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Further Studies of the Genus *Empoasca* (Homoptera Cicadellidae). Part I, Nine New Species of *Empoasca*

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FURTHER STUDIES OF THE GENUS EMPOASCA.
(HOMOPTERA CICADELLIDAE.)

PART I.
NINE NEW SPECIES OF EMPOASCA.

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During 1928 and 1929 the writer attempted to examine all available material and to bring together data and records on the species of minute green leafhoppers belonging to the Genus *Empoasca*. This work was published in January, 1931, as Technical Bulletin 231, U. S. Department of Agriculture, under the title "A Revision of the American Species of *Empoasca* Known to Occur North of Mexico."

Since the completion of that manuscript material has been collected especially in the western United States by the writer and a considerable amount of material has been forwarded for identification by other workers. The present paper includes the first new descriptions of North American species since the revision was published.

***Empoasca obrudens* n. sp.**

(Figs. 1, 1a, 1b.)

Resembling *maligna* in general form and appearance, but with distinct genital characters in both sexes and with a distinct brown spot just before each inner apical cell. Length, 3.7 mm.

Vertex broadly rounded, slightly produced beyond anterior margins of the eyes, parallel margined, twice wider between eyes than length at middle. Pronotum twice as wide as long with humeral angles prominent, projecting, wider than the eyes.

Color: Pale green, vertex, pronotum and scutellum mottled with white and yellow. Elytra greenish subhyaline with a distinct brown spot just before each inner apical cell.

Female genitalia: Female last ventral segment more than twice as long as preceding. Lateral angles produced into elongate lobes. Central portion of posterior margin excavated almost two-thirds the distance to the base, obliquely incised either side of a rounded, rather narrow, sunken, median lobe.

Male genitalia: Male valve longer than preceding, segment broadly V-notched posteriorly. Plates long and narrow, almost parallel margined, tapered to pointed apices. Of the male genital pieces the lateral processes of the pygofers are long and rather broad to near the

apices, where they are narrowed to pointed tips and upturned. The chitinous spines of the tenth segment are broad and similar to *pergandei*, slightly curved forward and with an anterior ventral pointed tip.

Described from a series of ten female and six male specimens in the Ball collection from Flagstaff, Arizona, collected by E. D. Ball, August 7, 1929. Holotype female, allotype male, and male and female paratypes in Ball collection. Male and female paratypes in author's collection.

Some of these are marked locust and this is probably the food plant. This species is easily distinguished from all known species of the genus by the unique female segment.

***Empoasca rubrafacia* n. sp.**

(Figs. 6, 6a.)

General form and size of obtusa, but distinctly marked by red bands on vertex and face and three brownish bands on pronotum and elytra. 3.5-3.75 mm.

Vertex broadly rounded, produced almost half its length before anterior margins of eyes, more than half as long at middle as width between eyes. Pronotum without prominent humeral angles, narrower than head.

Color: Pale green with a broad bright red band extending between eyes on margin of vertex. Face with a curved bright red band extending on either side from clypeus almost to margin of vertex where they are united by a curved band between eyes above antennae. Pronotum and scutellum almost entirely brown, anterior portion sometimes pale. A broad band extends across elytra just back of scutellum, but does not reach costa, and another across apex of wings including all the apical cells and extending farther anterior than apex of clavus, brown, veins in apical region pale. In faintly marked specimens the red bands on the vertex and face are usually conspicuous.

Female genitalia: Last ventral segment strongly roundly produced from base.

Male genitalia: Male valve broad, roundly produced. Plates rather long, upturned at apices, gradually narrowed to blunt tips and heavily set with coarse spines. Of the male genitalia the lateral processes are rather stout with divergent finger-like processes extending abruptly outwardly and slightly dorsally. The chitinous spines of the tenth segment are long, broad at base, rapidly tapered to a rather long narrow apical portion which is strongly curved ventrally and anteriorly.

Described from a series of twenty-four male and female specimens all from Arizona, collected by E. D. Ball during May, August and September, 1929 and 1931. Localities represented are Patagonia, Tucson and Superior. Those from Patagonia are labeled "B. willow."

Male holotype, female allotype and male and female paratypes in E. D. Ball collection. Male and female paratypes in collection of the author.

***Empoasca bitubera* n. sp.**

(Figs. 9, 9a.)

A small green species with a bluntly pointed head, and with distinct genital characters. Length, 2.5-2.7 mm.

Vertex bluntly pointed, produced one-half its length before anterior margin of eyes. At least one-third longer on middle than next the eyes. One-fifth wider between eyes than length at middle. Pronotum with broadly rounded humeral angles. Elytra about one-third longer than abdomen.

Color: Vertex pale green or white with irregular yellow markings. Pronotum dull green, posterior portion sometimes darker. Elytra dull green to smoky, apex smoky, subhyaline, veins pale as in *alboneura*.

Female genitalia: Female last ventral segment long, posterior margin almost truncate, slightly produced at middle.

