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## Illustrate the morphologic characters of Colorado potato beetle, *Leptinotarsa decemlineata* say, 1824 (Coleoptera: Chrysomelidae)

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### Abstract

A morphological study of the *Leptinotarsa decemlineata* Say, 1824 (Coleoptera: Chrysomelidae) has been done for specimens were collected from potato and eggplant fields of some villages in Erbil Governorate- Kurdistan region- Iraq, from the period of August- September / 2016. The adults described in detail, important body parts such as mouthparts, antenna, thorax, wings, legs, male and female genitalia parts were illustrated by a digital microscopic camera with their scales. Hosts, localities and date of collection were provided. Results indicated that this species is quite differ from all other its familiar in the genus by its morphological shape and habitat and host.

**Keywords:** Coleoptera, Chrysomelidae, *Leptinotarsa decemlineata* say

### Introduction

Chrysomelidae Latreille, 1802 commonly known as leaf beetles is the second largest phytophagous family of beetles within Chrysomeloidea Latreille, 1802, with seventeen subfamilies [1]. Its species widely distributed worldwide, having approximately 50 000 species in over 2000 genera [2]. Chrysomelidae feed on plants and some of them are regarded as pests in agriculture and forestry [3]. Chinery [4] mentioned that this family is the largest of three families comprising the Chrysomeloidea, with more than 25,000 species. Urban [5] mentioned that there are over 25 thousand species of this family in the world, where Jolivet *et al.*, [6] mentioned that about 30000– 50000 species are known, and Jolivet and Hawkeswood [7] mentioned that over 50,000 species distributed throughout the world, while Reid [8] mentioned that more than 60,000 species according to more progressive ones. Some species of the family are known to transmit plant viruses and some of these viruses are great commercial importance [9]. Four exotic genera have been introduced in the last 50 years for biological control of weeds (Julien & Griffiths 1998) Cited in: [10]. The family is usually classified into 19 Subfamilies [6]. Suzuki [11] divided the family into 20 subfamilies. The recent catalogue of Palaearctic Coleoptera Vol. 6 listed the existence of 28,560 taxa within the Chrysomeloidea (including Cerambycidae and Bruchinae as subfamily of Chrysomelidae) [12]. Seeno and Wilcox [13] mentioned that over 38 000 species occur within this family. The adults of leaf beetle feed on leaves, flowers, pollen and young shoots, and their larvae feed mainly on leaves or roots [14]. Adults and larvae of many species are serious pests of cultivated plants [3]. Pierce [15] raised the family to the rank of superfamily (Chrysomeloidea) in the Phytophaga on the basis of the characters of the tarsi, maxillary palpi, submentum and antennae of the adults. According to [16] the family divided into 17 subfamilies. [Mani (1968) put subfamily Chrysomelineae in the level of family Chrysomelidae] Cited in: [17]. Many scientists [4, 16, 18] agree that the general characteristics of the family are as follows:

1. Body shape diverse, usually robust, oval, or cylindrical, often brightly colored, spotted and striped.
2. Small to moderate sized, length 1.5- 22 mm.
3. Head prognathous or hypognathous, some deflexed.
4. Antennae rarely extending past middle of body, filiform, moniliform, weakly serrate or thickened apically, with no obvious 3- segment club.
5. Eyes rounded or emarginated.
6. Pronotum with or without defined margins.
7. Elytra usually covering abdomen.

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8. Tarsal segmentation formula 5- 5- 5, but appears 4- 4- 4 (Pseudotetramerous) which is the most outstanding characteristics.

