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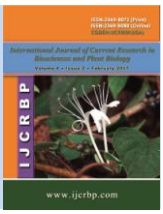

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Coleopteran-fauna (Insecta) Infesting Fruit Plantations in Jammu & Kashmir State (India): An Annotated Checklist and Biodiversity

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Abstract

This paper deals with 47 species of Coleopterans, belonging to 37 genera, distributed over 11 families, are associated with different kinds of fruit plantations, occurring in vast localities and areas of Jammu, Kashmir and Ladakh regions. The drupaceous fruit crops (stone, nut, ber), pome (apple, pear quince), berries and aggregate, have been found to be infested with 26 spp., 21 spp., 9 spp. and 1 sp. of Coleopterans under different families respectively. The apple fruit trees /crops (*Malus domestica*), showed highest number of Coleopteran species *i.e.*, 21, belonging to 8 families. This accounts for 44.68% of total Coleopteran-fauna of this region studied. This is followed by nut fruit crop (*Juglans regia*), with 12 spp. of Coleopterans species, accounts for 25.53% of total Coleopteran species of horticultural importance. The Scarabaeidae is found to be dominant family, having 15 spp., infesting diverse fruit plantations. This family in dominance is followed by Curculionidae, having 10 species damaging fruit plantations of J & K State. An up-to-date annotated systematic Check list has been provided. Besides this, information on biodiversity has also been given.

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Introduction

In Jammu and Kashmir State, Coleopteran-fauna (beetles, weevils) of horticultural importance include a total of 47 species under 37 genera, distributed over 11 families. These Coleopterans are associated with different kinds of fruit trees / crops, occurring in vast localities and areas of this State. The various families of order Coleoptera of horticultural importance are: Anobiidae, Buprestidae, Cerambycidae, Chrysomelidae, Coccinellidae, Curculionidae, Meloidae, Nitulidae, Scarabaeidae, Scolytidae and Tenebrionidae.

The larvae of Buprestids and Cerambycids cause considerable damage to fruit trees by making tunnels. The adults of Chrysomelids damage fruit trees by feeding on leaves and flowers, besides larvae feed on leaves or roots. The Coccinellids larvae and adults damage leaves of fruit plantations like cape gooseberry (ground cherry). Both adults as well as larvae in case of Curculionids (weevils) feed on various parts of the fruit trees. The adults of Meloid feed on leaves and flowers of sweet cherry plants. The Nitulid feeds on over-ripe apple fruit and sap.

The Scarabaeids cause heavy damage to foliage, flowers and roots of number of fruit trees (pome, drupaceous). The Scolytids or pin-and shot hole borers, make small

holes in wood of living fruit trees. These are serious pests of stone fruits (walnut, almond) and pome fruits (apple, quince). Anobiid is wood-destroying insect, especially abandoned fruit tree (apple). The damage caused by Tenebrionid is by feeding on leaves and beneath tree bark as in case of fruit tree (pomegranate).

Materials and methods

The database included in this paper is belonging to 47 Coleopteran species, under 37 genera of 11 families, infesting diverse and economically important fruit plantations, occurring in vast areas and localities of J & K State. This State is located in northern part of Indian sub-continent, in the vicinity of Karakorum and western Himalayan ranges. J & K State is bounded by: Indian States, *viz*. Himachal Pradesh and Punjab; China and China-administered part of Kashmir; Pakistan and Pakistan-administered portion of Kashmir. Jammu and Kashmir State is divided into three geographically and climatically different Provinces, *viz*., Ladakh (cold desert), Kashmir (temperate) and Jammu (sub-tropical). This State is of paramount zoo-geographical significance as well as rich in biodiversity.

In this paper, Coleopteran-fauna of horticultural importance, has been updated in view of the latest nomenclatural / systematic changes. In addition to this, data on host tree/ crop species, has also been updated. For the purpose of updating of faunal taxa and diversity, the relevant published works (national and international) besides, online data on taxonomic surveys and systematic checklist / catalogues of the world, have been consulted. For updating of changes pertaining to systematics of taxa, the important monographs and online databases followed are: Anon (2016a,b); Bright (2014); Cline et al. (2014); Danilevsky (2015); Kirejtshuk and Mantic (2015); Konstantinov et al. (2009); Lobl and Smetana (2010); Smith and Andrew (2006).

