SYSTEMATICS

Diabrotica calchaqui, a New Species of Luperini (Coleoptera: Chrysomelidae: Galerucinae), from Argentina

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ABSTRACT The new species *Diabrotica calchaqui* Cabrera & Cabrera Walsh is described and illustrated based on specimens collected from Cachi, Salta Province, Argentina. This new species is assigned to the *Diabrotica virgifera* group, subtribe Diabroticina, tribe Luperini. *D. calchaqui* is recognized by the combined characters of elytra green with yellow vittae in some specimens reduced to two or three spots, humeral plicae subparallel, elytral sulcus sometimes obsolete, and internal sac of median lobe with five sclerites. Differences between *D. calchaqui* with *Diabrotica porracea* Harold, *Diabrotica tumidicornis* Erichson, *Diabrotica mapiriensis* Krysan & Smith, and *Diabrotica fulvofasciata* Jacoby, of similar morphology, also are discussed. Adults have been found associated with cultivated Cucurbitaceae and wild Asteraceae flowers.

KEY WORDS *Diabrotica calchaqui*, Chrysomelidae, Galerucinae, Argentina, systematics

THE VIRGIFERA SPECIES GROUP OF *Diabrotica* Chevrolat was proposed by Smith and Lawrence (1967) to include 35 valid species, seven of them considered *incertae sedis.* Later, Wilcox (1972) placed in it 24 species of the original designation and those that Smith and Lawrence had designated *incertae sedis.* Krysan and Smith (1987) published the most comprehensive treatment of this group discussing the relationships and position of the species previously included. They described new species and provided a key for 18 species considered belonging to the group and listed another 19 species that, although not belonging to the group, share some of its external traits.

This species group is represented in South America by nine species, mainly distributed in the Andean region from Colombia to Chile. However, both species cited for Argentina, *Diabrotica panchroma* Bechyné and *Diabrotica emorsitans* Baly, are distributed in the subtropical region. Yet, the northwestern highlands of Argentina had not been explored for galerucines. During 2001 and 2002, we traveled in this region in search for species of *Diabrotica* and their natural enemies. This region, Yungas, Puna, and Prepuna biogeographical provinces (Cabrera and Willink 1980), is characterized by a series of north-south-oriented valleys and large plateaus between 1,000 and 4,000 m in elevation, isolated by arid mountainous chains of 4,000–6,000 m in elevation. Annual rainfall ranges from 50 to 600 mm and occurs almost exclusively during summer. Agriculture in this area is limited to the lower parts of the valleys, fringing the floodplains. It is completely irrigation dependent and consists of small, traditional polyculture farms. In this area, at an altitude of 2,460 m, we found a new species in the *virgifera* group.

The purpose of this article is to provide a full description of this new species, *Diabrotica calchaqui* Cabrera & Cabrera Walsh, adding morphological characters previously overlooked in the group, such as those of mouthparts, hind wing venation, binding patch, metendosternite, and some details of male and female genitalia. The main diagnostic features are illustrated, and biological data are provided.

Materials and Methods

Adults were collected with aspirators and cucurbitacin-baited cloths (Cabrera Walsh 2001) and reared in the laboratory on artificial diet (Campbell and Jackson 1987) and maize seedlings.

Morphological descriptions are complementary; the shared features between male and female are not repeated after being mentioned for the first time. Head capsule terminology follows Cabrera (2001) and Konstantinov (1998a), mouthparts Cabrera and Durante (2001), hind wing venation Kukalová-Peck and Lawrence (1993), metanotum Konstantinov (1998a) and Lingafelter and Konstantinov (2000), and metendosternite Lingafelter and Konstantinov (2000). Nomenclature for the parts of the male genitalia is based on Lindroth and Palmén (1970) and Mann (1985) and that of the female genitalia on Le Sage (1986) and Konstantinov (1998b, 2002). The abbreviations used to mention the venation scheme are SC, subcosta; RA, radial anterior; RP, radial posterior; r4, radial cross vein 4; MP, medial posterior; RP-MP2, radio-medial

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cross-vein 2; CuA, cubital anterior; AA, anal anterior; and AP, anal posterior.

Measurements were taken using an eye-piece micrometer on a Wild dissecting microscope at a magnification of 25× and indicated in millimeters. The range and average are provided for each measurement. Measurements and abbreviations used in the text are eye length (eL), determined by the linear distance from anterior to posterior margin of eyes; genal length (GL), distance measured between the anterior margin of eye to the base of mandible; length of pronotum (PL), linear distance from anterior to posterior margin measured along the midline; pronotum width (PW), defined as maximum pronotal width; humeral width (HW), maximum width across humeri; elytral length (EL), linear distance from pronotal base to apex of elytra, measured along suture; and elytral width (EW), maximum distance across both elytra. Body length was measured from the posterior margin of eyes to apical margin of elytra. Relative proportions of the above-described measurements eL/GL, PW/PL, HW/PW, and EW/HW were computed.

