

Taxonomic Redescription of the Weevils Infesting Banana (*Musa* sp.) in India

Arun Kumar Singh^{1*}, Payal Jaiswal² and Satyendra Patley³

¹Kerala Agricultural University, Thrissur, Kerala, 680656

^{2,3}Indra Gandhi Krishi Vishwavidyalaya, Raipur, 492012

*Corresponding Author E-mail: arunsingh260@gmail.com

Received: 30.01.2018 | Revised: 25.02.2018 | Accepted: 28.02.2018

ABSTRACT

Taxonomy ultimately focused on the 192 specimens of two species viz., *Cosmopolites sordidus* (68) and *Odoiporus longicollis* (124). Collected specimens of individual species were segregated into different populations according to the morphological variations within the species. The present study of economically important two species had 94 illustrations and 56 line diagrams. Detailed description of all the taxonomic characters like head, rostrum, (dorsal and lateral), antennae, pronotum, elytron, femur, tibia, tarsus, venter and genitalia were studied and presented with line diagrams. Taxonomic description of two species were supplemented with standard taxonomic terminology along with genital characters and loaded with the morphometric ratios. The taxonomic key was prepared for all the known species under genera *Cosmopolites*. The taxonomic study revealed that, morphological variations present among the groups may be due to environmental conditions, availability of food, and life stage of the plant on which they are feeding on. All the variations within the species were depicted with the differential distinguishing characters along with line diagrams. Among two species, major difference was observed within the three groups of *Odoiporus longicollis* which may be a new species. More morphological and molecular level studies are needed for the confirmation of new species if any.

Key words: Taxonomy, redescription, Rhynchophorinae, weevil, banana, India

INTRODUCTION

Banana is the fourth most important global food crop, in terms of gross value production⁸. India is the largest producer of banana and plantain in the world. Banana is attacked by more than 200 insect and non-insect pests^{17,18}. In India itself, more than 20 pests infest the banana crop which includes insects, mites, molluscs and birds¹⁶. Among the major insect pests, weevils i.e. rhizome weevil

(*Cosmopolites sordidus*) and pseudostem weevil (*Odoiporus longicollis*) are the most important and destructive pests of banana, as they not only destroy the crop but also effect the yield and quality of the product¹⁴. The damage level range upto 100 percent yield loss of banana by rhizome weevil⁸ and 10-90 percent yield loss of banana due to pseudostem weevil¹⁶.

Cite this article: Singh, A.K., Jaiswal, P. and Patley, S., Taxonomic Redescription of the Weevils Infesting Banana (*Musa* sp.) in India, *Int. J. Pure App. Biosci.* 6(1): 806-819 (2018). doi: <http://dx.doi.org/10.18782/2320-7051.6210>

A review work done on the taxonomy of these genera indicates that there are inadequacies which need to be addressed for streamlining the salient aspects. The available taxonomic information on is limited and lacking in essential diagnostic characters especially on genitalia, taxonomic terminology and require redefinition. The morphological variations have not been well documented which leads to confusion in identifying the pests. Even in those where detailed descriptions are available, these are lacking in morphometric ratios and need for more material and information. The genitalia diagrams available are incomplete, descriptions and diagrams are unsatisfactory.

Keeping these in view, the present study is proposed to bridge glaring lacuna of taxonomic knowledge for important species *Cosmopolites sordidus* and *Odoiporus longicollis*. These weevils were collected from seven different agroecological zones of Kerala and specimens were segregated into different groups owing to their morphological variations. Groups were named in the alphabetical order as Group A, Group B, Group C and Group D as per the number of variations. A taxonomic key has been included in study for identification of banana weevils. Taxonomic keys also given for the species of genus *Cosmopolites*.

RESULTS

Taxonomic key to both species

- Body oval shaped; antennomeres with sharp anterior edges; pronotum uniformly punctated on dorsum, hind leg extending way beyond the abdomen.....*Cosmopolites sordidus* (Germar)
- Body flattened and elongated; antennomeres with rounded anterior edges; pronotum laterally punctured with smooth disc and two transverse rows of punctures; hind leg not extending much beyond the abdomen.....*Odoiporus longicollis* (Olivier)

Rhizome weevil: *Cosmopolites sordidus* (Germar)

Synonyms: *Calandra sordida* Germar⁷, 299; Gyllenhal in Schoenherr, 1838: 925 (*Sphenophorus*); Chevrolat⁴, 289

Sphenophorus striatus Fahraeus in Schoenherr⁶, 251; Chevrolat², 140

Sphenophorus cribricollis Walker²⁰, 218; Marshall¹³, 576

Sphenophorus pygidialis Chevrolat¹, 198; Vaurie¹⁹, 5

Germar⁷ described the rhizome weevil of banana as *Calandra sordida*. Chevrolat⁴ raised the new genus *Cosmopolites* and changed the name of species *Calandra sordida* to *C. sordidus*. The genus *Cosmopolites*, comprises only two species, the banana weevil, *Cosmopolites sordidus* (Germar) and *C. pruinosus* Heller^{21,22,23}.

Digonistic characters: Oval shaped body; elytral striae well impressed, striae fade up in middle, giving vittae appearance; elytral intervals raised in between, distinctly polished, bare of punctures; pronotum with central smooth region; hind legs extending beyond pygidium.

Description:

General colour shiny black to ferrugineous (Plate 2, A, B, C). *Head* punctate, 3.8× as

broad as long, dorsum partially covered with eyes, 0.1× as long as and 1.7× as broad as rostrum. *Eyes* well visible ventrally than dorsally, moderately flat, posteriorly approximating, 3.25× as long as broad. *Rostrum* basally broad, dilated upto antennal insertion, rounded transversely, 0.8× as long as head and pronotum combined, 4.2× as long as broad basally; base 1.46× as broad as apex, shiny, finely impunctate from apex to middle, with coarse punctations from scrobe to base, with deep depression between eyes. *Scrobe* lateroventral, 4× as long as broad, dorsally enclosed, laterally concave (Plate 1, A, B). *Antennae* inserted 0.23× length from base of rostrum; scape clavate, shiny, impunctate, 0.8× as long as funicle and club combined, 5.63× as long as broad; funicle with six antennomeres;

all antennomeres nearly conical, with sharp anterior edges, II antennomere, 1.43×, 1.7×, and 1.5× as long as I, III, and VI respectively, 2.0× as long as IV and V; VI antennomere, 1.2× as broad as I, II, III and V, 1.3× as broad as IV; basally 0.61× club glabrous, 1.50× as long as broad (Plate 1, C).