Many researchers [19, 20, 21] studied the life cycle of different species of the family which have complete metamorphosis include, eggs- larvae- pupa- adult. Chrysomelinae Latreille, 1802 is a fifth largest subfamily of leaf beetles Chrysomelidae, more than 2000 species were found, with worldwide distribution [22], where Lopatin [23] mentioned that the subfamily Chrysomelinae comprises more than 130 genera and approximately 3,000 species throughout the world. Kasap [24] described some Chrysomelinae species belong to *Leptinotarsa*, *Crosita* and *Chrysomela* in Turkey. Kryzhanovskij [25] show that some species of Chrysomelinae are pests of cultivated plants others are apparently restricted to Dicotyledons while some feed on herbaceous plants others are confined to shrubs or tree. Booth *et al.*, [2] indicated that the adult and larvae almost feed openly, sometimes gregariously on the same host plants causing similar damage to foliage and herbaceous stems. Maican [26] studied some Mediterranean Chrysomelid Species newly entered in the collections of "Grigore Antipa" national museum of natural history, as results of the expeditions from Turkey and Tunisia during 2005-2006. Rozner and Rozner [27] organized ten collecting trips to record data to the leaf-beetle fauna of Macedonia and they have found 213 species (including *Leptinotarsa decemlineata* Say) of 61 genera of the Chrysomelidae. Aston [28] studied the Chrysomelidae of Hong Kong and provides an introduction and a key to 13 subfamilies belong to this family. Bukejs [29] studied some species of this family mistakenly reported for the Latvian fauna and deleted them from the check-list of Latvian Coleoptera and also provides general information on these species. Ghahari and Hawkeswood [30] studied the Chrysomelidae of Kurdistan province and adjacent areas, western Iran and collected a total of 25 species from 14 genera and 5 subfamilies. Bouchard *et al.*, [31] prepared a catalogue of Family-group names in Coleoptera including 862 names of Chrysomeloidea which included seven families including Chrysomelidae with 13 subfamilies. Hazmi *et al.*, [32] prepared a revision of Oriental *Monolepta* species and related groups within Chrysomelidae, they also redescribe the valid species and define the species limits. Ghahari and Jędryczkowski [33] dealt with the fauna of Chrysomelidae from the Arasbaran biosphere reserve and its neighboring areas in the Northwestern Iran, in a total 34 species from 20 genera and 5 subfamilies including this species were collected. Gavrilović and Ćurčić [34] studied the diversity of the Chrysomelidae of the Obreška Bara Special Nature Reserve (Vojvodina Province, Serbia) and provide a special reference to the host plants. Slipinski [35] prepared a national diagnostic protocol number 22 for Colorado Potato Beetle, *Leptinotarsa decemlineata* Say and included an introduction, taxonomic information, detection, identification, contact points for further information, references and an appendix. In Iraq, Derwesh [36] listed seven species within Chrysomelidae. Abdul-Rassoul [37] recorded three species of this family. El-Haidari *et al.*, [38] recorded one species within this family. Swailem and Amin [39] recorded *Aulacophora foveicollis* Lucas within this family. Shalaby *et al.*, [40] listed five species of this family. AL- Ali [41] recorded three species of Chrysomelidae. Hassan [21] Studied the life cycle of Poplar leaf beetle *Melasoma* (= *Chrysomela*) *populi* L. within this family in Duhok, Iraq. Hamamurad [17] studied the taxonomy of some subfamilies of this family and recorded 19 species including

*Leptinotarsa decemlineata* Say within 14 genera belong to six subfamilies in Erbil, Iraq. The aim of this study is to re-describe *Leptinotarsa decemlineata* Say in detail with drawing of important parts.