Drawings were made with camera lucida on a Leitz compound microscope and a Wild dissecting microscope. Electron micrographs of head and binding sites of elytra were taken with a scanning electron microscope (SEM) Jeol-JSM-T100; previously, these structures were mounted on metal studs and coated with gold-palladium.

The holotype, allotype, and a number of paratypes are deposited in the collection of the Museo de La Plata (MLP), La Plata, Buenos Aires Province, Argentina. Type label includes the species name, the type status and gender, and collectors.

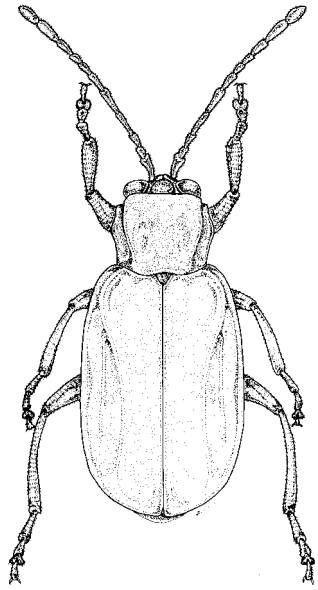

Fig. 1. *D. calchaqui*, male, dorsal habitus.

D. calchaqui, New Species
(Figs. 1–5)

Diagnosis. Body oblong, oval, moderately convex, elytra green with yellow vittae or two or three isolated spots, humeral plicae subparallel, elytral sulcus weak, obsolete in some specimens. Internal sac of the median lobe with five sclerites.

Male. (Fig. 1). Length, 5.18 mm; width, 2.31 mm.

Color. Head green tinged with yellowish brown; frons, antennal calli, labrum, distal part of mandibles, maxillae and labrum chestnut; basal part of mandibles greenish. Antennae chestnut, inner surface and apex of antennomere one tinged with green, apex of antennomere 11 dark brown. Pronotum bright green, distally tinged with yellowish brown. Scutellum amber; elytra and elytropleura green; humeral vittae yellow, extending from basal margin to three-fourths length of elytra. Coxae and basal one-third of femora yellowish brown, two-thirds of femora and tibiae lime green; tarsi chestnut. Venter, prosternum green, meso-metasternum yellowish brown tinged with cinnamon; abdomen green tinged with yellow.

Head. Hypognathous, vertex (Fig. 2A and E) finely and sparsely punctate, depressed above the antennal calli with a supraorbital pore above eye; antennal calli subtriangular, slightly elevated over surface of vertex, wider than antennal sockets, surface moderately shiny, smooth; midfrontal sulcus well developed; supra-antennal sulcus slightly distinct only on anterior margin of antennal calli; antennal sockets closed to the anterior margin of eyes, distance between them larger than transverse diameter of antennal sockets. Frontal ridge moderately raised in lateral view, narrow posteriorly, wider toward clypeus, surrounded laterally by four to five setae, and five to seven setae below the antennal sockets; anterofrontal ridge not separated from frontal ridge, as high as frontal ridge in lateral view. Antennae (Fig. 3A) 11-segmented, inserted immediately below midline of eyes, extended more than one-half the length of elytra; antennomere 2 short, slightly longer than 3, antennomeres 2 + 3 together more than one-half the length of antennomere 4; antennomeres 2 + three-fourths: 0.63; antennomeres 3–10 elongate, similar in length, antennomere 11 apically acuminate. Antennomeres 1–3 scarcely setose, antennomeres 4–11 densely setose throughout, with long erect setae on the apical margin. Eyes convex, posterior margin not demarcated from adjacent vertex; eL, 0.42 mm, surrounded by seven to eight setae laterally and four small setae near by the anterior margin of each eye. Genal space small; GL, 0.09 mm, approximately one-fourth the maximum length of the eye; GL/eL, 0.21. Clypeus short, frontoclypeal suture with a row of nine long setae. Labrum (Fig. 4A) transverse, approximately rectangular, anterior margin with a central notch, lateral margins slightly rounded, a row of six long setae at mid length, three short fine setae closed to the notch apically, and eight short sensilla on each side. Mandibles (Figs. 4B and 2C) symmetrical, pyramidal, five-toothed apically, sparsely and weakly setose, only teeth 3–5 visible on

