ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 7-18, 2019
doi: 10.5281/zenodo.2633828

Altica himalayensis (Chen), an emerging pest of temperate horticultural crops from Kashmir valley

G. Mahendiran[1], Mudasir Ahmad Dar[2] and Shahid Ali Akbar[2*]

[1]*Division of Germplasm collection and Characterisation, ICAR-National Bureau of Agricultural Insect Resources, P.B. No. 2491, H.A. Farm Post, Hebbal, Bellary Road, Bengaluru-560024, India.*
[2]*Department of Entomology, Central Institute of Temperate Horticulture, Srinagar-191132, Jammu and Kashmir, India.*

(Email: kingakbarali@gmail.com)

Abstract

Seasonality, host range, and biology of *Altica himalayensis* Chen are detailed. The species is one of the most dominant leaf beetle (Chrysomelidae: Coleoptera) found in the Kashmir valley. A major pest of *Rumex nepalensis* (locally known as *Abuji*), plant is used as a source of food, astringent qualities, and for dyeing purposes. During the present study the pest was also found to feed on *Polygonium aviculare* (new host plant) and adults were also found to exert considerable damage to a number of other major crops including, apricot, almond, apple, strawberry, and walnut. Updated checklist and taxonomic status of the genus *Altica* from India is also provided herewith.

Keywords: *Altica himalayensis, Polygonium aviculare, pest, biology, Kashmir.*

Received: 17 February 2018; Revised: 4 April 2019; Online: 11 April 2019.

Introduction

The family Chrysomelidae is one of the larger families of Coleoptera with more than 50,000 described species (LeSage, 1991). These insects are also known as flea beetles and constitute one of the most destructive phytophagous pests of agricultural plants (Kimoto, 2005; Aslan *et al.*, 2007). Within chrysomelids *Altica* represents a large genus with more than 300 described species worldwide (Reid and Beatson, 2015). These beetles have gained prominence for their role as beneficial in the biological control of noxious weeds and as a severe economic pest of crop plants (Aslan *et al*., 1999; Warchalowski, 2003). They occur in huge numbers, altering plant succession in dynamic habitats (Bach, 1994). Most of the species are small, metallic blue-green-bronze and similar to each other, with very few reliable external distinguishing morphological features. Male genitalic structure, aedeagus is the most reliable character for species delimitation. The exact number of described species still remains controversial. Presence of parthenogenetic populations and similar host plants cause considerable difficulty in defining the species limits (Laroche *et al.*, 1996; Jenkins *et al.*, 2009; Döberl, 2010; Xue *et al.*, 2011). The range of host plants of *Altica* species worldwide is enormous (Jolivet, 1991; Clark *et al.*, 2004); five primary host plant families (Onagraceae, Rosaceae, Ericaceae, Corylaceae, Cornaceae) for Holarctic species of *Altica* have been reported (Furth, 1980).

One of the most dominant Chrysomelid species from Kashmir valley; *A. himalayensis* is detailed here. Zeya *et al.* (2003), Nasim and Shabbir (2012) and Bhat (2017a, b) have previously reported *A. himalayensis* as a major pest of *R. nepaliensis* (*acetosa*?)and prominent biocontrol agent against Himalayan balsam (*Impatiens glandulifera*). However, during the present study the beetle was observed as an emerging pest of horticultural crops from the Kashmir valley. The pest infest broad spectrum

of temperate horticultural crops including apple, peach, cherry, apricot, almond, strawberry in addition to number of other previously reported host plants. The seasonality, biology and taxonomic status of the pest are detailed here.

Materials and Methods

Periodic monitoring of the pest was carried in orchards of Central Institute of Temperate Horticulture (CITH) during the years, 2014–2016. CITH is situated at 33.59^{o}N latitude and 74.50^{o}E longitude at an altitude of 1640m asl. Specimens were collected by hand picking method. Weekly observations on the pest population were recorded using standard UC IPM, sampling protocols. Immature stages (eggs, larvae, and pupae) were collected and reared in biosystematics laboratory of CITH for studies on biology of the pest. Larvae along with their host plant parts, infesting leaves, flowers and buds were reared at room temperatures (18°C–32°C). For digital images, Prog-Res-Capture Pro v.2.8.0 evolution digital camera was used on the same microscope with Combine ZP-Montage software. Later, images were cleaned with Adobe Photoshop CS6. List of abbreviations and depositories are: TL: Type Locality; TD: Type Depository; NA: Not available.

BMH: Bishop Museum, Hawai'i; **BMNH:** British Museum of Natural History; **MCZ:** Museum of Comparative Zoology, Harvard; **SAM:** Royal South Australian Museum, Adelaide; **NMSE:** National Museum of Scotland, Edinburgh.

Results

Systematics

Genus *Altica* was established by [*]Geoffrroy in 1762 for the type species *Chrysomela oleracea* Linneus (1758) and adopted by subsequent designations (Clark *et al.*, 2004; Doberl, 2010). As per Furth (1981) the genus name must be attributed to Fabricius (1775). The genus *Altica* is represented by nine species from India (Konstantinov and Vandenberg, 1996; Medvedev, 2004; Kimoto, 2005; Zhang *et al.*, 2006; Döeberl, 2010; Reid and Beatson, 2015). The updated checklist of the Indian species of the genus *Altica* is provided.