## Material and Methods

The study depends on ninety specimens which were collected from fields of potato *Ipomoea batatas* Poir. and eggplant *Solanum melongena* L. in some villages of Erbil Governorate from the period August- September / 2016. The specimens were killed by freezing for 48hrs, and then preserved after fixing their information in the insect collecting box, which treated with Seven 85% and Naphthalene balls. The morphology of the adults were studied by using dissecting microscope, while the minute parts were studied by the preparation of microscope slides by putting them in a beaker 100ml contains 50ml water and warming it to boiling temperature on a calm fire for 15 minutes to softening their parts and prevent their from breaking. For preparation of slides for microscopic examination, the adults dissected by using two fine pins, then the required parts (the head and abdomen) put in a beaker 100 ml contains 50ml water with KOH 10% and placed on a calm fire again with shaking for about ten minutes for dissolving of lipids mater of the body parts and destroying the muscles, after that they were placed in distilled water for 5 minutes twice in order to reduce the effect of the alkali. Mouthparts and abdomen were placed in ethyl alcohol 25% and dissected under microscope to obtain the different parts, then transferred to ethyl alcohol 50%, 75% and 100% respectively for two minutes for each concentrations to dehydration of water, then placed in Xylol for two minutes, for translucency, then prepared slides of each part by dropping some drops of Canada balsam and covered with a cover slide for examination under binocular dissecting microscope, also we used compound microscope and digital computerized microscope for studying the minute parts of the body, after that photos of these parts with their scales were taken by a digital computerized microscope and drawn by using of ocular micrometer and the length of the parts were measured by using a linear micrometer and a stage micrometer and a digital computerized microscope.

## Results

### *Leptinotarsa decemlineata* Say, 1824

#### Body (figs. 1a and b)

Large sized, about 11.1-11.2 mm long, 6.1- 6.2 mm wide, broadly oval shaped, strongly convex dorsally, nearly striated ventrally, bright yellow colored, vittated with black stripes extending along their forewing and black patches on the pronotum and the abdominal sternites.

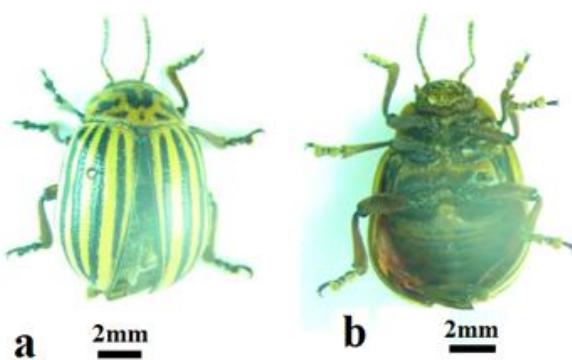


Fig 1: Body of *Leptinotarsa decemlineata* Say; a. (Dorsal view); b. (Ventral view)

#### Head (figs. 2a and b)

Prognathous type, nearly oval shaped, yellow colored with median-frontal black spot, about 1.9-2.1 mm long, 2.6-2.7 mm wide; Compound eyes black, elongate-round shaped, inner margin depressed, more-far distance between them about 1.9- 2.1 mm, nearest distance about 1.5- 1.6 mm; Vertex flat, with two big dark black spots laterally, with low small punctures; Frons yellow colored, flat, with close punctures and one black triangular central spot; Antenna (fig. 2c) nearly moniliform, with eleven antennomeres, collectively about 3.5-4.0 mm long, not extending beyond the prothorax, first four antennomeres nearly without hairs and pale brown but the remainder are haired and brown colored, 1<sup>st</sup> antennomere cup shaped, longer than the 2<sup>nd</sup> antennomere which is nearly cup shaped, antennomeres 3-5 tube-like, antennomeres 6-7 cup shaped, antennomeres 8-10 nearly rectangular shaped, antennomere 11<sup>th</sup> oval shaped, longer than the 10<sup>th</sup> antennomere; Clypeus (fig. 2d) flat, semi-circular shaped, with small punctures and pale yellow setae, about 0.4-0.6 mm length; Labrum (fig. 2e) small, nearly rectangular shaped, distal margin concaved, with small punctures and moderately haired, yellow- brownish colored, about 0.4- 0.6 mm length; Mandible (fig. 2f) big, black colored, high sclerotized, 0.9- 1.3 mm length, apical part with two dents, the inner shorter than the outer, dorsal surface with few pale yellow setae; Maxilla (fig. 2fg) big, with four digitiform palpomeres palpus, palpomeres long are: 0.1, 0.3, 0.3, 0.2 respectively, 1<sup>st</sup> tubular, 2<sup>nd</sup> and 3<sup>rd</sup> wide cup-shaped, brown colored and the 4<sup>th</sup> truncated, shorter than the 3<sup>rd</sup> and black colored, lacinia covered by moderately dense of golden setae, galea two pieces covered by moderately dense of golden setae, both the inner and the outer are nearly tubular shaped; Labium (fig. 2h) small, with three palpomeres palpus, pale brown colored except for the 3<sup>rd</sup> palpomere which is dark brown, prementum nearly oval shaped, 2<sup>nd</sup> palpomere of labial palpus nearly cup shaped, swollen and bigger than the 1<sup>st</sup> and the 3<sup>rd</sup> palpomeres.