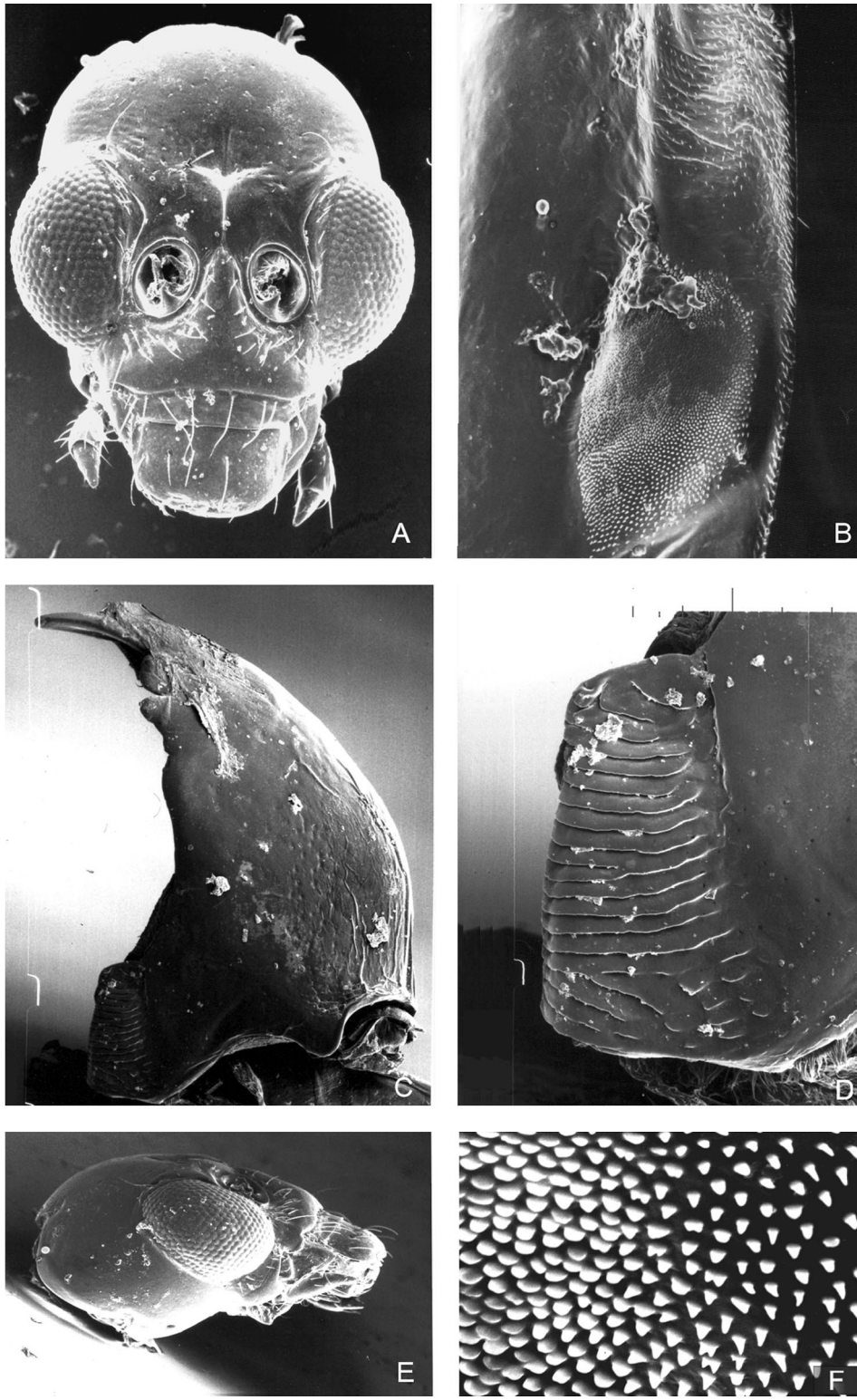

Fig. 2. *D. calchaqui* (A) head, frontal view (100×). (B) Binding patch, ventral view of elytron (100×). (C) Mandible, external face (200×). (D) Mandible, detail of mola (750×). (E) Head, lateral view (100×). (F) Detail of binding patch (1,500×), basal area with stump-shaped spicules, and distal area with sharktooth-shaped spicules. Bars, 100 μm (C and D).