Genus *Altica* Geoffroy, 1762

Altica aenea (Olivier, 1808)

Galeruca aenea Olivier, 1808: 646; TL: Java; TD: BMH, SAM

Taxonomic history: *Haltica aenea*: Heikertinger and Csiki, 1939: 247 (as synonym of *A. cyanea* sensu auctt.); *Altica aenea*: Gressitt and Kimoto, 1963: 890 (as synonym of *A. cyanea* sensu auctt.); *Haltica australis* Blackburn, 1889: 1493; Weise, 1923: 109 (synonym of *A. cyanea* sensu auctt.); *Altica australis*: Gressitt and Kimoto, 1963: 890 (as synonym of *A. cyanea* sensu auctt.); Scherer, 1982: 480 (valid species); *Haltica ignea* Blackburn, 1889: 1494 (type locality: Northern Territory); Reid and Beaton, 2015; *Haltica bicolora* Jacoby 1904: 182 (type locality: southeast New Guinea) Reid and Beaton, 2015; *Altica jussiaeae* Gressitt 1955: 34 (type locality: Palau) Reid and Beaton, 2015; *Altica caerulea* sensu Weise, 1923, nec Olivier 1791; Weise, 1923: 109; *Altica cyanea* sensu auctt. nec Weber, 1801; Maulik, 1926: 422; *Altica corrusca* sensu auctt. nec Erichson, 1842; Bryant and Gressitt, 1957.

Distribution in India: Jhansi-Chatarpur, Rishikesh (Reid and Beaton, 2015).

General distribution: Tropical Australia, Southeast Asia, West Pacific Islands of Palau, Fiji, New Caledonia and Vanuatu, New Guinea, Sri Lanka, Andaman Islands, (Gruev and Döberl, 2005).

Altica birmanensis (Jacoby, 1896)

Haltica birmanensis Jacoby, 1896: 254; TL: Burma; TD: MCZ, BMNH

Taxonomic history: Maulik 1926: 422 (junior synonym of *A. cyanea*); *Altica birmanensis*: Gressitt & Kimoto, 1963: 890 (as junior synonym of *A. cyanea*); Takizawa, 1978: 78 (valid species, as *A. birmensis*); Medvedev, 2009: 24 (junior synonym of *A. cyanea*); *Altica birmaensis* [misspelling]: Scherer, 1969: 129 (as junior synonym of *A. cyanea*); *Altica birmensis* [misspelling]: Kimoto, 1972: 38; *Haltica indica*

Shukla, 1960: 80 (type locality India, Reid and Beaton, 2015)

Distribution in India: Sikkim, Eastern Himalayas (Kimoto, 1967).

General distribution: Vietnam, Taiwan, Timor, New Guinea (Reid and Beaton, 2015).

***Altica bicosta* Shukla, 1960**

Altica bicosta Shukla, 1960: NA; TL: NA; TD: NA

Taxonomic history: The species was synonymised with *A. brevicosta* by Scherer (1969), however was recently advocated as valid species by (Reid and Beaton, 2015).

Remarks: Illustration of the dorsal view of the penis suggests that this may be a different species, not *A. brevicosta* (*A. caerulea*). As such Reid and Beaton (2015) have removed *A. bicosta* from synonymy with *A. brevicosta* and *A. caerulea* and suggest it be treated as a valid species. The species is so far reported only from Northwest India (Reid and Beaton, 2015)

***Altica caerulea* (Olivier 1791)**

Galeruca caerulea Olivier 1791: 590; TL: East Indies; TD: NMSE

Taxonomic history: *Graptodera coerulea* [misspelling]: Allard, 1891: 230; *Haltica coerulea* [misspelling]: Maulik, 1926: 423; *Altica coerulea* [misspelling]: Gressitt & Kimoto, 1963: 890 (misidentification, as junior synonym of *A. cyanea*); Kimoto, 1966: 35 (valid species); *Altica coelurea* [misspelling]: Kimoto, 1972: 47; *Haltica elongata* Jacoby, 1884: 28 (type locality: Sumatra); Reid and Beaton, 2015; *Altica elongata*: Kimoto, 2001: 159; *Altica brevicosta* Weise, 1922: 110 (type locality: Luzon, Java, Canton, Darjeeling); Kimoto, 1972: 47 (jun. syn. *A. caerulea*); Medvedev, 2009: 22 (valid species); Döberl, 2010: 493 (jun. syn. *A. caerulea*); *Altica brevicostata* [misspelling]: Kimoto,1965: 490; *Haltica brevicosta*: Chen, 1933: 51(see Reid and Beaton, 2015).

Distribution in India: Northwest Punjab, Mysore, Himalayas (Kimoto, 1967).

General distribution: Burma, China (Chekiang, Hainan I., Kwangtung), Indonesia (Borneo, Java, Sumatra), Korea, Laos, Peninsular Malaysia, Nepal, Pakistan, Philippines (Luzon), Sri Lanka, Taiwan, Thailand, Vietnam (Gruev and Döberl, 2005).

***Altica foveicollis* (Jacoby, 1889)**

Altica foveicollis Jacoby, 1889: NA; TL: NA; TD: BMNH

Taxonomic history: The species was treated as synonym of *A. aenea* (as *A. cyanea*) by Döberl (2010). However Reid and Beaton (2015) advocate it as a valid species.

Remarks: Photographs of a syntype show that *A. foveicollis* is densely microsculptured, with costate and finely punctured elytra and the male genitalia illustrated by Scherer (1969: 130), and different host plants suggest the species to be distinct from *A. aenea* (Reid and Beaton, 2015). Hence is here treated as valid species. The paper of Jacoby (1889) is not available for any further remarks about the about.

Distribution in India: Sikkim, Himalaya (Kimoto, 1967)

General distribution: Kotbari (Pakistan), Comilla, Dhaka (Bangladesh) (Gruev & Döberl, 2005)

***Altica himalayensis* (Chen, 1936)**

Haltica himalayensis Chen, 1936: 80; TL: NA; TD: NA

Taxonomic history: *Haltica himensis* Shukla, 1960, Agra Univ. J. Res., 9: 79 Kimoto and Takizawa, 1973, Kontyu, Tokyo, 41: 179 (=*himalayensis*); *Altica himalayensis* Chujo, 1966, J. Coll. Art and Sci. Chiba Univ., Nat. Sci., ser. 4: 556; *Altica himensis* Scherer, 1969, Pac. Ins. Mon., 22: 130 (see Reid and Beaton, 2015).