#### **Thorax (figs. 3a, b, c and d)**

Pronotum (fig. 3a) wider than long, about 2.6-2.8 mm long and 5.1-5.3 mm wide, convex dorsally, with black spots, the two median spots elongated and convergent basally, yellow-brownish, nearly rectangular shaped, anterior margin concave, posterior margin rounded with high density of pale yellow setae, anterior and posterior angle rounded, procoxal cavities open behind, prosternum (fig. 3b) narrowed, about 0.7-0.9 mm long and 2.7-2.9 mm wide, with a fitting cavity of the antennae, Prosternal process nearly oval shaped, with high density of irregular punctures; Mesonotum (fig. 3c) slightly convex, scutellum small, wider than long, about 0.9-1.1 mm long and 1.6-1.8 wide, triangular shaped, brown colored, with high density of small punctures; Mesosternum (fig. 3d) flat, mesocoxal cavities big; Metanotum (fig. 3c) nearly convex, metasternum (fig. 3d) flat, metacoxal cavities opened between the metasternum and the anterior margin of 1<sup>st</sup> abdominal sternite; Forewings (fig. 3e) big, stout, convex, covering all abdominal segments, yellow colored, vittated with four longitudinal punctuated black wide irregular vitae, the 2<sup>nd</sup> and 3<sup>rd</sup> vittae confluent apically; Hind-wings (fig. 3f) leathery, with clear venation, pale orange colored, cross veins rp-mp2, cu-a1-mp4 present; Legs (fig. 3g, h, i and j) pale yellow to brown colored, joints and tarsomeres brown to black, femura nearly oval elongated at the middle, tibiae slightly cylindrical shaped, tarsi (fig. 3h) five tarsomeres the 1<sup>st</sup> three nearly as the same size and are bi-lobed to enclose the next tarsomere,

the 4<sup>th</sup> very small and hidden within the 3<sup>rd</sup> tarsomere (Pseudotetramerous), the 5<sup>th</sup> tarsomere is tubular and swollen apically and as twice as long of the 3<sup>rd</sup>, claws two divergent hooks, black colored.

#### **Abdomen (figs. 4a, b, c and d; figs. 5a and b)**

Male abdomen (figs. 4a and b) slightly oval shaped, with seven obvious poorly sclerotized rectangular tergites dorsally, the 1<sup>st</sup> is the narrowest and the 2<sup>nd</sup> is the widest, last visible abdominal tergite (fig.4c) rounded at apex, with five obvious sclerotized rectangular sternites ventrally, 1<sup>st</sup> sternite anterior margin depressed to fit the coxae which separated medially by wide projection, last visible abdominal sternite (fig.4d) straight at apex with two small projections, about 4.3-5.1 mm long and 5.1-5.4 mm wide, pale brown colored, 1<sup>st</sup>- 5<sup>th</sup> sternites with black spot at lateral margin, 1<sup>st</sup>- 4<sup>th</sup> sternites with black, oblong spots on either side of midline, either side of the 5<sup>th</sup> sternite with two black spots, connexivae wide. Female abdomen (figs. 5a and b) resemble to male in outlines except for its bigger size and the sternites black spots are smaller and last visible abdominal sternite rounded at apex and either side of the 5<sup>th</sup> sternite with one black spot.