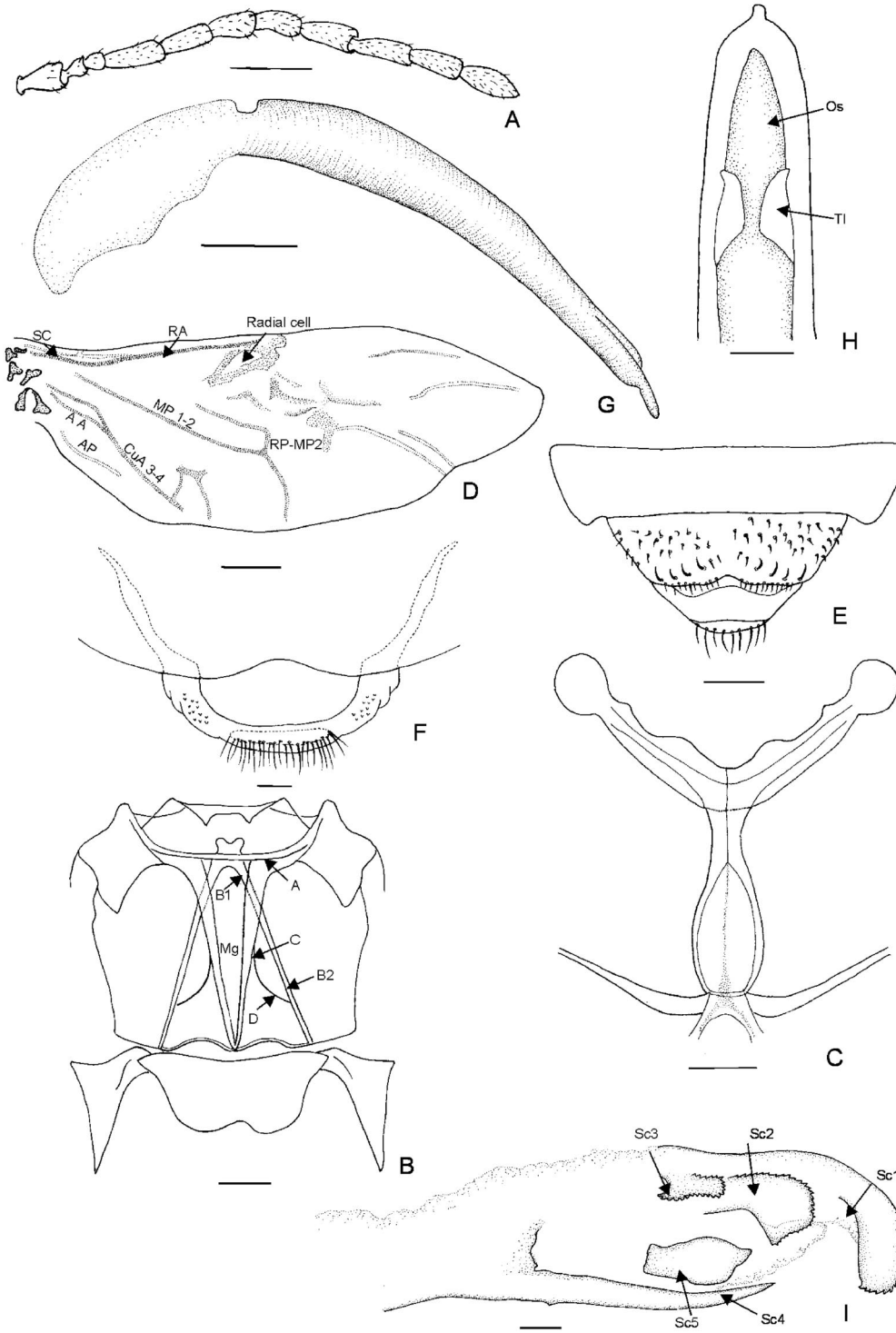

Fig. 3. *D. calchaqui*, male (A) antenna, ventral view. (B) Metanotum. (C) Metendosternite, dorsal view. (D) Hind wing. (E) Abdomen, apical sternites. (F) Abdomen, detail of tergite VIII and sternum VII, ventral view. (G) Median lobe, lateral view. (H) Median lobe, detail of apex, ventral view. (I) Internal sac of median lobe. Bars, 1 mm (A–D, F, J), 0.1 mm (G–I), and 0.1 mm (K–M). A, metanotal ridge a; AA, anal anterior vein; AP, anal posterior vein; B1, metanotal ridge b1, B2; C, metanotal ridge c; CuA 3 + 4, cubito anal vein 3 + 4; D, metanotal ridge d; Mg, median groove; MP 1–2, medial posterior vein 1–2; Os, ostium; RA, radial vein; RP-MP2, radial posterior-medial posterior vein 2; Sc1, sclerite 1; Sc2, sclerite 2; Sc3, sclerite 3; Sc4, sclerite 4; Sc5, sclerite 5; SC, subcostal vein; Tl, triangular lobe.