Material examined: India, Kashmir, Srinagar, CITH, 1640m, 15♀♀, 22♂♂, 07.iv.2015, 22.v.2015, 32♀♀, 17♂♂, 16.v.2016, 11.vi.2016 (coll. Mudasir Ahmad & Shahid Ali Akbar).

Distribution in India: Meghalaya (Khasi Hills), Kumaun Hills, (Uttarakhand), Assam, Himalaya, N.W. Himalaya, Kashmir, Simla (Himachal Pradesh), Sikkim, Uttar Pradesh and West Bengal (Kimoto, 1967; Scherer, 1969; Editor-Director, 1999; Döberl, 2003).

General distribution: Nepal, Bhutan, Taiwan, China (Tibet), Pakistan (Döberl, 2003; Löbl and Smetana, 2010; Nadein *et al.,* 2012; Azad *et al.,* 2015).

***Altica viridicyanea* (Baly, 1874)**

Graptodera viridicyanea Baly, 1874: 199; TL: Nagasaki, Japan; TD: BMNH

Taxonomic history: *Haltica viridicyanea* Maulik, 1926, Fauna India, Chrysom. & Halt., 422; *Altica viridicyanea* Ohno, 1960, Toyo Univ., Bull. Dept. Lib. Arts 1: 78, 86 (see Reid and Beaton, 2015).

Distribution in India: No specific state wise details provided (Chujo & Kimoto, 1961).

General distribution: Japan (Honshu, Sado I., Shikoku, Kyushu, Tsushima, Tanegashima); Ryukyu Is. (Okinawa); Korea; Manchuria; China (Gruev and Döberl, 2005).

***Altica caerulescens* (Baly, 1874)**

Graptodera caerulescens Baly, 1874: 190; TL: Nagasaki, TsuSima; China: Chusan; TD: NA

Taxonomic history: *Haltica caerulescens* Maulik, 1926, Fauna India, Chrysom. & Haltic., 421; *Altica caerulescens* Ohno, 1960, Toyo Univ., Bull. Dept. Lib. Arts 1: 79, 91(see Reid and Beaton, 2015).

Distribution in India: No specific state wise details provided (Chujo and Kimoto, 1961).

General distribution: Japan (Honshu, Sado I., Ao-ga-shima, Hachijo-jima, Shikoku, Kyushu, Tsushima); Ryukyu Is. (Amami-Oshima, Okinawa, Ishigaki, Miyako); Korea; Manchuria; China; Formosa; Taiwan (Gruev & Döberl, 2005).

***Altica* spec. A (Doeberl, 2003)**

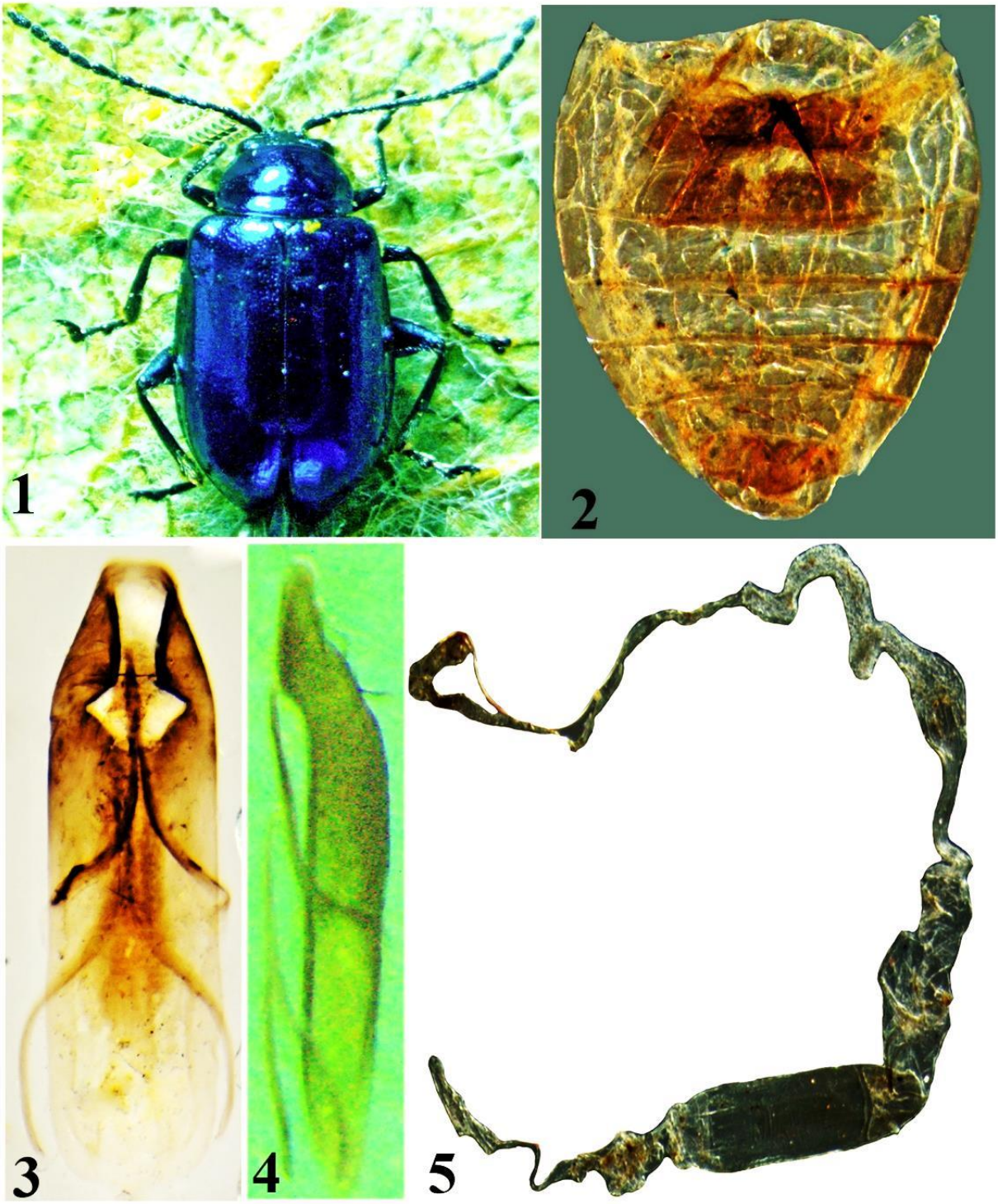
Altica spec. A Doeberl, 2003: NA; TL: NA; TD: NA

Remarks: Kashmir, Lake Anchar, IX- 16-1985, leg. C.W. and L.B. O'Brien and probably represents an undescribed species (Doeberl, 2003). The species has been reported from Kashmir (India) only.