The faunal records of valid Coleopteran species / genera, with host plant species, are given in the Systematic Checklist. The synonymies of the taxa are listed under the valid species, given with in parentheses. The references pertaining to author (s) reporting and describing these taxa from different localities of J & K State, are given in the long brackets in front of each listed species. In addition to this, number of abbreviations with respect to host tree species and families, and Coleopteran-fauna families, are given in the text. The keys to the abbreviations, are cited at the end of Checklist and table.

Results and discussion

I. Systematic Checklist

Family 1. Anobiidae
Subfamily: Dorcatominae
1. *Caenocara* sp. [Bhat, 1987]
Host: MD

Family 2: Buprestidae (Jewel beetles)
Subfamily: Buprestinae
2. *Anthaxia* (*Anthaxia*) *baconis* Thomson
(= *Anthaxia baconis* Thomson) [Bhat, 1987]
Host: PG
3. *Anthaxia scalptipennis* Obenberger [Bhat, 1991]
Host: PG
Tribe 1: Chrysobothrini
4. *Chrysobothris mali* Horm [Rishi, 1968]
Hosts: PAR, PC, MD
Tribe 2: Psilopterini
5. *Capnodis carbonaria* (Klug.) [Biley and Vitezslav, 2016]
(=*Capnodis kashmirensis* Fairmaire) [Rishi, 1968]
Hosts: MD, PC

Family 3. Cerambycidae
Subfamily 1. Cerambycinae
Tribe1:Cerambycini
6. *Aeolesthes* (*Aeolesthes*) *holosericea* (Fabricius) [Danilevsky, 2015; Lobl and Smetana, 2010)]
(=*Aeolesthes holosericea* Fabricius) [Gahan, 1906; Gupta, 2015; Gupta and Tara, 2013, 2014; Tara et al., 2009].
Host: MD
7. *Aeolesthes* (*Aeolesthes*) *sarta* Solsky [Danilevsky, 2015; Lobl and Smetana, 2010]
(= *Aeolesthes sarta* Solsky) [Bhat et al., 2010; Gaffar and Bhat, 1991; Khan et al., 2013; Mir and Wani, 2005; Rishi, 1968]
Hosts: CO, JR, MD, PP
Tribe 2: Purpuricenini
8. *Purpuricenus kabakovi* Miroshnikov and Labanov [Ghate et al., 2006]
Host: wild cherry-"Kavchair"
Subfamily 2. Lamiinae
Tribe 1. Acanthocinini
9. *Rondibilis* sp. [Bhat, 1987]
Hosts: JR, MD, PA
Tribe 2. Batocerini

10. *Apriona* (*Apriona*) *cinerea* Chevrolat [Danilvesky, 2015; Lobl and Smetana, 2010]
(=*Apriona cinerea* Chevrolat) [Rishi, 1968]
Hosts: MD, PP

Family 4: Chrysomelidae
Subfamily 1. Cassidinae
Tribe: Hispini
11. *Dactylis padohertyi* (Gestro) [Gupta et al., 2012]
Host: MD
Subfamily 2. Cryptocephalinae
Tribe 1. Cryptocephalini
Subtribe: Cryptocephalina
12. *Cryptocephalus* sp.
Host: MD
Subfamily 3: Alticinae
Tribe: Alticini
Subtribe: Alticina
13. *Altica caerula* Olivier [Bhat, 1991]
Hosts: MD, VV
Subfamily 4: Halticinae
Tribe: Halticini
14. *Haltica semipicens* Jacaby [Rishi, 1968]
Hosts: MD, PAR, PP

Family 5: Coccinellidae
Subfamily: Epilachninae
Tribe: Epilachnini
15. *Epilachana vignitioctopunctata* [Jamwal et al., 2013]
Host: PM