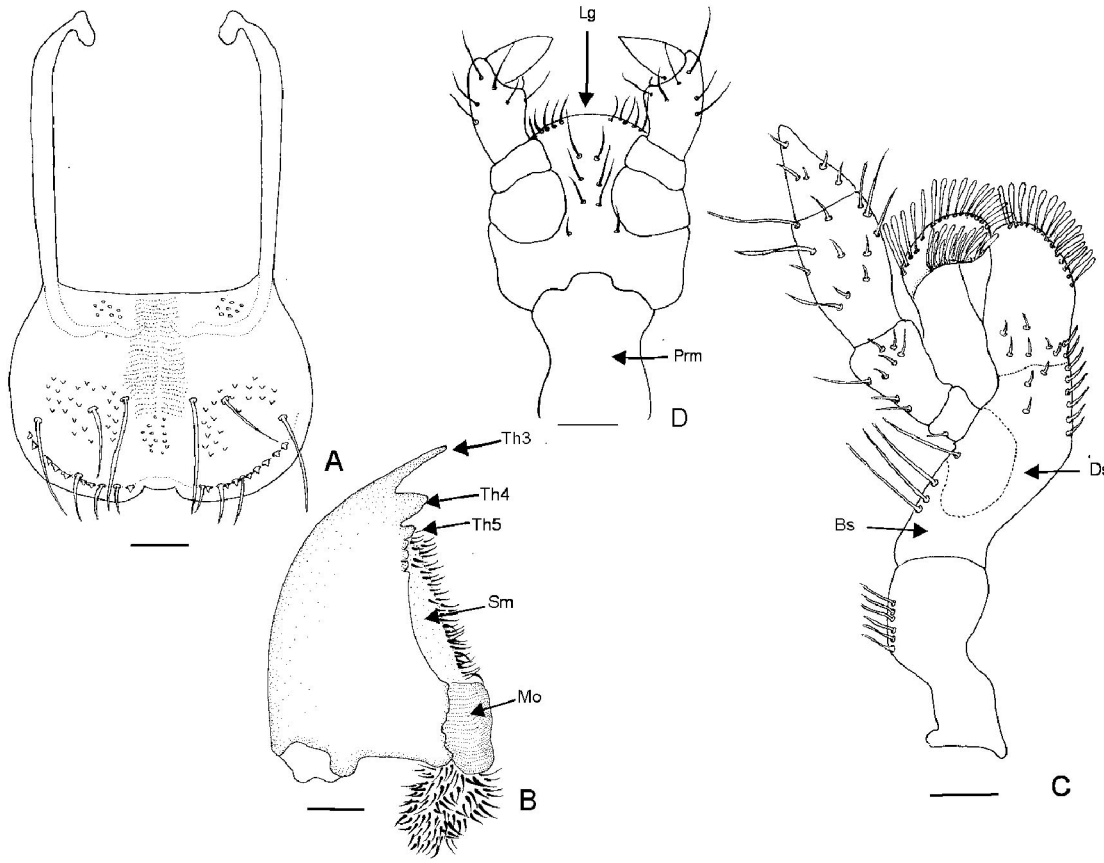

Fig. 4. *D. calchaqui*, male (A) labrum, dorsal view. (B) Mandible, external face. (C) Maxilla, ventral view. (D) Labium, ventral view. Bars, 0.1 mm. Bs, basistipes; Ds, dististipes; Lg, ligula; Mo, mola; Prm, prementum; Sm, setose membrane; Th3, tooth 3; Th4, tooth 4; Th5, tooth 5.

external face; tooth three narrow, very acute, >2.0 times length of tooth 4; inner margin of tooth three smooth; tooth 4 almost blunt, 2.0 times the length of tooth 5, which is small, blunt at apex; inner margin of the mandible with two or three very short denticles, the rest smooth; setose membrane extended from inner surface of the mandible to above the mola; mola longer than wide, sculptured with rows of fine grinding ridges (Fig. 2D); prosthecal fringe formed by long setae. Maxillae (Fig. 4C), cardo narrow proximately, widens apically with six long setae; basistipes with four long setae situated in the latero-external margin; dististipes finely striate on the inner-lateral margin, six small setae on inner margin, and three setae closed to lacinia; galea and lacinia well developed, one-segmented, with a fringe-like pilosity apically; galea subcylindrical, apically wider than base. Maxillary palpi well developed, four-segmented, surpassing the galea; palpomere one subrectangular; palpomere two subconical, palpomere 3, subcylindrical, longer than palpomere 4; palpomere 4 subconical, strongly tapering apically, digitiform sensillum patch in the externo-basal corner of palpomere 4, evident with higher resolution. Labium (Fig. 4D) with four pair of long setae between the bases of palps. Ligula membranous, scarcely developed, globose, bearing five setae. Labial palp three-segmented, with palpomere 1 subrectangular; palpomere 2 longer than 3, subcylindrical, longer than wide; palpomere 3 subconical with narrow base.

Thorax. Pronotum slightly convex, shiny, evenly, finely punctate, rectangular, 1.31 times wider than long, greatest width near middle; PW, 1.38 mm; deeply bifoveate; anterior margin almost straight, the posterolateral margins slightly expanded anteriorly; anterior lateral and posterior lateral angles rounded with a long, thin seta on each one. Prosternum transverse, convex; procoxal cavities open, rounded, inserted at middle, contiguous; intercoxal prosternal process thin, extended between procoxae to about one-half their length. Mesonotum and scutellum fused; scutellum triangular, smooth. Mesosternum shorter than metasternum at midline, intercoxal mesosternal process thin, extended to one-half the length of mesocoxae; mesocoxal cavities inserted on posterior margin, nearly contiguous, broadly open laterally to mesepimeron. Metanotum transverse, wider than long; metanotal ridge D (Fig. 3B) intersecting C anteriorly to midpoint