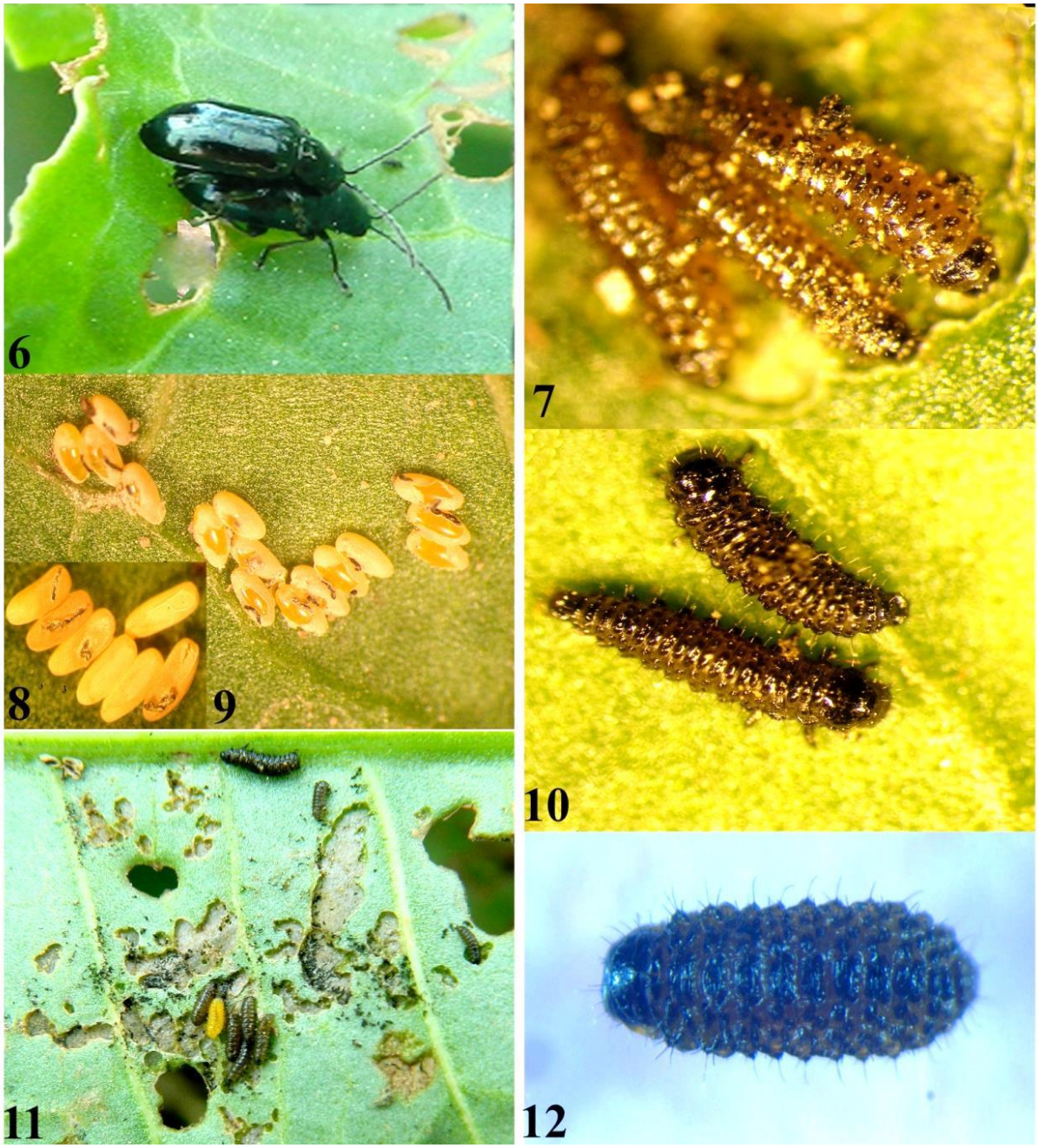
Study of type materials by Reid and Beaton (2015) signifies that all the common *Altica* species in the Indo-malaya have been misidentified. As such the *A. cyanea* of many authors should correctly be named *A. aenea* (Olivier, 1808), which is widely distributed (Kizub, 2016); *A. cyanea* Weber 1801, should correctly be applied to *A. caerulea*; The *A. caerulea* (Olivier, 1791) should be applied to the species generally known as *A. brevicosta* (Weise, 1922); *A. birmanensis* is a valid species but has been misidentified or conflated with *A. cyanea*.

Chen (1936) described the species under the name *Haltica himalayensis*. Chujo and Kimoto (1961) established valid name of genus as *Altica* from *Haltica* that was subsequently accepted by Scherer (1969); Kimoto (1967); Reid and Beatson (2015). Shukla (1960) described *Haltica himensis* as new species from N.W. Himalaya. The species was later treated as *Altica himensis* by Scherer (1969) and eventually synonymized with *Altica himalayansis* by Kimoto & Takizawa (1973). The species is well established in Indian Himalayan regions (Kumaun Hills, Khasi Hills, Himachal Pradesh, Sikkim, Kashmir, Uttar Pradesh, West Bengal, Nepal, Bhutan, Taiwan, Asia, China (Tibet) (Singh *et al.*, 1986; Shah and Jyala, 1998). There is at least one established subspecies *A. himalayansis japonica* Ohno, 1960 confined to Japan and feeding on *Jussiaea prostrata* (Roxb.).