#### **Male Genitalia (figs. 4e, f, g and h)**

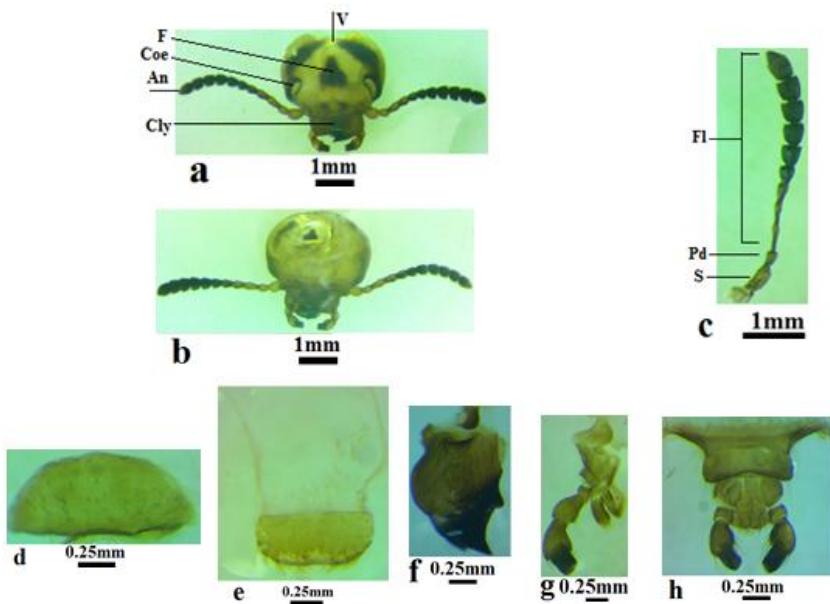
Aedeagus (fig. 4e) is a median tubular piece, banana shaped, brown colored, length about 3.0- 3.4 mm, its apical part rounded, its basal hood shaped, pale brown, slightly sclerotized; paramere (fig. 4f) is a chitinized part of the genital pocket near the middle of the aedeagus Brown colored, Y- shaped, present at the apical part of aedeagus and which surrounds it with its lateral folds extending around the aedeagus from below while the remainder projects anteriorly below the aedeagus, this Y-shaped structure forms the paired, lateral lobes spiculum gastrale (fig. 4g), it serves as an attachment for the powerful muscles which control the copulatory apparatus. At its apical end, the aedeagus possesses an opening called the apical orifice or median aperture. An internal sac (fig. 4h) lies within the aedeagus and is continuous posteriorly with it at its apical orifice.

#### **Female Genitalia (figs. 5c, d and e)**

Female genitalia is appendages of 8<sup>th</sup> and 9<sup>th</sup> abdominal segments which forming elongate telescopic ovipositor, slightly sclerotized excepted highly sclerotized of posterior and anterior margin, 8<sup>th</sup> abdominal sternite (fig. 5c) small, the anterior margin with slightly invagination at the middle, 9<sup>th</sup> sternite (fig. 5c) large, oval shaped, moderately sclerotized, anterior margin nearly straight, posterior margin concave at the middle with slightly invagination at 1/3 of posterior part, its surface covered by moderate dense of short-long, pale setae and low dense of small punctures, 9<sup>th</sup> tergite (fig.5d) with two short, semi-triangular, sclerotized, separated plates, styli absent. Flowers and Eberhard [42] studied the female genitalia in many Chrysomelidae.