of C, ridge B_1 intersecting A below the median groove. Metasternum transverse, slightly concave centrally, with a small bidentate projection between inner margin of metacoxae; sparsely setose centrally, setae longer than pro-mesosternum; lateral one-half of metasternum, metepisternum and metepimeron densely setose; metacoxal cavities inserted on posterior margin, narrowly separated. Metendosternite (Fig. 3C) with stalk longer than wide; lateral arms, thin, obtusely divergent, apically rounded; mesofurcal-metafurcal tendons poorly developed, inserted near middle of lateral arms; ventral process poorly developed. Hind wings (Fig. 3D) with veins RA, MP, CuA well sclerotized, veins SC and AA scarcely sclerotized. SC connected to RA more than one-half its length, radial cell darkly pigmented, elongate, subtriangular; RP-MP_2 not reaching r_4; AA unbranched and connected to CuA_{3+4} at about one-half the distance from the origin of CuA; cubital anal cell closed, elongate; cubital anal cell two absent; AP short, scarcely sclerotized, apical field with veins RP barely noticeable. Elytra slightly wider than pronotum; HW/PW, 1.29, greatest width near the posterior one-third of elytra; EW/HW, 1.40; humeral calli rounded, slightly prominent; surface dense, irregularly punctate, punctures coarser than on pronotum. Humeral plicae subparalell extended to two-thirds of the elytron, elytral sulcus weak, obsolete in some specimens; epipleura anteriorly broad, gradually narrowed along apical half; inner surface of elytra with an oval binding patch (Fig. 2B) covered with stump-shaped spicules on basal half and small sharktooth-shaped spicules on the apical half; surface near the basal angle (Fig. 2F) covered with small, thin, sparse spicules. Legs with femora fusiform, tibiae dorsally carinate, metatibiae longer and slenderer than pro-mesotibiae, apical margin of meso-metatibiae with short spurs; trochanters and femora sparsely setose; femora of meso-metalegs and tibia of all legs densely setose ventrolaterally. Tarsomere one of pro and mesolegs oval, shorter than tarsomeres 2 + 3 together; tarsomere one of metalegs elongate, longer than tarsomeres 2 + 3 together; tarsal claws bifid, inner claw more than one-half the length of the outer; tarsomeres setose dorsally with long sparse setae. Pro-mesolegs with a ventral adhesive patch covering one-half the length of protarsus, and approximately three-fourths on mesotarsus.

Abdomen. Sternite five 1.5 mm, slightly emarginate apically (Fig. 3E) with about eight apically curved setae near apical margin, last tergite (Fig. 3F) with a row of long setae. *Genitalia:* median lobe (Fig. 3G) symmetrical, without basal spurs, evenly curved in lateral view, constricted at about the basal one-third, in dorsal view; anteriorly slender, tapering slightly toward the apex, scarcely deflexed, apically with a small projection; orificial plate (Fig. 3H) elongate, apically acute, separated from apex by approximately one-fourth the length of the orifice plate; basal foramen continues as a fine longitudinal groove; ostium wide, rounded, with a pair of well developed triangular lobes attached to the sides. Internal sac of median lobe (Fig. 3I) with five sclerites: sclerite 1 rounded and curved apically, toothed on the apical and inner margins; sclerite 2 wide, slightly rounded apically, finely toothed laterally and apically; sclerite 3 short, wide, toothed on the inner and apical margins, place on the top of the basal part of sclerite 2; sclerite 4 elongate in lateral view, pointed apically, with a triangular basal denticle, sclerite 5 as sclerotized as sclerite 3, broad, situated near sclerite 4.

Variation of Paratypes. *Color.* In many species green fades to yellowish brown, but bright green would be the prominent color of well preserved or live specimens. The degree of green of the elytra, thorax, head (except vertex), and prosternum vary from lime green to parrot green, but in some cases the head varies toward yellowish brown. The vertex is frequently the darkest area of the head. Labrum and mouthparts vary from chestnut to piceous. Antennae (except the basal two antennomeres) unicolorous, vary from cinnamon to dark brown, occasionally parrot green. The basic pattern of elytral vittae is variable, it may extend to the apex or be interrupted and looks like two or three isolated spots situated in humeral, medial, or apical elytral area, in some specimens the vittae are pale. Meso-metasternum varies from chestnut to dark brown. The external face of femora and tibiae are straw yellow or all legs are dark brown, in occasional specimens coxae, trochanthers, femora, tibiae, and tarsomeres 1 bright green, whereas the remaining tarsomeres vary from chestnut to dark brown. Abdomen varies from green tinged with yellow to yellowish brown, in which case the apical sternite is greenish. Length, 5.05–5.34 mm; width, 2.31–3.36 mm (N = 15 males, averages in brackets).

Head. Antennomere 2, 0.13–0.16 mm [0.14] subequal to antennomere 3, 0.16 mm [0.16], in some specimens antennomere 2 is slightly longer than 3, antennomeres 2 + 3 together vary from more than one-half to about three-fourths the length of antennomere 4, A2 + three-fourths, 0.63–0.96 [0.73]. Maximum length of the eye, eL, 0.42–0.59 mm [0.50], the genal space of the majority of specimens is approximately one-fourth, or a little less, of eL; GL, 0.09–0.13 mm [0.11]; GL/eL, 0.17–0.26 [0.22].