Description and diagnosis (Figs 1-5): Body more or less flat, medium sized, metallic blue to green with reddish or bronze sheen; head shapeoval, from lateral side convex; frontal ridge forms angular T–shaped ridge with head capsule along the anterior margin; antennae long, 11–segmented, filiform, raised, contiguous, oval and well delimited from frontal ridge laterally and from each other by furrows;



Figures 1-5: *Altica himalayensis*: **1.** Adult; **2.** Abdomen ventrites; **3-4.** Ventral and lateral side of male aedeagus; **5.** Female genitalia with receptacle of spermatheca and cylindrical spermathecal pump.



Figures 6-12: Biological stages of *Altica himalayensis*: **6.** Mating pair; **7.** First and second instars; **8-9.** freshly laid yellowish eggs, eggs about to hatch; **10.** Larvae with distinct black spots; **11.** Fourth instar; **12.** Fifth instar.

orbital line present; inter–antennal space slightly wider than diameter of antennal socket, but narrower than transverse diameter of eye; eyes small; clypeus long, labrum typical; pronotum more or less narrow with ante basal transverse impression, legs covered with hair especially tibiae, tarsi and peritarsus; tarsi two segmented and bilobed peritarsus ending with long claw bearing two curved spines. Abdomen ventrites with diffuse microsculpture and with recumbent pubescence; aedeagus in dorsal view parallel-sided with a narrowly truncate tip; dorsal

surfaces slightly curved in lateral view, ventral surface almost straight; venter without a distinct transverse or oblique ridges; female: tignum long, basal part narrow with pointed tip, lateral arms narrowly triangular to threadlike, and apex broadly triangular; spermathecal collum of variable length; vaginal palpi short, conical with obliquely truncate apex.

Seasonality and biology (Figs 6-12)

The life cycle of *A. himalayensis* from Kashmir Himalayas is atypical for alticines. Two generations occur in a year. During the latter half of November as the temperature goes down the pest undergoes diapause (usually for 2–3 winter months). The first generation of the pest after diapausing, become active and frequent in occurrence from second week of March and highest pest densities are attained during the month of July. During the start of the new season and onset of spring (starting weeks of March till latter half of April), the pest infestation becomes most conspicuous on *R. nepalensis*, a herbaceous perennial plant. The pest feeds, mates and oviposits on the tender leaves of *R. nepalensis* plants. The pest quickly multiplies and within a month (from March to April) all the life stages of the pest can be found on the host plant. These larvae are also seen to migrate and infest strawberry plants and cause damage. Usually 4 or 5 larval instars were observed. Pupation takes place in soil from first week of May and almost all the motile stages of the pest disappear by the end of second and third week of May. The second generation of the pest and the newly emerged adults from pupation are cited in the third week of June and onwards. With plenty of food available and conditions favorable, population increases. It is the second generation of the pest that infests major temperate horticulture crops and cause considerable damage. Larvae of the second generation are also seen actively feeding on the major fruit crops during July and the month of August. Pupation takes in the first week of September. Adult's emerges towards the end of September and beginning of October. The pest drops activity with very small population alive during the month of November and others diapause.

***Egg*:** The eggs are laid in loose clusters 6–14 in number, yellowish in colour, elliptical in shape (9–16μm length and 3.8–4.4μm width) laid on underside the leaves of the host plant. Incubation period ranges from 7–12 days after which a small larva emerges out from the egg.

***Larva*:** Larvae appear distinct with the presence of dark tubercles and prominent blunt-tipped setae. Newly hatched larvae are about 1.370–1.522 mm long and 0.431–0.650mm in width and mature larvae measures about 3.150–3.421 mm in length and 0.7–0.9mm in width. Pupation lasts for 12–15 days and usually takes place in soil. Larva is an external feeder and feed on leaves.

***Adult*:** The adults are small, shiny metallic blue in colour (4.201–5.321mm in length and 3.310–3.762mm in width). Males are slightly smaller in size than the female. The insect overwinters in the adult stage under the ground in cracks and crevasses.