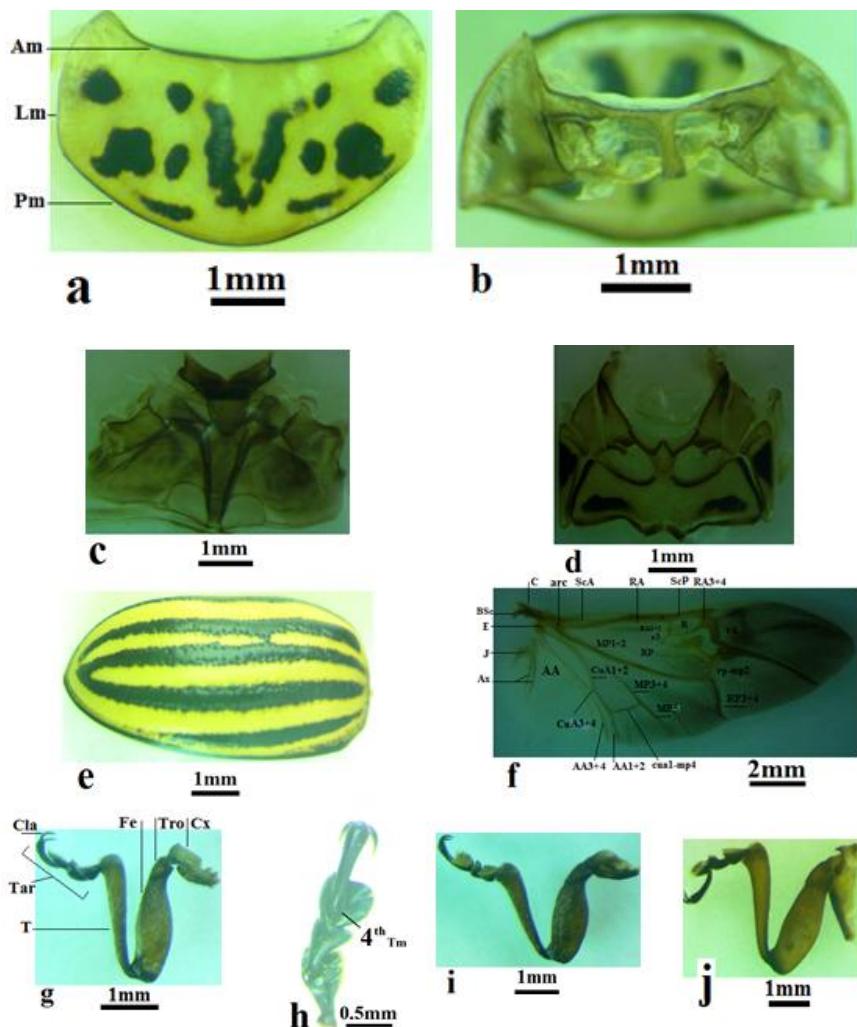
#### **Spermatheca (fig. 5e)**

The spermatheca is slightly sclerotized, its capsule and neck curved, brown color, smooth, ramus and collum are separated, cornu and nodulus are fused, the spermathecal duct is long, narrow and weakly coiled and enters the capsule at the collum, the spermathecal gland opens into the ramus. Varma [43] used the shape and size of the spermatheca capsule to separate many species of the Chrysomelidae.



**Fig 2:** Head and its parts of *Leptinotarsa decemlineata* Say

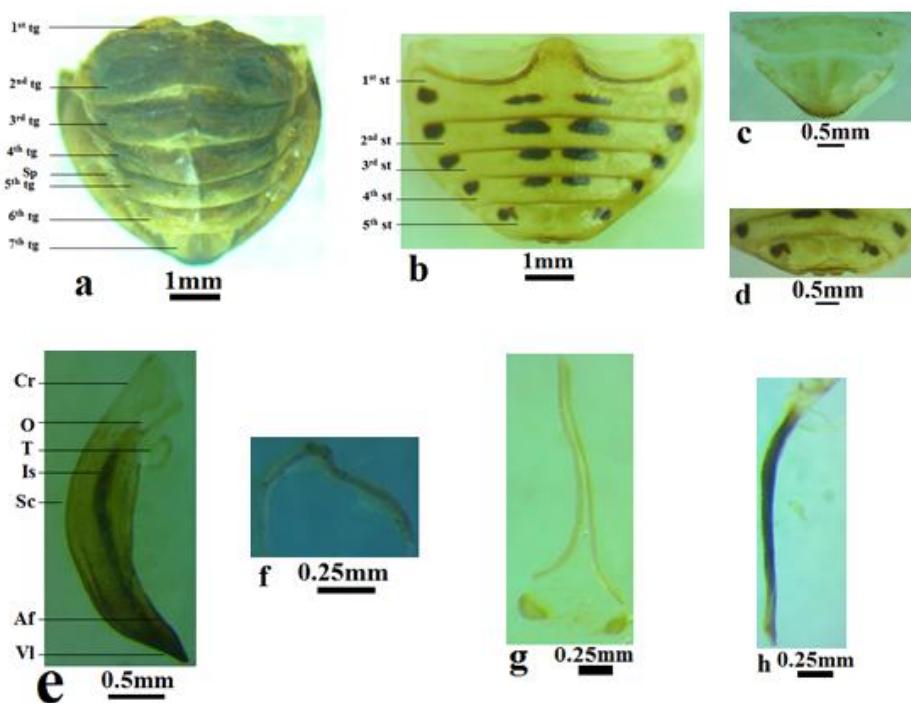
a. Head (Dorsal view); b. Head (Ventral view); c. Antenna d. Clypeus; e. Labrum; f. Mandible; g. Maxilla; h. Labium  
An: Antenna; Coe :Compound eye; Cly: Clypeus; F: Frons; Fl :Flagellum; Pd: Pedicel; S :Scape; V: Vertex