Male genitalia: Male valve broadly, angularly excavated posteriorly. Plates broad at base, not twice as long as broad, gradually narrowed to bluntly pointed apices. Of the male genital pieces the lateral processes of the pygofer are curved inwardly then curved abruptly outwardly with apices diverging. The apex is turned sharply upward. The oedagus is distinct by having a long narrow spine-like process which arises near the base, and another one which arises about half way from the base. The chitinous spines of the tenth segment are broad, slightly curved forward, apex abruptly pointed and curved slightly inwardly.

Described from a series of twenty-two male and female specimens collected at Tucson, Arizona, May 26, 1929. Yarnell Mts., Arizona, October 4, 5, and 8, 1929, and Cedar, Utah, August 28, 1930, by E. D. Ball. The food plant is marked "Guterh." Also a series of specimens collected at Santa Clara, Utah, May 5, 1929, and at Las Vegas, Nevada, May 6, 1929, from Gutierrezia.

Holotype male and allotype female and male and female paratypes in author's collection. Male and female paratypes in Ball collection.

***Empoasca calcea* n. sp.**

(Figs. 8, 8a.)

Resembling *arida* and *abrupta* in general appearance, but with distinct genital characters. Length, 2.7-3 mm.

Vertex rounded, produced about one-third its length before anterior margins of eyes, about one-fifth wider between eyes than length at middle. Elytra one-third longer than abdomen.

Color: Vertex dull green washed with yellow. Pronotum smoky green with a row of five white spots sometimes fused, along anterior margin. Pronotum and elytra dull smoky green. Scutellum with a pale green band across middle. Veins of elytra paler.

Female genitalia: Last ventral segment of female with posterior margin slightly produced.

Male genitalia: Male valve almost truncate, slightly indented at middle. Plates one-half longer than combined basal width, rather rapidly, convexly narrowed on apical third to pointed apices. Of the male genital pieces the lateral processes of the pygofers are rather short and thick with apices enlarged and blunt, slightly upturned. Chitinous spine of the tenth segment long and thick, ventral half curved anteriorly and ventrally, apical portion rather abruptly narrowed and produced.

Described from a series of eighteen male and female specimens collected at Tucson, Arizona, during April, May and June, 1929 and 1930, by E. D. Ball. Part of these are labeled "Celtis."

Male holotype and female allotype in Ball collection. Male and female paratype in Ball collection and in the author's collection.

***Empoasca reflexa* n. sp.**

(Figs. 7, 7a.)

In general appearance resembling *snowi* but slightly smaller and with different female genitalia. Length, 3-3.5 mm.

Vertex bluntly, angularly produced about one-half its length before the anterior margins of the eyes. One-half wider between eyes than length at middle. Pronotum with humeral angles strongly produced and prominent. Elytra long, produced about one-third their length beyond apex of abdomen.

Color: Vertex green, usually with a central white stripe and an oblique white dash next either eye. Pronotum variable, sometimes with three white spots on anterior portion. Elytra greenish subhyaline.

Female genitalia: Female last ventral segment with posterior margin slightly produced posteriorly.

Male genitalia: Male valve rather broadly rounded, plates triangular, tapered and upturned, sometimes flaring at tips. Of the male genital pieces the lateral processes of the pygofers are stout and have a recurved finger terminal process pointing inwardly in ventral view. In lateral view the tip is abruptly and sharply pointed. Chitinous spine of tenth segment long narrowed to a long sickle-like terminal half which is anteriorly and ventrally curved.

Described from a series of twelve male and female specimens collected at San Rita Mt., Arizona, July 17 and 22, 1930 and 1931, by Dr. E. D. Ball. These are labeled "Sapind."

Male holotype and female allotype in Ball collection. Male and female paratypes in Ball collection and in the author's collection.

Empoasca medora n. sp.

(Fig. 4.)

In general appearance and coloration resembling *aspersa*, but more robust and with distinct female genitalia. Length, .3 mm.

Vertex bluntly rounded, produced approximately one-half its length beyond anterior margins of the eyes, not quite twice as wide between eyes as median length.

Color: Vertex pale yellow, pronotum, scutellum and elytra pale green to white. Elytra rather uniformly mottled with smoky or gray. Veins white, margined with smoky.

Female genitalia: Last ventral segment longer than preceding, posterior margin roundly notched either side of a broad median lobe, which is slightly indented at middle. These notches form a rather evenly rounded lobe at each lateral angle. Male unknown.

Described from five female specimens labeled Medora, N. D., collected July 25, 1924, by Dr. E. D. Ball.

Holotype, female and female paratypes in Ball collection. Female paratype in the author's collection.

Empoasca bidens n. sp.

(Figs. 2, 2a.)

A small blunt-headed species related to *alboneura*. Elytra mottled with smoky. This species can be distinguished easily from all others by the character of the chitinous spine on the tenth segment. Length, 2.8-3 mm.

Vertex bulbous, bluntly rounded, produced about one-third its length before anterior margins of eyes. Only slightly longer on middle than next the eyes. About one-third wider than long. Elytra produced almost half their length beyond apex of abdomen.

Color: Vertex white to faint greenish. Ocelli and a pair of spots above ocelli on vertex darker. Pronotum with anterior portion usually paler, marked with dark spots, usually a broad median pale stripe extending longitudinally across pronotum. Elytra smoky green, venation white, conspicuous.