Pronotum coarsely punctate, with semi-rounded edges, dorsally flattened, 1.27× as long as broad, base 1.85× as broad as apex, uniformly punctate dorsally and ventrally, punctures more broad medially than laterally, narrow with smooth surface centrally (Plate 1, D). *Scutellum*, subquadrate, 0.8× as long as broad, with slight humeral angle.

Elytra punctatostriate, curved apically covering back of abdomen, apex subrounded, partially exposing pygidium; 2.91× as long as broad; basally 1.15× and 2.16× as broad as middle and apex respectively; striae 1.28× as broad as interstriae, with deep punctures, broad and continued, intervals with row of punctations; tenth stria abbreviated, not continued to base (Plate 1, O).

Sternum flattened, pro, meso and metasternum with pits; prosternum 3.17× as long as mesosternum and 1.32× as long as metasternum.

Legs densely punctate, procoxae globularly raised; pro and mesocoxae cylindrical, metacoxae oval; pro, meso and metacoxae separated by 0.2×, 0.58× and 2× of its breadth respectively; all femur laterally compressed, curved, distal end widened, ventrally inflated medially, emarginated beyond, bilobed apically, with groove; metafemur 1.12× and 1.23× as long as pro and mesofemur respectively, each reaching apex of pygidium (Plate 1, E, F, G). Tibia moderately straight, grooved beneath, provided with a row of setae on each side of groove; uncinata, uncus arising from middle of tibial apex, apically curved downwards, punctures aligned into pubescent striae; premucro in addition to uncus arising from outer apical margin, premucro more prominent in protibia; metatibia 1.13× and 1.3× as long as pro and mesotibia respectively (Plate 1, H, I, J). Tarsi pseudotetramerous, sclerotised extensions of

tarsal segment IV distinctly separating bases of claws, I and II subequally broad, III tarsal segment 1.21× as broad as II tarsal segment, tarsi of all three legs subequal, IV tarsal segment 1.28×, 2.51× and 1.54× as long as I, II, and III respectively; 0.7× and 0.58× as broad as II and III respectively; III tarsal segment triangular, first three tarsal segments with short silky hairs towards edges, apically with long reddish brown setae (Plate 1, K, L, M).

Venter shiny black, arcuate in profile, sternites uniformly punctate, sternite I, 1.2×, 1.31×, 1.47×, and 1.82× as long as II, III, IV and V, respectively (Plate 1, N).

Female genitalia (Plate 4, 6): Spermatheca 'C' shaped, sclerotized at distal arm, distal arm 1.25× as long as proximal arm, subcylindrical; angle between proximal and distal arms obtuse; ramus well differentiated from nodullus (Plate 4, C; Plate 6, D). Spiculum ventrale with shaft short, globous, truncated posteriorly, 1.9× as long as basal plate, apical end truncated with few setaceous hairs (Plate 1, R, S, V, W).

Male genitalia (Plate 5, 6): Spiculum gastrale vestigial. Aedeagus arcuate medially, base 1.13× as broad as median lobe apically, slightly arcuate at base, length: breadth ratio 1.73:1; apophyses 3.28× as long as median lobe, spatulate, apically pointed; median lobe, short, sturdy, sclerotized, with slight ventral curve; endophallus with spicule at apical end. Tegmen with dorsal piece as broad as basal piece; parameres short, slender, apically pointed, 1.43× as long as base; manubrium elongate, slender, 0.85× as long as median lobe, uniformly thick, with broadened, subconical apex (Plate 1, P, Q, T, U, V).

Total length: 6.7–8.0±0.18 mm; *Standard length:* 6.8–8.3±0.2 mm; *Breadth:* 3.8–3.4±0.14 mm.

Specimen examined: 1♀, INDIA: Kerala: Kasargod: Padannakad, N 12° 15.423' E 075° 07.018', 13 m, 29.ix.2014, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 2♀, 1♂, Wayanad: RARS Ambalavayal, N 11°28.160' E 076°29.553', 12.ix.2015, 883 m, Coll. Arun Singh, Pheromone trap; 5♀, 2♂, Wayanad:

Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 4♀, 4♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, 1♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 21.ix.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, 1♂, Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.vi.2015, 32 m. Coll. Arun Singh, Host *Musa × paradisiaca* L.; 1♀, 1♂, Kottayam: RARS Kumarakom, N 09°37.650' E 076°25.871', 18.ix.2015, 3 m, Coll. Arun Singh, Pheromone trap; 1♂, Alappuzha: ORARS Kayamkulam, N 09°10.57992' E 076°31.03746', 20.ix.2015, 2 m, Coll. Arun Singh, Pheromone trap.

Distribution: American Samoa, Angola, Argentina, Australia, Bangladesh, Benin, Bermuda, Bolivia, Borneo, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Chile, China, Colombia, Comoros, Congo, Cook Island, Costa Rica, Cuba, Democratic Republic of Congo, Dominica, Ecuador, El Salvador, Fiji, French Guiana, Gabon, Ghana, Grenada, Guadeloupe, Guam, Guatemala, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Israel, Jamaica, Japan, Kenya, Madagascar, Malawi, Malaysia, Maldives, Mali, Martinique, Mauritania, Mauritius, Mexico, Myanmar, New Caledonia, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, Papua New Guinea, Peru, Philippines, Portugal, Puerto Rico, Republic of Korea, Reunion, Rwanda, Saint Helena, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Island, Somalia, South Africa, Spain, Sri Lanka, Suriname, Taiwan, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Uganda, United States of America, Venezuela, Vietnam, Wallis and Futuna Islands. India: Andaman Islands, Assam, Bihar, Delhi, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks: Female have rostrum 1.09× longer than male. Elytral striae are broader at base,

narrowed down length, striae II, IV, VI, VII, and VIII fade away in the mid length providing vittae appearance. All collected specimens were segregated into four different groups owing to their morphological variations. Groups were named in the alphabetical order as Group A, Group B, Group C and Group D. Above description is based on individuals of Group A. In total 26 specimens studied under this group. Differential distinguishing characters of three groups are compared in Table 1. Variations among these four groups discussed as follows;