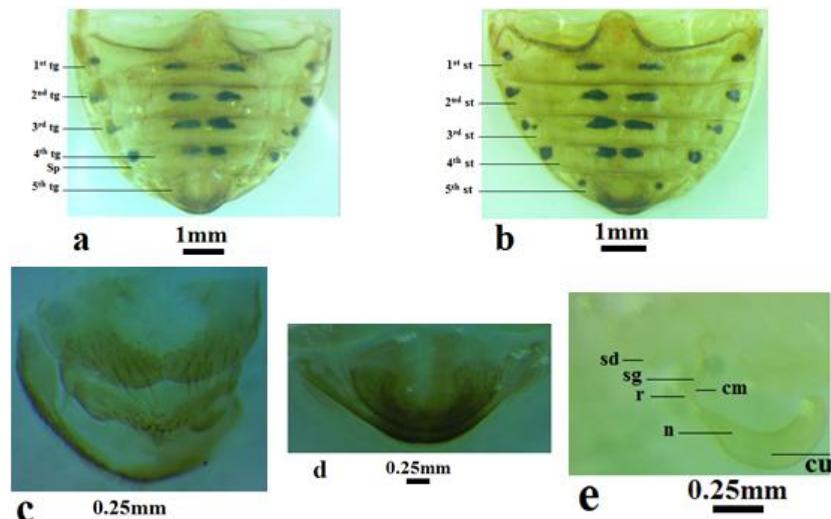
**Fig 3:** Thorax and its appendages of *Leptinotarsa decemlineata* Say

a. Prothorax (pronotum); b. Prothorax (prosternum); c. Meso-metanotum; d. Meso-metasternum e. Fore-wing; f. Hind wing; g. Foreleg; h. Tarsi; i. Midleg; j. Hindleg

AA: Anal Anterior vein; Am: Anterior margin; arc: arculus; C: Costa; Cla: Claw; Cx: Coxa; CuA3+4: Cubitus Anterior vein 3+4; cual-mp4: Cubitus anal 1- median posterior 4; E: Empusal; Fe: Femur; J: Jugal; MP<sub>1+2</sub>: Media posterior vein 1+2; MP3: Media Posterior vein 3; Pm: Posterior margin; R: Radial cell; rp-mp2: radial posterior vein – media posterior vein 2; RP: Radial Posterior vein; RP3+4: Radial Posterior vein 3+4; r3: Radial transversal vein 3; r4: Radial transversal vein 4; RA: Radial Anterior vein; Sc: Subcostal vein; Tar: Tarsi; T: Tibia; 4<sup>th</sup> Tm: 4<sup>th</sup> tarsomere; Tro: Trochanter