Thorax. Pronotum varies from subquadrate to rectangular; PW/PL, 1.05–1.53 [1.31]; PW, 1.18–1.45.mm [1.33]; HW/PW, 1.29–1.67 [1.33]. In some specimens, the elytral sulcus is nearly indiscernible, EW/HW, 1.26–1.41 [1.30].

Female. The specimens studied are similar in color and sculpturing to the males. Length, 6.17 mm; width, 3.33 mm

Head. Antennae extended to about one-half the length of elytra; antennomere 2 (A2), 0.13 mm, shorter than antennomere 3 (A3), 0.19 mm; together more than one-half the length of antennomere 4, antennomere 2 + three-fourths, 0.61. Eyes slightly smaller than in male; eL, 0.39 mm; GL, 0.16 mm, more than one-third of eL; GL/el, 0.41.

Thorax. Pronotum rectangular, 1.57 times wider than long; PW, 1.65 mm. Elytra wider than pronotum; HW/PW, 1.40; EW/HW, 1.44.

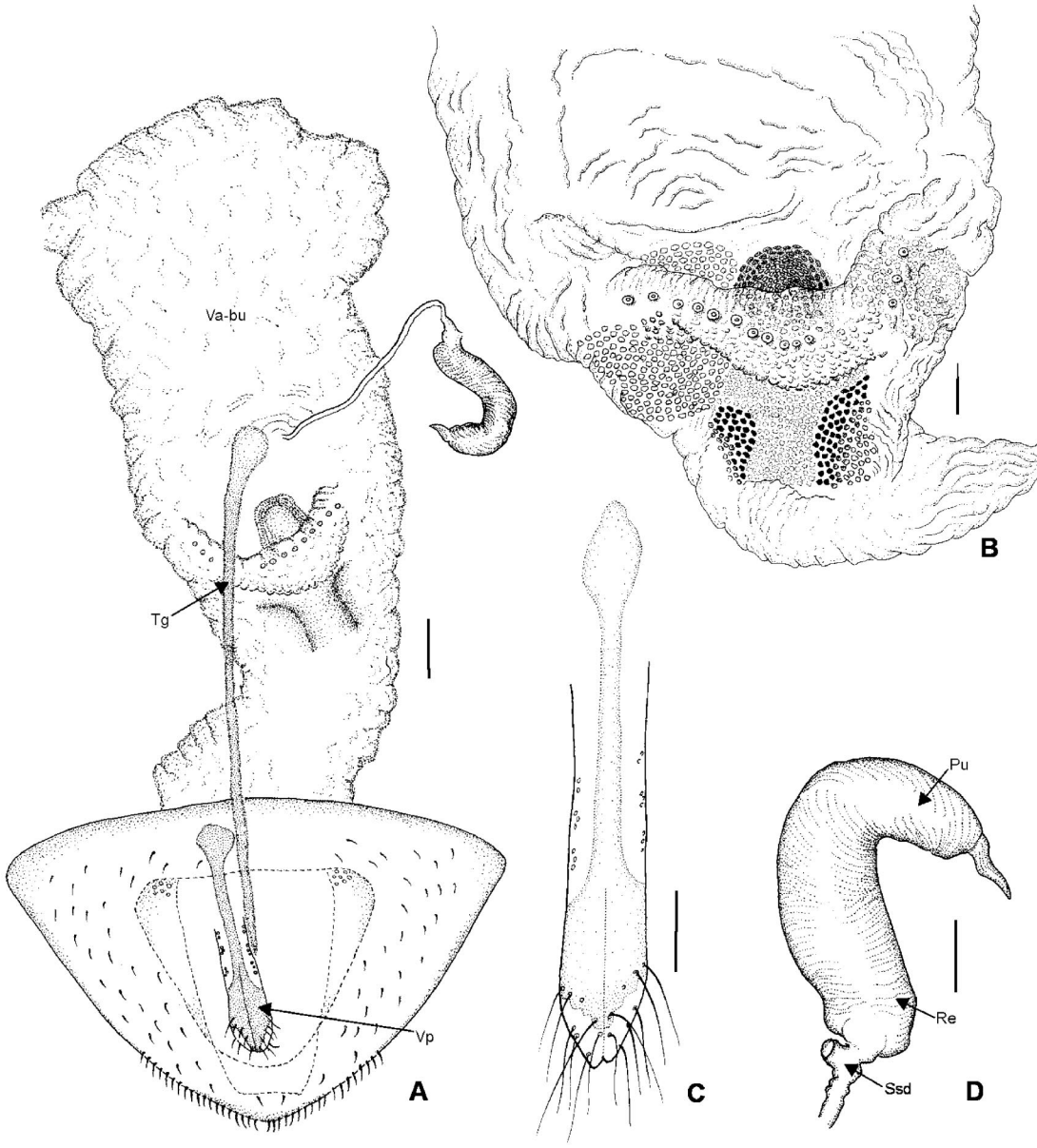

Fig. 5. *D. calchaqui*, female (A) genitalia. (B) Detail of vagina. (C) Vaginal palpi. (D) Spermatheca. Bars, 0.1 mm. Pu, pump; Re, receptacle; Ssd, sclerotized spermathecal duct; Tg, tignum; Va-bu, vagina-bursa copulatrix; Vp, vaginal palpi.