Variation I (Group B):

Remarks: In total 18 specimens studied under this group. The characters of this group are similar with the group A in many extents, the variations among the groups are as follows;

General colour shiny ferrugineous (shiny black to ferrugineous in group A; shiny black with micropilose setae in Group C), ovate, coarsely punctate (Plate 2, D, E, F) (Group A, mainly black coloured with very few micropilose setae; Group C dull black, covered with mat of micropilose setae). **Tibia** ferrugineous (black in group A; black with micropilose setae in group C), covered with thick layer of micropilose setae, row of punctures running down the length (Group A with very few micropilose setae; Group C with micropilose setae arising from punctures, mat of micropilose setae present all along length). **Pygidium** not clearly visible on dorsum, covered with mat of setae (setae more dense in case of Group C).

Genitalia: No difference in the female and male genitalia are observed.

Total length: 6.4–8.2±0.23 mm; **Standard length:** 6.1–7.9±0.21 mm; **Breadth:** 2.0–3.3±0.19 mm.

Specimens examined: 1♀, INDIA: Kerala: Kasargod: RARS Pilicode, N 12°12.09420' E 075°09.78282', 25 m, 16.xi.2014, Coll. Arun Singh, *Musa × paradisiaca* L.; 1♂, Wayanad: RARS Ambalavayal, N 11°28.160' E 076°29.553', 12.ix.2015, 883 m, Coll. Arun Singh, Pheromone trap; 2♀, 1♂, Wayanad: Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 1♀, 3♂, Wayanad:

Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 3♀, 2♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 21.ix.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, 1♂, Palakkad: RARS Pattambi, N 10°48.781' E 76°11.506', 12.ix.2015, 54 m, Coll. Arun Singh, Pheromone trap; 1♀, Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.vi.2015, 32 m. Coll. Arun Singh, Host *Musa × paradisiaca* L.; 1♂, Alappuzha: ORARS Kayamkulam, N 09°10.57992' E 076°31.03746', 20.ix.2015, 2 m, Coll. Arun Singh, Pheromone trap; 2♀, Trivandrum: RARS Vellayani, N 8° 26.44' E 076° 59.33' 28 m, 23.x.2014, Coll. Arun Singh, Host *Musa × paradisiaca* L.

Variation II (Group C):

Remarks: In total 17 specimens studied under this group. The characters of this group are similar with the Group A in many extents, the variations among the two group are as follows; **General colour** dull black, body ovate, 3.1× as long as broad, coarsely punctate, distinct tuft of micropilose nodules arising from the punctures (Plate 2, G, H, I) (Group A mainly black coloured with very few micropilose setae; Group B shiny ferrugineous with few setae). **Rostrum** coarsely punctate, 0.84× as long as head and thorax combined, rounded transversely, micropilose arising at punctures (micropilose setae on punctures are confined to the basal region in Group A and B). **Elytra** same as that of group A, differs in thick tuft of small setae at apical end, apical two third area covered with mat of micropilose setae (micropilose not dense in Group A, B and D). **Total length:** 6.9–7.26±0.14 mm; **Standard length:** 6.32–6.92±0.16; **Breadth:** 2.6–2.9±0.12.

Specimens examined: 2♀, 3♂, INDIA: Kerala: Wayanad: Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 4♀, 2♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, 1♂,

Wayanad: Andoor, N 11°35.226' E 076°13.572', 21.ix.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, 1♂, Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.vi.2015, 32 m. Coll. Arun Singh, Host *Musa × paradisiaca* L.

Variation III (Group D):

Remarks: In total seven specimens were studied under this group. Specimen very small as compared to other three groups. The characters of this group are similar with the Group A in most cases, the variations among the two group are as follows;

General colour shiny black, ovate body, coarsely punctate, prothoracic punctures devoid of setae (Plate 2, J, K, L).

Total length: 5.74–6.31±0.22 mm; **Standard length:** 5.32–5.67±0.18 mm; **Breadth:** 2.2–2.4±0.13 mm.

Specimens examined: 1♀, 1♂, INDIA: Kerala: Wayanad: Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 2♀, Wayanad: Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host *Musa × paradisiaca* L.; 1♂, Palakkad: RARS Pattambi, N 10°48.781' E 76°11.506', 12.ix.2015, 54 m, Coll. Arun Singh, Pheromone trap; 1♀, 1♂, Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.vi.2015, 32 m. Coll. Arun Singh, Host *Musa × paradisiaca* L.

Sexual dimorphism

Sexes are difficult to separate in this species. Female have rostrum 1.09× longer than male. Antennal insertion is closer in case of female. Distance from scrobe to anterior margin of head in case of male 0.91× as long as in case of female. Apically rostrum more arcuate in case of female.

Key to the species of *Cosmopolites* Chevrolat:

Elytral striae well impressed, striae fade up in middle, giving vittae appearance; elytral intervals raised in between, distinctly polished, bare of punctures; pronotum.

Table 1. Comparison between differential distinguishing characters of four groups of *Cosmopolites sordidus* (Germar)

Characters	Group A	Group B	Group C	Group D
General body colour	Shiny black to slightly ferrugineous	Shiny ferrugineous	Dull black	Shiny black
Micropilose setae	Present all over the body	Very few micropilose setae arising from the punctures	Very few micropilose setae arising from the punctures	Prothoracic punctures devoid of Micropilose setae
Size	6.7-8.0±0.18 mm	6.4-8.2±0.23 mm	6.9-7.26±0.14 mm	5.74-6.31±0.2 mm

- with central smooth region.....*C. sordidus* (Germar)
- Elytral striae feebly impressed, striae does not fade up in middle; elytral intervals uniform, not polished; pronotum evenly punctate and pruinose.....*C. pruinosis* Heller

Psuedostem weevil: *Odoiporus longicollis* (Olivier)

Synonyms: Chevrolat², 140 (*Rhynchophorus*); Chevrolat⁴, 288

Sphenophorus glabridiscus Walker²⁰, 218; Csiki⁵, 65

Sphenophorus planipennis Gyllenhal in Schoenherr, 1838: 911; Chevrolat⁴, 288

Sphenophorus glabricollis Gyllenhal in Schoenherr, 1838: 913; Chevrolat⁴, 288

Rhynchophorus gages Herbst¹¹, 17; Csiki⁵, 65

Odoiporus longicollis var. *major* Heller¹⁰, 33; Csiki⁵, 65

Genus *Odoiporus* was first described by Chevrolat⁴ for *Calandra longicollis* (Olivier), which is the only single species in the genus. Chevrolat³ synonymized *Calandra longicollis* to *Sphenophorus longicollis*, and later in 1885, proposed new genus *Odoiporus*, and designated *longicollis* as type species. There were many morphological variants reported^{12,16} but still the genus has only a single species, which suggests that many species are yet to be discovered under the genus. This species had been reported with many colour variants, including ferrugineous and the dark black one^{15,16}.