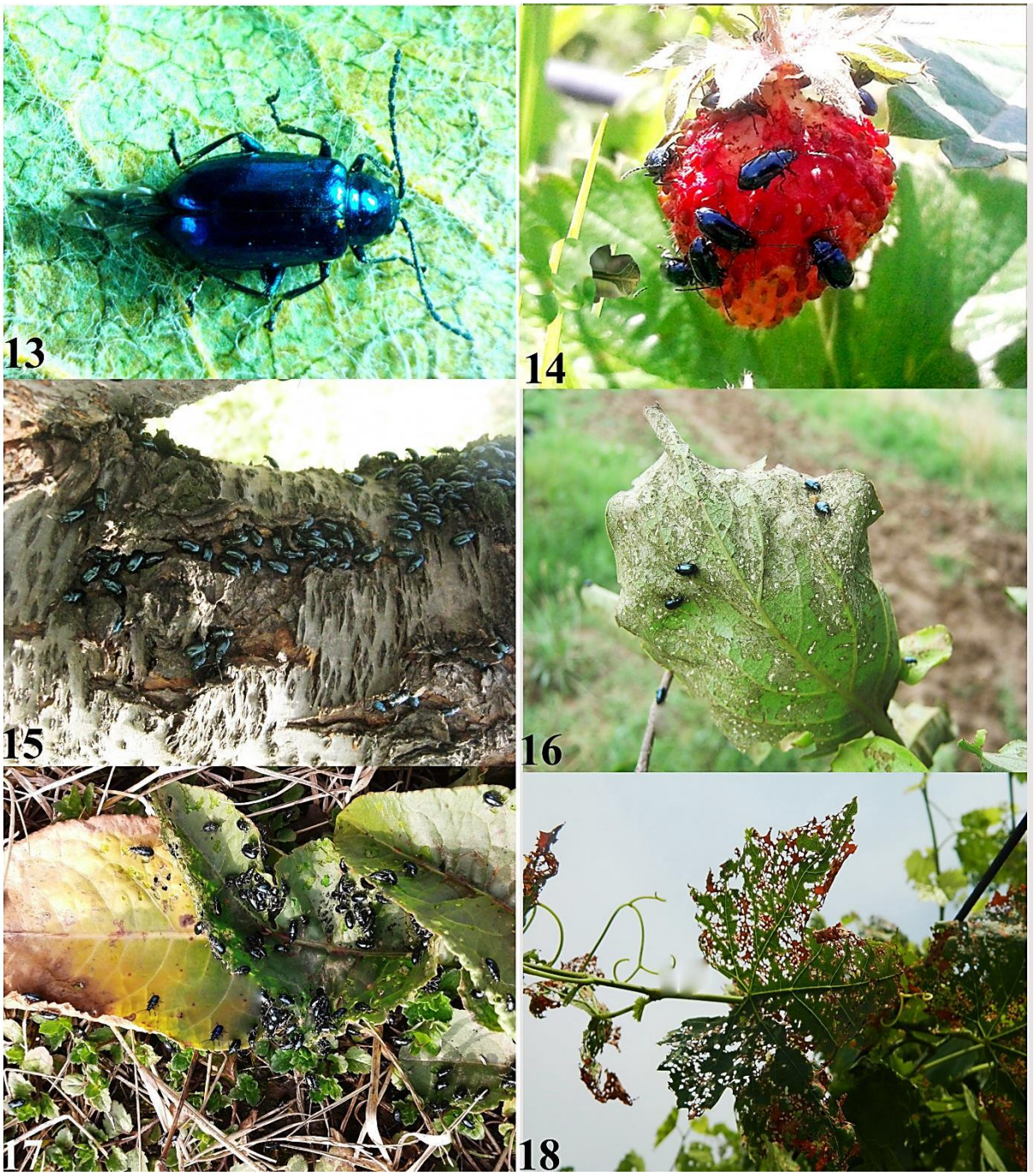
On an average life cycle completes in 49-63 days. Adult longevity was recorded at 65–71 days and with each stage (eggs, larvae, and pupa) lasts for 9–12, 28–36, 12–15 days respectively.

Damage (Figs 13-18)

The pest is voracious and defoliates the fruit trees resulting in reduced yield and less vigor of tree. Adults are highly gregarious forming swarms while larvae are an external feeder and feed on leaves. The adult and larvae feed together and skeletonises leaves leaving only midribs and few veins. This characteristic damage and large pest populations were found in all the orchards sampled. No threshold limits of the pest has been set so far, however it was found that 7–8 beetles/leaf can cause complete skeletonisation within 24 hours and in case of heavy infestations about 20–40 beetles were present per leaf. High incidence and severity rates were observed in case of heavy pest infestations.

Acknowledgements

The authors are thankful to Director, CITH and ICAR for providing necessary facilities and encouragements. The corresponding author would also like to thank Department of Science and Technology (DST),



Figs. 13-18. Seasonality and nature of damage: **13, 15.** Overwintering adults; **14, 16-18.** Adult feeding on various fruit crops.

Govt. of India, New Delhi for research encouragement and financial assistance rendered via; N-PDF Fellowship program: File No: PDF/2015/000866.

References

[*]Conserved name ICZN. 1994. However, David G. Furth argued that *Altica* had been cited by Geoffroy, 1762, and O. F. Müller, 1764, invalidly, and the first valid citation is Fabricius, 1775.

Allard, E. 1891. Collection d'insectes formée dans l'Indochine par M. Pavie consul de France au Cambodge. Coléoptères. Phytophages. Nouvelles Archives du Muséum d'Histoire Naturelle Series 3(3): 229–234.

Aslan, I., Gruev, B. and Ozbek, H. 1999. A preliminary review of the subfamily Alticinae (Coleoptera, Chrysomelidae) in Turkey. Turkish Journal of Zoology 23: 373–414.

Aslan, I., Ozbek, H. and Güçlü, C. 2007. Studies on biology and parasitoids of *Psylliodes cupreus* (Koch) (Coleoptera, Chrysomelidae) feed on *Crambe orientalis* L. (Brassicacea). II. Plant Protection Congress, (Isparta) 50–51.

Azad, M.W.A., Naeem, M., Bodlah, I. and Mohsin, A.U. 2015. New locality records of Chrysomelidae (Coleoptera) from Pothowar tract of the Punjab. Asian Journal of Agriculture and Biology 3(1): 41–45.

Bach, C.E. 1994. Effects of a specialist herbivore (*Altica subplicata*) on Salix cordata and sand dune succession. Ecological Monographs 64: 423–445. http://dx.doi.org/10.2307/2937144.

Baly, J.S. 1874. Catalogue of the phytophagous Coleoptera of Japan, with descriptions of the species new to science. The Transactions of the Entomological Society of London 1874: 161- 217. https://doi.org/10.1111/j.13652311.1874.tb 00164.x.

Bhat, D.M. 2017a. First report of *Rumex acetosa* L. as a host plant of *Altica himensis* Shukla (Coleoptera: Chrysomellidae) from Kashmir. Journal of Advanced Zoology 38(1): 79-81.

Bhat, D.M. 2017b. First Report of Some Insect Pests Damaging *Rumex acetosa* L. in Kashmir Himalaya. Trends in Biosciences 10(12): 2168-2171.

Blackburn, T. 1889. Further notes on Australian Coleoptera, with descriptions of new genera and species. Proceedings of the Linnean Society of New South Wales 3(2): 1387–1506.

Bryant, G.E. and Gressitt, J.L. 1957. Chrysomelidae of Fiji (Coleoptera). Pacific Science 11: 3–91.