Abdomen. Last tergite covered with numerous long setae evenly distributed. *Genitalia* (Fig. 5A). Sternite 8 weakly sclerotized, apodeme (tignum) slender, slightly curved posteriorly. Styles (vaginal palpi) (Fig. 5C) subcylindrical, rounded at apex with 14 setae. Vagina + bursa copulatrix large, undivided, with sclerotized area in the middle part (Fig. 5B). Spermathecal duct (Fig. 5D) uncoiled, with a short sclerotized portion inserted basally in the receptacle; spermathecal gland elongate. Receptacle of spermatheca subcylindrical shaped, not well distinguishable from pump; pump curved, with a small pointed appendage at apex.

Variation of Paratypes. Length, 6.17–6.63 mm; width, 2.37–3.33 mm (N = 14 females, averages in brackets).

Head. Antennomere 2 (A2), 0.13–0.19 mm [0.15] varies from slightly shorter to equal than antennomere 3 (A3), 0.16–0.23 mm [0.15], together from more than one-half to three-fourths, or more, the length of antennomere 4 (A2 + three-fourths), 0.61–0.88 [0.79];

eL, 0.39–0.56 mm [0.47]; genal space, GL, 0.13–0.19 mm [0.14]; one-fourth or more eL, GL/el, 0.23–0.41 [0.29].

Thorax. Pronotum subquadrate to subrectangular; PW/PL, 0.87–1.57 [1.28] times wider than long; PW, 1.41–1.65 mm [1.54]. Elytra wider than pronotum; HW/PW, 1.24–1.56 [1.37] and EW/HW, 1.14–1.46 [1.32].

Remarks. The presence of yellow elytral vittae on *D. calchaqui* resembles those of *Diabrotica porracea* Harold, *Diabrotica tumidicornis* Erichson, and *Diabrotica fulvofasciata* Jacoby. Nevertheless, males of the two last species have greatly enlarged antennomeres: antennomeres 7–9 in *D. tumidicornis* and 5–10 in *D. fulvofasciata,* whereas the antennomeres of *D. calchaqui* are not enlarged.

D. porracea is a common species in Central America and eastern Venezuela that has green elytra with diffuse yellow elytral vittae from humerus to apex, although they are sometimes reduced or invisible medially. *D. calchaqui* can be distinguished from *D. porracea* by the generally smaller size, the narrow elytral vittae, in some specimens with only two or three isolated spots and a single weak discal sulcus. *D. porracea,* however, has no elytral vittae and possesses four or five discal sulci. The elytra, vertex, and scutellum of most specimens of *D. porracea* is paler than that of *D. calchaqui.* The male genitalia is decisive for distinguishing *D. calchaqui,* the sclerites of the internal sac are different from those of *D. porracea.* In *D. calchaqui* the lateral arm of sclerite 1 is broad and bended apically, with the external margin saw-like, whereas that of *D. porracea* is narrow. Also, sclerite 2 is broader than that of *D. porracea* and sclerite 4 is narrowed at apex.

However, specimens of *D. calchaqui* with two or three yellow spots cannot be confused with *D. mapiriensis gussi* Krysan & Smith from Peru because of the latter's piceous coloration of the head, antennae (except the two basal antennomeres), scutellum, metasternum, tibiae, and tarsi. Males of *D. calchaqui* also can be differentiated from the shape of the sclerites of the internal sac of the median lobe.

Type Material. HOLOTYPE: male, ARGENTINA: Salta: Cachi, 22-II-2001, on *Cucurbita maxima* Duchense (Cucurbitaceae), Cabrera Walsh & Cabrera col. ALLOTYPE: female, same locality, date and collector of the holotype. Paratypes: 10 males and 10 females, with the same label data as holotype except for listed dates: Salta: Cachi, 02-II-2002, Cabrera Walsh col, five males and four females, same locality, date and collector of the holotype. All material deposited in MLP.

Etymology. The name of this new species refers to its site of discovery, the Calchaqui Valleys, in Salta Province.

Biological Notes. This species was collected on squash, *C. maxima,* and *Viguiera tucumanensis* Grisebach (Asteraceae) flowers but no other crops or pastures co-occurring with these. The sole other *Diabrotica* species found in the area was the widespread *Diabrotica speciosa* (Germar) (*fucata* group), distributed almost throughout South America.

In the laboratory, 32 eggs were obtained on maize seedlings and incubated at 25°C on moist blotting paper (Cabrera Walsh 2001), but after 40 d, none hatched, suggesting this species has diapausing eggs.

Geographic Range. This species is only known from the localities of Cachi and Payogasta, distant 20 km apart, in the province of Salta, northwestern Argentina. It is also the first citation for a *virgifera* group species in the Andean regions of Argentina.

Acknowledgments

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