Diagnostic characters: Dorsally flattened and elongated body. One-third of antennal club pubescent at base, antennomeres with rounded anterior edges; pronotum uniformly punctuated at lateral edges, with smooth disc and two rows of punctures medially; apically truncated elytra.

Description:

General colour shiny black to ferrugineous (Plate 4, A, B, C). *Head* flat, basally 3.1× as broad as long, smooth, shiny, 0.12× as long as and 2.16× as broad as rostrum. *Eyes* partially visible dorsally, posteroventrally approximating, 1.95× as long as broad.

Rostrum 0.74× as long as head and pronotum combined, 5.81× as long as broad basally, base 1.70× as broad as apex, slightly arcuate at apex, finely punctate shiny from apex to scrobe, with coarse punctations from base to antennal insertion, with deep depressions between eyes. *Scrobe* lateroventral, enclosed dorsally, concave laterally, 4.9× as long as broad (Plate 3, A, C; F, H). *Antennae* black, inserted 0.24× length from base of rostrum; scape 0.70× as long as funicle and club combined, 6.20× as long as broad, clavate shiny, with or without punctures; funicle with six antennomeres, antennomeres subglobular, with round anterior edges; I antennomere, 1.08× as long as II, 1.80× as long as III, IV and V, 1.625× as long as VI; VI antennomere, 1.28×, 1.44×, 1.35×, 1.28× and 1.21× as broad as I, II, III, IV and V; club 0.42× glabrous basally, 1.31× as long as broad, last segment dorsolaterally flattened, apically triangular; club along with IV, V, and VI antennomere bears sensory setae (Plate 3, K).

Prothorax with disk smooth and plain, dorsally glabrous, constricted near anterior margin, laterally distinctly punctate, 1.37× as long as broad basally, base 2.0× as broad as apex; central smoother region with two rows

of fine punctures (Plate 3, P). *Scutellum* ovidal, 1.0× as long as broad, base 1.2× broad as apex.

Elytra punctatostriate, apically subtruncate broadly exposing pygidium, almost rectangular, basally 2.48× as long as broad, base 1.04× and 1.37× as broad as middle and apex respectively, punctures deep broad and continued with distinct tuft of micropilosity, intervals smooth and raised, tenth stria abbreviated, not continued to base; humeri bare and shiny (Plate 3, M).

Sternum black, flat and punctate; metasternum 1.41× and 3.83× as long as pro and mesosternum respectively; metepisternum with pits and as broad as mesepimeron and mesepisternum.

Legs procoxae raised, globular; pro, meso and metacoxae apart by 0.37×, 1.34× and 1.1× of breadth, respectively; all femora laterally compressed, curved, distal end widened, ventrally inflated at middle; metafemur 1.19× and 1.29× as long as pro and mesofemur respectively (Plate 3, L, N, O). Tibiae uncinatae, with uncus arising from inner apical angle; metatibia 1.04× and 1.08× as long as pro and mesotibia respectively; punctures not aligned into striae, grooved beneath and provided with a row of setae of more or less equal length on each side of groove internally from base to apex; bears premucro at outer apical angle in addition of uncus, two additional spine in between uncus and premucro; third spine and premucro more prominent in protibia (Plate 3, S, V, W). Tarsi of all three legs subequal, pseudotetramerous, sclerotised extensions of IV tarsal segment distinctly separating bases of claws, I and II tarsi subequally broad, with small setae ventrally at apical end; III tarsal segment 2.9× as broad as II tarsal segment; IV tarsal segment 2.05×, 3.9× and 1.54× as long as I, II, and III respectively; 0.77× and 0.26× as broad as II and III respectively; tarsal segment three widely dilated, pilose ventrally except for base and V-shaped median area (Plate 3, X, Y, Z).

Venter not arcuate in profile, sternites uniformly punctured, sternite V 1.28×, 1.89×, 3.43× and 2.75× as long as I, II, III and IV

respectively; I sternite, 1.08×, 1.12×, 1.30× and 1.48× as broad as, II, III, IV and V respectively (Plate 3, a).

Female genitalia (Plate 3, 5): Spermatheca having proximal arm 1.0× as broad and as long as distal arm, subcylindrical, angle between proximal and distal arms obtuse; ramus not differentiated from nodulus (Plate 3, b, e; Plate 5, A, D); basal plate slender with spatulate, apically pointed and bifurcated lobed base fixed with sternite VIII; spiculum ventrale globous, truncated posteriorly, arm 4.78× as long as spiculum ventrale and 1.3× as broad as spiculum ventrale basally, setae absent at base.

Male genitalia (Plate 3, 5): Aedeagus with median lobe slightly arcuate medially in profile, broadest and slightly arcuate at base, length: breadth ratio 1.63:1, broadest at its junction with apophyses; apophyses 4.65× as long as median lobe, spatulate bearing sharp pointed hooks at apex. Tegmen with dorsal piece as broad as basal piece; parameres short, slender, with pointed apices, 1.75× as long as basal piece; manubrium elongate, slender, 2.91× as long as median lobe, 0.62× as long as apodeme of aedeagus; apophyses, uniformly thick, with broadened, subrounded apex bearing pointed curved hooks (Plate 3, h, I, l; Plate 5, F, G, H).

Total length: 9.70–12.13±0.31mm; **Standard length:** 8.50–19.21±0.24mm; **Breadth:** 3.5–4.4±0.16mm.

