriles replaced to *Idioscopus atkinsonii*. Anufriev in 1970 changed it to *Amritodus atkinsoni* (Lethierry) stand as a valid name. Species *Idioscopus nagpurensis* (Pruthi) was described by Pruthi^[19]. Under the genus *Idiocerus* Malnado – capriles has, shifted to genus *Idioscopus*. *Idioscopus nitidulus* (Walker) was earlier described by Lethierry as *I. niveosparsus* in 1889, later on Baker^[21] described as *I. incertus*. In 1980 as *I. fretyagi* by Ahmed *et al.*, and as *I. karachiensis* by Ahmed *et al.*^[20]. *Idioscopus clypealis* (Lethierry), is described in 1903 under the genus *Idiocerus*. Again in the same year melichar described *Idiocerus nigroclypeatus* later on Distant described the same species as *Idiocerus scutellatus*. All these species were synonymised by Baker^[15] as *Idioscopus clypealis*, now stand as valid name. Species like *Idioscopus decoratus* Viraktamath^[22], *Idioscopus dworakowskiae*, Viraktamath^[23], *I. spectabilis* Viraktamath^[23], *I. jayashriae* Viraktamath and Viraktamath,^[24] was reported to breed on mango. *Busoniomimus manjunathi* was described by Viraktamath and Viraktamath^[24]. Typhlocybiinae leafhopper *Amrasca splendens* was described by Ghauri^[25] stand as valid name. *Amrasca splendens* species can be easily distinguished from other mango leafhopper species by the presence of acuminate first hind tarsomere along with brightly coloured, brown deep red, face reddish anteriorly and rest yellow including genae and lora. Two round spots anteriorly with reddish margin, where has in other species hind tarsomere I truncate. Pygofer in male genitalia of *Busoniomimus nanjunathi* triangular with projections on ventral side distinguish from other species pygofer with aedeagus Y shaped basal strut, dorsal apodeme stout on the middle of Aedeagus. *Amritodes brevistylus* more are less similar to *A. atkinsoni* in morphology and coloration except Aedeagus with elongated preatrium, shaft comparatively short and a pair of basal spine which absent in *A. atkinsoni*. Aedeagus without preatrium with elongated shaft, third apical cell of the fore wing with black spot, clavus yellowish green, aedeagual shaft sinuate and and pygofer with ventral processes, pronotum parrot green without black spot and two black basal triangle is the character of *Idioscopus decoratus*. Third apical cell of the forewing without black spot, face and vertex is uniformly ochraceous without irregular black spots is common in both *I. spectabilis* and *I. dworakowskiae* but differ in pronotum with large discal spot and basal half of the scutellum is black in *I. spectabilis* as compare to pronotum immaculate, scutellum with two triangular basal brown spots in *I. dworakowskiae*. Face irregularly marked with brown patches, pronotum with brown patches, style anterior portion longer than the posterior and the aedeagus with 2 pair of processes and one pair reaching 1/3rd of the Aedeagus is the characters of *I. nitidulus*. Face

and vertex with two round spots in apex, face lemon yellow, pronotum yellowish green without black spots and scutellum with two basal black triangle spot and two small dots in between them are common in both *I. clypealis* and *I. nagpurensis* but differ in clypellus full black, Aedeagus with two process reaching full length and apex of style pointed in *I. clypealis* but clypellus half basal black, Aedeagus with two pair of processes not reaching the full length, apex of aedeagal shaft knob like and apex of style with small round lobe in *I. nagpurensis*. Clypellus without any black spot, face and vertex lemon yellow, pronotum with brown patches is common in *I. anasuyae* and *I. jayashriae* but differ in aedeagual shaft broad at base narrowed and strongly curved apical hook has a pair lateral curved processes in mid length in *I. anasuyae* where has in *I. jayashriae* Aedeagus shaft with caudal denticle slightly before gonopore differs.

5. Conclusion

With the above key characters and well-illustrated photographs one can easily identify mango leafhopper species complex found in India.

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