Chen, S.H. 1933. Some species of Halticinae from Canton. Peking Natural History Bulletin 8: 43–58.

Chen, S.X. 1936. Notes on some flea beetles from Tropical Asia (2). Sinensia 7(1):80–88.

Chujo, M. and Kimoto, S. 1961. Systematic catalog of Japanese Chrysomelidae (Coleoptera). Pacific Insects 3(1): 117–202.

Clark, S.M., LeDoux, D.G., Seeno, T.N., Riley, E.G., Gilbert, A.J. and Sullivan, J.M. 2004. Host plants of leaf beetle species occurring in the United States and Canada. Sacramento: The Coleopterist's Society. 476pp.

Döberl, M. 2003. Alticinae from India and Pakistan Stored in the Collection of the Texas A. & M. University, U.S.A. (Coleóptera, Chrysomelidae). Bonner zoologische Beiträge 51: 297-304.

Döberl, M. 2010. Beitrag zur kenntnis der afrotropischen Arten von *Altica* Geoffroy, 1762 unter Ausschuss der Arten Madagaskars (Coleoptera: Chrysomelidae, Alticinae). Entomologische Zeitschrift, Stuttgart 120(2): 51–72.

Editor-Director, 1999. State Fauna Series. Fauna of Meghalaya Parts (Insects). i-iv, Published Director. Z.S.I. Calcutta. 1-666pp.

Fabricius, J.C. 1775. Systema Entomologiae Insectorum. Flensburgi et Lipsiae. 94-122 pp.

Furth, D.C. 1980. Zoogeography and host plants of Longitarsus in Israel, with descriptions of six new species Coleoptera: Chrysomeidac. Israel Journal of Entomology 13: 79–124.

Furth, D.G. 1981. *Altica* of Israel (Coleoptera: Chrysomelidae: Alticinae). Israel Journal of Entomology 14: 55–66.

Geoffroy, E.L. 1762. Histoire abrégée des insectes qui se trouve aux environs de Paris, dans laquelle ces animaux sont rangés suivant un ordre méthodique. Tome première. Durand, Paris, xxxviii. 523pp.

Gressitt, J.L. 1955. Coleoptera: Chrysomelidae. Insects of Micronesia 17(1): 1–60.

Gressitt, J.L. and Kimoto, S. 1963. The Chrysomelidae (Coleopt.) of China and

Korea. Part 2. Pacific Insects Monograph1: 301–1026.

Gruev, B. and Döberl, M. 2005. General distribution of the Flea beetles in the palaearctic subregion (coleoptera, chrysomelidae: alticinae) Supplement. Pensoft Series Faunistica No 42. ISSN 1312-0174. Bulgaria: Pensoft Publishers. 1312pp.

Heikertinger, F. and Csiki, E. 1939. Chrysomelidae: Halticinae 1. Coleopterorum Catalogus 25(166): 1–336.

Jacoby, M. 1884. Note III. Descriptions of new genera and species of phytophagous Coleoptera from Sumatra. Notes from the Leyden Museum 6: 9–70.

Jacoby, M. 1889. Viaggio di Leonardo Fea in Birmania e regioni vicine. – List of the phytophagous Coleoptera obtained by Signor L. Fea at Burmah and Tenasserim, with descriptions of the new species. Annali del Museo Civico di Storia Naturale di Genova 27: 147–237.

Jacoby, M. 1896. Descriptions of the new genera and species of phytophagous Coleoptera obtained by Mr Andrewes in India. Part II. Crysomelinae [sic], Halticinae and Galerucinae. Annales de la Société Entomologique de Belgique 40: 250–304.

Jacoby, M. 1904. Descriptions of new genera and species of phytophagous Coleoptera obtained by Dr Loria in New Guinea. Annali del Museo Civico di Storia Naturale di Genova 41: 469–514.

Jenkins, T.M., Braman, S.K., Chen, Z., Eaton, T.D., Pettis, G.V. and Boyd, D.W. 2009. Insights into flea beetle (Coleoptera: Chrysomelidae: Galerucinae) host specificity from concordant mitochondrial and nuclear DNA phylogenies. Annals of the Entomological Society of America 102 (3): 386–395. http://dx.doi.org/10.1603/008.102.0306.

Jolivet, P. 1991. Selectiontrophique chez les Alticinae (Col., Chrysomelidae). Bulletin Mensuel de la Société Linnéene de Lyon 60 (1): 26–40.

Kimoto, S. 1965. A list of specimens of Chrysomelidae from Taiwan preserved in the Naturhistorisches Museum, Wien (Insecta: Coleoptera). Annalen Naturhistorisches Museum Wien 68: 485–490.

Kimoto, S. 1966. A list of the chrysomelid specimens of Taiwan preserved in Zoological Museum, Berlin. Esakia 5: 21–38.

Kimoto, S. 1967. A list of the chrysomelid specimens from the Himalayas and Kashmir, preserved In the Zoological Museum, Berlin: Esakia. 90pp.

Kimoto, S. 1972. A list of the chrysomelid beetles collected by Prof. K. Yasumatsu in India and Pakistan in 1963 (Col. Chrysomelidae). Entomological Review, Japan 24(1–2): 43–48.

Kimoto, S. 2001. Checklist of Chrysomelidae of southeast Asia, south of Thailand and west of Irian Jaya of Indonesia, IX. Alticinae. Bulletin of the Institute of comparative Studies of International Cultures and Societies 28: 153–249.

Kimoto, S. 2005. Systematic Catalog of the Chrysomelidae (Coleoptera) from Nepal and Bhutan Bull. Kitakyushu Kitakyushu Museum of Natural History & Human History Ser. A 3: 13–114.

Kimoto, S. and Takizawa, H. 1973. The chrysomelid beetles of Nepal, collected by the Kokkaido University scientific expedition to Nepal Himalaya. part II. Kontyu 41: 170–180.