**Fig 4:** Male abdomen and its appendages of *Leptinotarsa decemlineata* Say

a. Male abdomen (Dorsal view); b. Male abdomen (Ventral view); c. Last visible abdominal tergite; d. Last visible abdominal sternite; e. Aedeagus (Median lobe) (Lateral view); f. Tegmen (Lateral lobe) (Paramere); g. Spiculum gastrale; h. Internal Sac  
 1<sup>st</sup> - 7<sup>th</sup> tg: 1<sup>st</sup> - 7<sup>th</sup> Tergites; 1<sup>st</sup> - 5<sup>th</sup> st: 1<sup>st</sup> - 5<sup>th</sup> sternites; Af: Apical flap; Cr: Crest of median lobe; Is: Internal sac; O: Basal orifice; Sc: Sclerite of the internal sac; Sp: Spiracle; T: Tegmen; VI: Ventral lobe

**Fig 5:** Female abdomen and its appendages of *Leptinotarsa decemlineata* Say

a. Female abdomen (Dorsal view); b. Female abdomen (Ventral view); c. Female genitalia (Posterior view); d. Female genitalia (Dorsal view); e. Spermatheca.  
 1<sup>st</sup> - 6<sup>th</sup> tg: 1<sup>st</sup> - 6<sup>th</sup> Tergites; 1<sup>st</sup> - 5<sup>th</sup> st: 1<sup>st</sup> - 5<sup>th</sup> sternites; Sp: Spiracle; cm: collum; cu: cornu; n: nodulus; r: ramus; sd: spermathecal duct; sg: spermathecal gland

**Material Examined:** Ainkawa: 26/6/2014, 12♂13♀; Ainkawa: 19/4/2015, 15♂13♀; Shamamk, 5/8/2016, 18♂16♀; Shamamk: 17/8/2016, 15♂16♀; Shamamk: 1/9/2016, 25♂28♀; Qushtappa: 5/9/2016, 35♂41♀.

## Discussion

This species differs from the nearest species from it the false potato beetle *Leptinotarsa juncta* (Germar) which feed on horse nettle- *Solanum carolinense*, by 2 black spots on clypeus and A-shaped spot on frons, sometimes interrupted into 2 or 3 spots, pronotum marked with numerous black spots, 2 median spots more elongate, each elytron with 5 black vittae, 3rd and 4th connected apically, space between

them black. elytral strial punctures in regular rows, vita 2 does not reach apex of elytra, black spot on outer margin of femur, Abdomen: sterna I-V with 6 black discoidal spots and sterna VI with 2 black spots, length 10.2-11.9 mm, width 6.7-8.4 mm. And differs from the *Leptinotarsa haldmani* (Rogers) by its color is uniform blue or green, elytra lacking vittae. And differs from the *Leptinotarsa defecta* (Stål) [Synonyms: *Myocorina defecta* Stål, 1859, *Chrysomela defect* (Stål), 1859] by its only 2 shortened vittae present on each elytron, coarse elytral punctures in very regular rows, dark spots are present on legs, especially on femora, hosts *Solanum eleagnifolium* L. – and horse nettle; *Solanum tridynamum*. And differs from the *Leptinotarsa texana* Schaeffer by each

elytron with 4 vittae, vitta 1 is shorter than the others, coarse elytral punctures in very regular rows outlining vittae; rows 2 to 9 bordering vittae; row 10 does not border a vitta near lateral margin, legs flavous, without dark spots on femora, or darkened joints and tarsi; host: *Solanum eleagnifolium* Cavanilles. And differs from the *Leptinotarsa tumamoca* Schaeffer, by head immaculate, reddish-brown, abdomen unicolorous, reddish-yellow, legs unicolorous, reddish-yellow, only known host: *Physalis acutifolia* Gray, common name: sharp-leaf ground-cherry, an invasive weed of arid lands. And differs from the *Leptinotarsa undecimlineata* (Stål) by vitta 1 shorter than other 4 and adjacent to the sutural margin, vitta 2 joins the sutural margin  $\frac{3}{4}$  the way down the elytron, legs unicolorous, black, abdomen unicolorous, black, hosts: *Solanum mitlese*, *S. lanceolatum* Cav., *S. ochraceoferrugineum* (Dunal).

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