Specimens examined: 7♀, 5♂, INDIA: Kerala: Kasargod: Padannakad, N 12° 15.423' E 075° 07.018', 13 m, 29.ix.2014, Coll. Ramesha B., Host: *Musa × paradisiaca* L.; 15♀, 18♂, Kasargod: Padannakad, N 12° 15.423' E 075° 07.018', 13 m, 29.ix.2014, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 1♀, 2♂, Wayanad: RARS Ambalavayal, N 11°28.160' E 076°29.553', 12.ix.2015, 883 m, Coll. Arun Singh, Pheromone trap; 8♀, 6♂, Wayanad: Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 2♀, 5♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 4♀, 1♂,

Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.iv.2015, 32 m. Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 2♀, Kottayam: RARS Kumarakom, N 09°37.650' E 076°25.871', 18.ix.2015, 3 m, Coll. Arun Singh, Pheromone trap; 3♀, Alappuzha: ORARS Kayamkulam, N 09°10.57992' E 076°31.03746', 20.ix.2015, 2 m, Coll. Arun Singh, Pheromone trap; 2♀, 1♂, Trivandrum: Vellayani, N 08°25.74006'; 076°59.17194', 28m; 23.x.2014, Coll. Sivakumar T, Host: *Musa × paradisiaca* L.

Distribution: Bhutan, China, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. India: Andaman Islands, Assam, Bihar, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks: All collected specimens were segregated into three different groups owing to their morphological variations. Groups were named in the alphabetical order as Group A, Group B and Group C. Above description is based on individuals of Group A. In total 82 specimens studied under this Group A. Differential distinguishing characters of three groups are compared in Table 3. Variations among these three groups can be discussed as follows:

Variation I (Group B):

Remarks: In total 41 specimens were examined under Group B. The characters of this group are similar with the Group A in many extents, the variations among the groups are as follows:

General colour shiny black (Plate 4, D, E, F). **Rostrum** slender, 0.74× as long as head and pronotum combined, base 1.52× as broad as apex; transversely rounded, shiny from apex to scrobe centrally on dorsal view in male, laterally shallow rugose run along the length upto apex, leaving shiny mid region. Female with eye prominent on dorsal view. **Scrobe** thinner than group A, 4.3× as long as broad (Plate 3, B, D, G, I) (Group A with laterally more prominent rugose at base, extending upto scrobe, apex to scrobe rugose not arranged in

row in males; Group C with smooth rostrum from apex to scrobe, very few punctures in basal region). **Prothorax** 1.32× as long as broad basally, with length subparallel on basal three fourth, convergent subapically to apex, flanks uniformly punctate, disc smooth with very few shallow punctures, basal rugose joins with lateral row of rugose (Plate 3, Q) (Group A with less rugose laterally, basal row of rugose does not join with lateral one; Group C with very few rugose laterally in apical 0.60× of pronotum length). **Legs** smoother at base, uniformly punctate along the length, rugose area more prominent towards apex. All femora laterally compressed, curved; metafemur 1.15× and 1.25× as long as pro and mesofemur respectively; metatibia 1.06× and 1.25× as long as pro and mesotibia respectively. Tibial spines more prominent, protibia with more prominent fourth spine between premucro and third spine is sharper (Plate 3, T) (Group A with two additional spine in between uncus and premucro; third spine and premucro prominent in protibia; Group C with three spines on protibia, spine between third and premucro rudimentary).

Female genitalia (Plate 3, 5): Spermatheca having proximal arm 1.02× as broad and as long as distal arm, subcylindrical, angle between proximal and distal arms obtuse, less sclerotized than group A (Plate 3, c, f; Plate 5, B, E); spiculum ventrale with manubrium slender, swollen apex; basal plate, bifurcated lobed base fixed with sternite VIII (pointed apex in case of Group A, basal lobes comparatively less globous in case of Group C; additional loop, 0.52× as long as VIIIth sternite present in Group C).

Male genitalia: Plate 3, j, k, m; Plate 21, I, J, K

Total length: 10.1–11.0±0.30 mm; **Standard length:** 8.4–9.9±0.23 mm; **Breadth:** 3.6–4.3±0.18 mm.

Specimens examined: 2♀, 3♂, INDIA: Kerala: Kasargod: Padannakad, N 12° 15.423' E 075° 07.018', 13 m, 29.ix.2014, Coll. Ramesha B., Host: *Musa × paradisiaca* L.; 9♀, 7♂, Kasargod: Padannakad, N 12° 15.423' E 075° 07.018', 13 m, 29.ix.2014, Coll. Arun

Singh, Host: *Musa × paradisiaca* L.; 5♀, 2♂, Wayanad: Narrikundu, N 11°36.230' E 076°12.906', 02.iii.2015, 858 m, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 2♂, Wayanad: Andoor, N 11°35.226' E 076°13.572', 03.iii.2015, 879 m, Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 5♀, 2♂, Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.iv.2015, 32 m. Coll. Arun Singh, Host: *Musa × paradisiaca* L.; 1♂, Kottayam: RARS Kumarakom, N 09°37.650' E 076°25.871', 18.ix.2015, 3 m, Coll. Arun Singh, Pheromone trap; 1♀, 2♂, Trivandrum: RARS Vellayani, N 08°25.74006' E 076°59.17194', 28 m; 23.x.2014, Coll. Arun Singh, Pheromone trap.