Kizub, I.V. 2016. Notes on Oriental Galerucinae Latreille, 1802 with description of a new species of the genus Palpoxena Baly, 1861 (Coleoptera: Chrysomelidae). Munis Entomology & Zoology 11(1): 18-25.

Konstantinov, A.S. and Vandenberg, N.J. 1996. Handbook of Palearctic flea beetles (Coleoptera: Chrysomelidae: Alticinae). Contributions on Entomology International 1(3): 237–439.

Laroche, A., DeClerck-Floate, R.A., LeSage, L., Floate, K.D. and Demeke, T. 1996. Are Alticacarduorum and Alticacirsicola (Coleoptera: Chrysomelidae) different species? Implications for the release of A. cirsicola for the biological control of Canada thistle in Canada. Biological Control 6(3): 306–314. http://dx.doi.org/10.1006/bcon.1996.0039.

LeSage, L. 1991. Family Chrysomelidae leaf beetles, pp. 301-323, in Y. Bousquet (ed.) Checklist of beetles of Canada and Alaska. Ottawa, Ontario: Canada Communication Group, vi. 430 pp.

Löbl, I. and Smetana A., (eds.) 2010, Catalogue of Palaearctic Coleoptera. Chrysomeloidea. Volume VI. – Stenstrup: Apollo Books. 600pp.

Maulik, S. 1926. The fauna of British India including Ceylon and Burma. Coleoptera. Chrysomelidae (Chrysomelinae and Halticinae). London: Taylor & Francis.xiv + 442 pp.

Medvedev, L.N. 2004. A revision of the genus *Chaloenus* Westwood, 1861 (Coleoptera: Chrysomelidae: Alticinae) from Oriental region. Russian Entomological Journal 13 (4): 245–252.

Medvedev, L.N. 2009. Alticinae of Indochina. Moscow: KMK Scientific Press. 224 pp.

Nadein, K., Ahmed, Z. and Sergeev, M. 2012. Distributional notes on Chrysomelidae from Pakistan and Afghanistan. Beiträge zur Entomologie 62: 225–233.

Nasim, G. and Shabbir, A. 2012. Shifting herbivory pattern due to climate change: A case study of Himalayan balsam from Pakistan. Pakistan Journal of Botany 44: 63–68.

Olivier, A.G. 1791. Encyclopédie métodique, ou par ordre de matières: par une société de gens de lettres, de savans et d'artistes; précédée d'un vocabulaire universel, servant de table pour tout l'ouvrage, ornée des portraits de Mm. Diderot et d'Alembert, premiers éditeurs de l'Encyclopédie. Paris: Histoire naturelle. Insectes. Tome sixième. Pars 1. Panckoucke, 704 pp.

Olivier, A.G. 1808. Entomologie, ou histoire naturelle des insectes, avec leur caractères génériques et spécifiques, leur description, leur synonymie, et leur figure enluminée. Coléoptères. Desray, Paris: Tome sixième. 613–1104 pp. + 46 plates.

Reid, C.A.M. and Beatson, M. 2015. Disentagling a taxonomic nightmare: a revision of the Australian, Indomalayan and Pacific species of *Altica* Geoffroy, 1762 (Coleoptera: Chrysomelidae: Galerucinae). Zootaxa 3918: 503–551.

Scherer, G. 1969. Die Alticinae des Indischen Subkontinentes (Coleoptera – Chrysomelidae). Pacific Insects Monograph 22: 1–251.

Scherer, G. 1982. Erichson-Typen im Zoologischen Museum, Berlin (Coleoptera – Chrysomelidae – Alticinae). Deutsch Entomologische Zeitschrift. 29 (4–5): 479–481. http://dx.doi.org/10.1002/mmnd.19820290412.

Shah, L. and Jyala, M.N. 1998. Population dynamics and host specificity of flea beetle Altica himensis Shukla (Coleoptera: Chrysomelidae: Alticinae) in Kumaon Himalayas. Entomon 23(4): 299–305.

Shukla, S.P. 1960. Entomological survey of Himalaya. part XXX- on some Chrysomelidae (Coleoptera) from the North-West (Punjab) Himalaya. Agra University Journal of Research (Science) 9: 65–88.

Singh, S.J.P., Rose, H.S. and Gautam, R.K. 1986. The biology of the flea beetle, Altica caerulea Olivier (Coleoptera: Chrysomelidae: Alticinae) a pest on mountainous weed *Rumex* sp. Entomon 11 (3): 175–178.

Takizawa, H. 1978. Notes on Taiwanese chrysomelid larvae, V. Entomological Review, Japan 31(1–2): 75–84.

UC IPM, 2017. Available from: http://www.ipm.ucdavis.edu. Accessed on January 28, 2018.

Warchalowski, A. 2003. Chrysomelidae, The leaf beetles of Europe and Mediterranean area. Warszawa: Nature optima dux Foundation. 600pp.

Weise, J. 1922. Chrysomeliden der Indo-Malayischen Region. Tijdschrift voor Entomologie 65: 39–130.

Weise, J. 1923. Results of Dr E. Mjöberg's Swedish scientific expeditions to Australia 1910–1913. 31. Chrysomeliden und Coccinelliden aus Queensland. Arkiv för Zoologi 15(12): 1–150.

Xue, H.J., Li, W.Z., Nie, R.E. and Yang, X.K. 2011. Recent speciation in three closely related sympatric specialists: inferences using multi-locus sequence, post-mating

isloation and endosymbiont data. PLoS One 6(11): e 27834. http://dx.doi.org/10.1371/journal.pone.0027834.

Zeya, S.B., Khan, M.A. and Ahsan, M.M. 2003. *Altica himensis* Shukla A pest of Mulberry and its Management. Indian Silk 1-8.

Zhang, L.J., Yang, X.K., Cui, J.Z. and Li, W.Z. 2006. A key to the genus *Mimastra* Baly (Coleoptera: Chrysomelidae: Galerucinae) from China, with the description of a new species. Entomological News 117: 203-210.