Female genitalia: Last ventral segment with posterior margin roundly produced.

Male genitalia: Male valve short, broadly rounded, plates rather strongly narrowed to produced attenuated tips (in ventral view) which are upturned. Of the male genital pieces the lateral processes of the pygofer are broad in ventral view and appear abruptly narrowed and upturned at apex. The chitinous spine of the tenth segment is broad directed ventrally and is terminated by two teeth with a concave portion between.

Described from a series of four male and two female specimens collected at Hauchuca Mts., Arizona, by Dr. E. D. Ball, June 15, 1930.

Holotype male and allotype female in Ball collection. Paratype male and female specimens in Ball collection. Paratype male in author's collection.

***Empoasca calcara* n. sp.**

(Figs. 3, 3a.)

In general appearance resembling *fabae*, but with distinct male genitalia. Length, 3.-3.2 mm.

Vertex bluntly rounded, produced about one-third its length before anterior margins of the eyes, more than one-third wider between eyes than length at middle. Pronotum with humeral angles prominently produced.

Color: Vertex pale green, marked with yellow. Pronotum dull green, anterior portion paler, with three rather distinct white spots just back of margin of vertex. Pronotum with a paler green spot near middle. Elytra smoky green, veins inconspicuous.

Female genitalia: Female last ventral segment rather roundly produced.

Male genitalia: Male valve concavely rounded. Plates gradually tapered to blunt tips. Of the male genital pieces the lateral processes of the pygofer are very short and setaceous. They are smaller than in any species described at present. The chitinous spine of the tenth segment is broad at base, curved posteriorly and strongly narrowed near the apex which is sharp-pointed.

Described from fourteen male and female specimens collected at Yarnell Heights, Granit Dell, Glenn Oaks and Patagonia, Arizona, during July and October, 1929 and 1930, by E. D. Ball.

Male holotype and female allotype in Ball collection. Male and female paratypes in collection of E. D. Ball and in author's collection.

***Empoasca infusca* n. sp.**

(Figs. 5, 5a.)

Resembling *birdii* in appearance and color pattern, but with bright greenish tint and genital characters distinct. Length, 3.3-3.5 mm.

Vertex bluntly rounded, produced more than one-half its length before anterior margins of eyes, two-thirds as long on middle as width between eyes. Elytra long, more than one-third produced beyond apex of abdomen.

Color: Markings similar to *birdii*. Green washed with smoky brown. Vertex with a spot either side of apex, a spot next either eye

on base of vertex and a median stripe pale. Pronotum with three large spots on anterior margin and a median stripe on scutellum pale. Elytra with clavus and a transverse band before apex of clavus extending to costa of elytra brownish. Apices of elytra frequently smoky. In dark specimens the anterior half of elytra usually brownish with a pale area on middle of each costa.

Female genitalia: Last ventral segment with posterior margin gradually produced at middle.

Male genitalia: Male valve concave posteriorly. Plates rather long, convexly tapered to pointed apices. Of the male genital pieces the lateral processes of the pygofers are rather short, heavy at their bases and tapered to rather sharp apices. Chitinous spine of the tenth segment rather long, apical half slender and ventrally curved.

Described from a large series of specimens collected at Columbus, Canal Winchester, Carroll, and Worthington, Ohio, during April and May, 1931 and 1932, by Paul Oman, Dr. E. P. Breakey and the author, from Buckeye in shrubby growth.

Holotype male and allotype female in author's collection. Male and female paratypes in collections of the author, E. D. Ball, Paul Oman, and E. P. Breakey and the U. S. National Museum.

Superficially this species, *birdii* and *vincula*, cannot be distinguished because each is variable in intensity of color and the patterns are frequently very similar. The genital characters, however, are different and on this basis they are easily separated.

EXPLANATION OF PLATE I.

Genitalia of *Empoasca*.

- - - - - Indicate styles of male.
 - - Indicate oedagus of male.
 - Indicate lateral processes of pygofers of male.

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| 1. <i>E. obrudens</i> , female segment. | 5a. <i>E. infusca</i> , lateral view of male. |
| 1a. <i>E. obrudens</i> , lateral view of male. | 6. <i>E. rubrafacia</i> , ventral view of male. |
| 1b. <i>E. obrudens</i> , ventral view of male. | 6a. <i>E. rubrafacia</i> , lateral view of male. |
| 2. <i>E. bidens</i> , ventral view of male. | 7. <i>E. reflexa</i> , ventral view of male. |
| 2a. <i>E. bidens</i> , lateral view of male. | 7a. <i>E. reflexa</i> , lateral view of male. |
| 3. <i>E. calcara</i> , ventral view of male. | 8. <i>E. calcea</i> , ventral view of male. |
| 3a. <i>E. calcara</i> , lateral view of male. | 8a. <i>E. calcea</i> , lateral view of male. |
| 4. <i>E. medora</i> , female segment. | 9. <i>E. bitubera</i> , lateral view of male. |
| 5. <i>E. infusca</i> , ventral view of male. | 9a. <i>E. bitubera</i> , ventral view of male. |