Variation II (Group C):

Remarks: Only 1♀ studied under this group. The characters of this group are similar with the Group A in many extent, the variations among the groups are as follows; *General colour* shiny ferrugineous (Plate 5, G, H, I). *Rostrum* slender, 0.77× as long as head and pronotum combined, base 1.67× as broad as apex; transversely rounded, scrobes enclosed dorsally; coarse punctation from base to antennal insertion, shiny from apex to scrobe. *Eye* prominent on dorsal view. *Scrobe* 0.82× as long as of group A, 4.1× as long as broad, concave laterally, ventrally touching rostrum (Plate 3, E; J) (Group A with laterally more prominent rugose extending upto scrobe, apex to scrobe finely punctured; rugose arranged in row in males; Group B with finely punctate rostrum, laterally shallow rugose run along the length upto apex in rows). *Prothorax* 1.35× as long as broad basally, with length subparallel on basal three fourth, convergent subapically to apex, flanks uniformly punctate in two third of apex, disc smooth with very few shallow punctures in middle; apical end separated by constriction at edges (Plate 3, R) (Group A with less rugose laterally, basal row of rugose does not join with lateral one; Group B with prominent rugose laterally, basal row of rugose join with lateral one). *Legs* smoother at base, rugose more prominent towards apex. Femora laterally compressed, curved, uniformly punctate along the lateral length, leaving dorsal central portion smooth and

shiny, metafemur 1.03× and 1.14× as long as pro and mesofemur respectively. Protibia with three spines, spine between third and premucro rudimentary, rugose are smaller and confined to lateral edges; mesotibia and metatibia with series of small spines at apical end, metatibia 1.21× and 1.23× as long as pro and mesotibia respectively; tibial spines less prominent, protibia lack prominent fourth spine between premucro, third spine not prominent (Plate 3, U) (Group A with two additional spine in between uncus and premucro; third spine and premucro more prominent in protibial; protibia with more prominent fourth spine between premucro and third in Group B).

Female genitalia (Plate 3, 5): Spermatheca 'C' shaped, proximal arm 1.04× as broad and as long as distal arm, subcylindrical, angle between proximal and distal arms obtuse, less sclerotized than group A; spiculum ventrale not glabrous, loop present at the base of apodeme of spiculum ventrale, loop 0.52× as long as VIIIth sternite; basal bifurcated arms uniform in length and 1.45× as broad as apodeme; apodeme slender and not glabrous at apex. Basal plate slender with spatulate pointed apex and bifurcated lobed base fixed with sternite VIII (Plate 3, d, g; Plate 5, C) (pointed apex in case of Group A; no loop present on spiculum ventrale in Group A and Group B).

Total length: 10.4 mm; *Standard length:* 9.6 mm; *Breadth:* 4.1 mm.

Specimens examined: 1♀, INDIA: Kerala: Thrissur: BRS Kannara, N 10°32.250' E 076°19.238', 12.iv.2015, 32 m. Coll. Arun Singh, Host: *Musa × paradisiaca* L.

Sexual dimorphism

Sexes can be separated on the basis of rostral and pygidium characters. Rostrum in females is more slender and longer compared to males and males have broader rostrum. Distance from scrobe to apex of rostrum is more in case of females. While distance from base of rostrum to scrobe is more in case of males, as the antennal insertion in case of females is nearer to the head in females (Plate 3, A, B, C, D, E, F, G, H, I, J). Pygidium is more pointed in case of females.

Table 2: Comparison between differential distinguish characters of three groups of *Odoiporus longicollis* (Olivier)

Characters	Group A	Group B	Group C
<i>General body colour</i>	Shiny black to slightly ferrugineus	Shiny black	Shiny ferrugineus
<i>Rostrum punctuation</i>	Laterally more prominent rugose at base extending upto scrobe; apex to scrobe rugose not arranged in row in males	Laterally less prominent rugose from base to scrobe; shiny from apex to scrobe centrally on dorsal view in male, shallow rugose run along the length in one row each of side upto apex laterally, demarking shiny region centrally	Smooth rostrum from apex to scrobe, very few punctures in basal region
<i>Pronotum punctuation</i>	Less rugose laterally, basal row of rugose does not join with lateral one	Flanks uniformly punctate, disc smooth with very few shallow punctures, basal rugose joins with lateral row of rugose	Very few rugose laterally in apical 0.60× of pronotum length
<i>Protibial spine</i>	Prominent third spine and premucro	Sharper third spine and elongated premucro	Three spines on protibia, spine between third and premucro rudimentary, third spine blunted
<i>Spiculum ventrale</i>	Slender and pointed apodeme without any additional loop	Globous and swollen apodeme, without any additional loop	Basal bifurcated arm slender and not globous, additional loop, 0.52× as long as VIII th sternite,

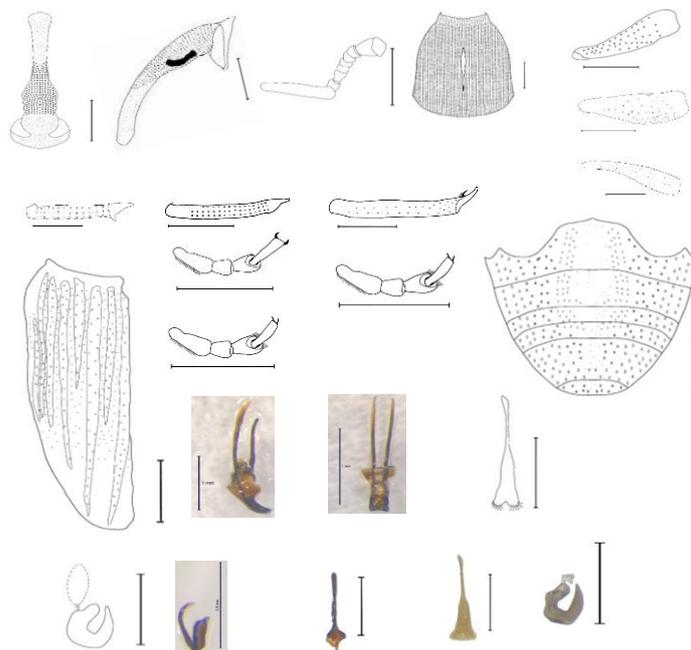


Plate 1: *Cosmopolites sordidus*: (A) Rostrum, dorsal view; (B) Rostrum, lateral view; (C) Antenna; (D) Pronotum, dorsal view; (E) Profemur; (F) Mesofemur; (G) Metafemur; (H) Protibia; (I) Mesotibia; (J) Metatibia; (K) Protarsus; (L) Mesotarsus; (M) Metatarsus; (N) Venter; (O) Elytron, dorsal view. (P) Aedeagus, ventral; (Q) Aedeagus, lateral; (R) Spiculum ventrale; (S) Spermatheca; (T) Spicule; (U) Tegmen; (V) Spiculum ventrale; (W) Spermatheca. Scale= 1mm

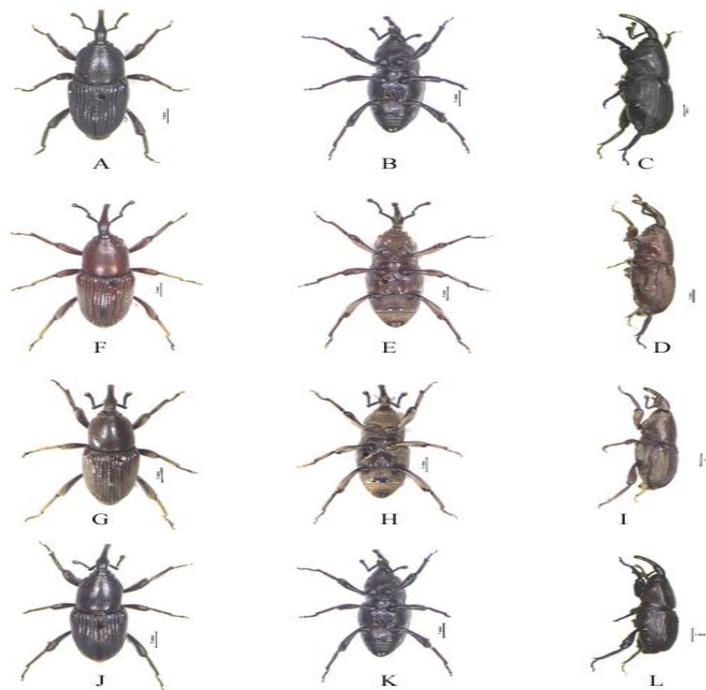


Plate 2: *Cosmopolites sordidus*: Habitus of variations, dorsal view; ventral view and lateral view; (A)-(C) Group B; (D)-(F) Group B; (G)-(I) Group C; (J)-(L) Group D. Scale= 1mm

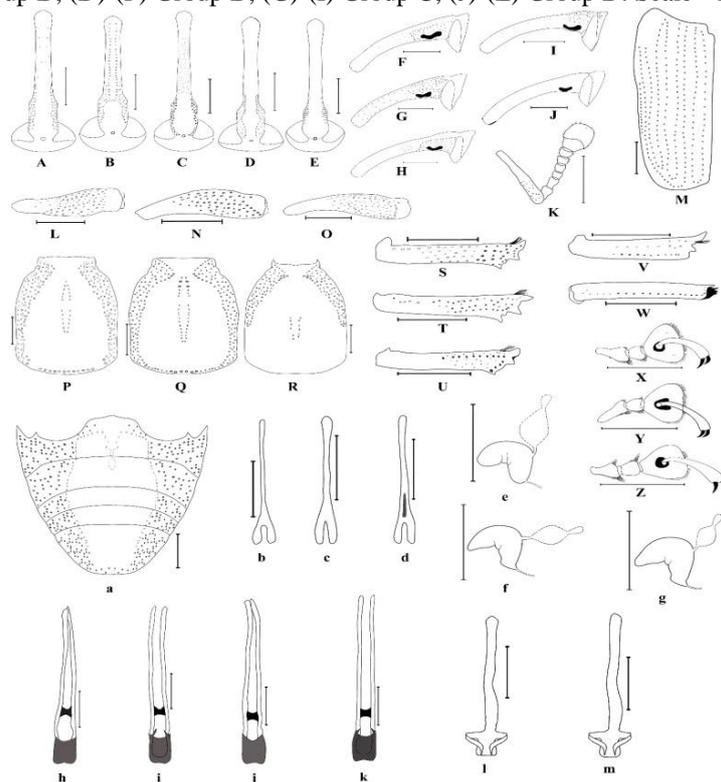


Plate 3: *Odoiporus longicollis*: (A)-(E) rostrum, dorsal view; (A) ♂ of Group A (B) ♂ of Group B (C) ♀ of Group A (D) ♀ of Group B (E) ♀ of Group C; (F)-(J) rostrum, dorsal view; (F) ♂ of Group A (G) ♂ of Group B (H) ♀ of Group A (I) ♀ of Group B (J) ♀ of Group C; (K) Antenna; (L) Profemur; (M) Elytron, dorsal view; (N) Mesofemur; (O) Metafemur; (P)-(R) Variations on Pronotum, dorsal; (P) Group A; (Q) Group B; (R) Group C; (S)-(U) Variations on Protibia; (S) Group A; (T) Group B; (U) Group C; (V) Mesotibia; (W) Metatibia; (X) Protarsus; (Y) Mesotarsus; (Z) Metatarsus; (a) Venter; (b)-(d) Spiculum Ventrale, (b) Group A (c) Group B (d) Group C; (e)-(g) Spermatheca, (e) Group A (f) Group B (g) Group C; (h)-(k) Aedeagus, (h) Group A, dorsal view (i) Group A, ventral view (j) Group B, dorsal view (k) Group A, ventral view; (l)-(m) Tegmen, (l) Group A (m) Group B. Scale= 1mm

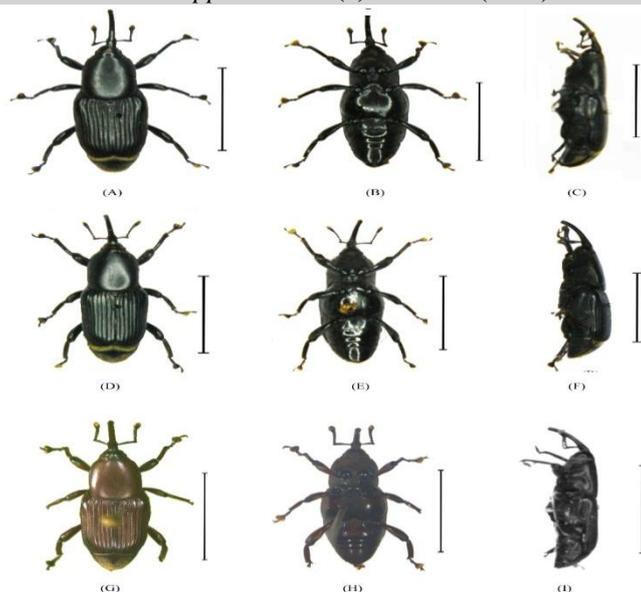


Plate 4: *Odoiporus longicollis*: Habitus, dorsal; ventral and lateral view; (A)-(C) Group A; (D)-(F) Group B; (G)-(I) Group C. Scale= 1cm



Plate 5: *Odoiporus longicollis*: (A)-(C) Spiculum Ventrale, (A) Group A; (B) Group B; (C) Group C; (D)-(E) Spermatheca, (D) Group A; (E) Group B; (F)-(G) Aedeagus, Group A, (F) Dorsal view; (G) Ventral view; (H) Tegmen, Group A; (I)-(J) Aedeagus, Group B, (I) Dorsal view; (J) Ventral view ;(K) Tegmen, Group B. Scale= 1mm

CONCLUSION

Various colour morph was available in both the species but among four group of rhizome weevil, no difference were observed in genitalia characters. These particular coloured morphological variations may be recorded due to differential feeding or available food material (host plants). Variations may be due to the environmental variations in different zones of collection and the microclimatic

conditions within the soil/underground zone as this particular weevil is a poor flier and thus unable to move frequently to long distance. Whereas in case of pseudostem weevil female genitalia of Group C had a significant difference with the other two groups but more morphological study coupled with molecular study is needed to assure the confirmation of new species if any. This report corroborates in line with Shukla¹⁶ as many morphological

variants appear to be reported but still the genus had been reported with single species, which suggests that many species are yet to be discovered under the genus.

REFERENCES

- Chevrolat, L. A. A. Diagnoses de curculionides de la Martinique. *Ibid.* **2**: 197–198 (1880).
- Chevrolat, L. A. A. Note synonymique relative aux Coleopteres Curculionites de la tribu des Calandrides. *Ann. Soc. Entomol. Fr. Bull.* **2(3)**: 137–140 (1882a).
- Chevrolat, L. A. A. Notes synonymique relative aux Coleopteres Curculionites de la tribu des Calandrides. *Ann. Soc. Entomol. Fr. Bull.* **(6) 2(3)**: 145 (1882b).
- Chevrolat, L. A. A. Calandrides. Nouveaux genres et nouvelles espèces, observations, synonymies, doubles emplois de noms de genres et d'espèces, etc. 3e partie. *Ann. Soc. Entomol. Fr.* **(6)5**: 275–292 (1885).
- Csiki, E. Curculionidae: Rhynchophorinae and Cossoninae. In: Junk, W. and Schenkling, S. (Eds.), *Coleopterorum Catalogus. Pars 134.* W. Junk. Berlin, 152 (1936).
- Fahraeus, O. I. New species. In: Schoenherr, C. J. 1845. *Genera et species curculionidum, cum synonymia hujus familiae. Species novae aut hactenus minus cognitae, descriptionibus a Dom. L. Gyllenhal, C. H. Boheman, O. J. Fahraeus et entomologis aliis illustratae. Tomus octavus. – Pars secunda. Supplementum continens.* Roret, Parisii/Fred. Fleischer, Lipsia, 504 (1845).
- Germar, E. F. *Insectorum species novae aut minus cognitae, descriptionibus illustratae.* Coleoptera. Halae, J. C. Hendelii et filii. [Also: *Coleopteronun species novae aut minus cognitae, descriptionibus illustratae.* (Alternative title)]. **1**: 624 (1824).
- Gold, C., Pinese, B., and Pena, J. In: Pena, J. E., Sharp, J., and Wysoki, M. (eds.), *Tropical Fruit Pests and Pollinators.* CAB International, Wallingford, United Kingdom, pp. 13–56 (2002).
- Gyllenhal, L. New species. In: Schoenherr, C. J. *Genera et species curculionidum. cum synonymia hujusfamiliae. Species novae aut hactenus minus cognitae, descriptionibus a Dom. Leonardo Gyllenhal, C. H. Boheman, et entomologis aliis illustratae.* Paris, Roret, **4(2)**: 601–1121 (1838).
- Heller, K. M. Neue Käfer von Celebes III. *Abh. Ber. Mus. Dresden,* **7(3)**: 1–41 (1898).
- Herbst, J. F. W. *Natursystem aller bekannten in- und ausländischen Insekten, als eine Fortsetzung der von Büffonschen Naturgeschichte. Der Käfer.* **6**: Pauli, Berlin, 520 (1795).
- Lalitha, N. and Ranjith, A. M. Color morphs of pseudostem weevil *Odoiporus longicollis* Olivier. *Insect Environ.* **6(1)**: 6 (2000).
- Marshall, G. A. K. New Curculionidae, with notes on synonymy. *Ann. Mag. Nat. His.* (10), **6**: 551–577 (1930).
- Nair, M. R. G. K. and Visalakshi, A. A. *Monograph on Crop Pests of Kerala and Their Management* (3rd Ed.). Department of Extension, Kerala Agricultural University, Thrissur, 227 (1999).
- Padmanaban, B., Sundararaju, P., and Sathiamoorthy, S. Incidence of banana pseudostem borer, *O. longicollis* Oliv. (Coleoptera: Curculionidae) in banana peduncle. *Indian J. Entomol.* **63**: (2001).
- Shukla, A. Insect pests of banana with reference to weevil borers. *Int. J. Pl. Prot.* **3(2)**: 387–393 (2010).
- Simmonds, N. W. *Bananas.* (2nd Ed.). Longmans Press, London, 291 (1966).
- Singh, S. S. Observations on *Odoiporus longicollis* (Coleoptera: Curculionidae) in Kathmandu valley and its suburbs. *J. Entomol.* **28**: 410 (1966).
- Vaurie, P. Revision of the Genus *Sphenophorus* in South America. *Am. Mus. Novit.* **26(56)**: 1–30 (1978).

20. Walker, F. Characters of some apparently undescribed Ceylon insects. *The Ann. Mag. Nat. His.* **4(3)**: 217–224 (1859).
21. Zimmerman, E .C. Rhynchophorinae of Southeastern Polynesia (Coleoptera: Curculionidae). *Pac. Insects*, **10(1)**: 47–77 (1968a).
22. Zimmerman, E. C. The *Cosmopolites* banana weevils (Coleoptera: Curculionidae: Rhynchophorinae). *Pac. Insects*, **10**: 295–299 (1968b).
23. Zimmerman, E. C. *Cosmopolites pruinosus*, a new pest of banana. *J. Eco. Entomol.* **61**: 870–871 (1968c).