Family 6: Curculionidae
Subfamily 1: Dryophthorinae
Tribe: Sphenophorini
16. *Odoiporus longicollis* (Olivier) [Azam et al., 2007; Tara et al., 2010]
Host: MP
Subfamily 2. Entiminae
17. *Myllocerus discolor* Boheman [Tara et al., 2010]
Host: ZM
18. *Myllocerus* (*Myllocerus*) *fotedari* Ahmad and Dar [Ahmad and Dar, 1975]
Host: MD
19. *Myllocerus* (*Myllocerus*) *kashmirensis* Marshall [Marshall, 1916; Bhat, 1991]
Hosts: JR, MD, PAR, PC, PDO
20. *Myllocerus* (*Myllocerus*) *rusticus* Pascoe [Bhat, 1991]
Hosts: JR, MD, PAR, PC, PDO
21. *Myllocerus* sp. [Khan et al., 2016; Mir and Wani, 2005]
Host: JR

Tribe 2: Phyllobini
22. *Phyllobius* sp. [Rishi, 1968]
Hosts: MD, PC, PDO
Subfamily 3: Lixinae
Tribe 3: Cleonini
23. *Xanthochelus faunus* [Tara et al., 2010]
Host: Z
Subfamily 4: Molytinae
Tribe: Mecysolobini
24. *Neomecyslobus porrectirostris* (Marshall) [Anon, 2016a,b]
(=*Alcides porrectirostris* Marshall) [Mir and Wani, 2005, 2007]
(=*Alcidodes porrectirostris* Mrshall) [Khan et al., 2016; Sheikh and Bhat, 1990]
Host: JR
Subfamily 5: Rhnchaeninae
25. *Rhynchaenus* sp. [Zaka-ur-Rab, 1991]
Host: JR

Family 7: Meloidae
Subfamily: Meloinae
26. *Lytta flavipennis* (Matschulsky) [Bhat, 1987]
Host: PA

Family 8: Nitulidae
Subfamily: Cybrocephalinae
27. *Cybrocephalus* sp. [Bhat, 1987]
Host: MD

Family 9. Scarabaeidae
Subfamily 1: Cetoniinae
Tribe: Cetoniini
28. *Protaetia* (*Protasia*) *impavida* Janson [Rishi, 1968]
Host: PA
29. *Protaetia neglecta* Hope [Rishi, 1968; Mir and Wani, 2005]
Hosts: JR, MD, PP, VV
Subfamily 2. Dynastinae
Tribe 1. Oryctini
30. *Oryctes nasicornis nasicornis* (Linnaeus) [Bhat et al., 2005]
Hosts: Nursery plants of horticultural importance
31. *Oryctes rhinoceros* (Linnaeus) [Rishi, 1968]
Hosts: JR, PAR
Tribe 2.: Pentodontini
32. *Heteronychus sublaevis* (Fairmaire) [Rishi, 1968]
Host: VV
Subfamily 3. Melolonthinae
Tribe 1: Macrodactylini
33. *Macrodactylus subspinosus* Fabricius) [Rishi, 1968]

Hosts: FV, PP, VV

Tribe 2: Melolonthini

34. *Brahmina* sp. [Bhat et al., 2005]
Hosts: Nursery plants of horticultural importance
35. *Hilyotrogus holosericeus* (Redtenbacher) [Bhat et al., 2005]
(=*Ancylonychaholos ericeus* Redtenbacher) [Redtenbacher, 1844]
Hosts: Nursery plants of horticultural importance
36. *Melolontha indica* Hope [Bhat et al., 2005]
Hosts: Nursery plants of horticultural importance
37. *Melolontha melolontha* (Linnaeus) [Rishi, 1968]
Hosts: MD, PC
38. *Lasiotropus poonensis* Reitter [Bhat et al., 2005]
Hosts: Nursery plants of horticultural importance

Subfamily 4. Rutelinae

Tribe 1. Adoretini

39. *Adoretus ladakanus* Ohaus [Rishi, 1968]
Hosts: MD, PA, PC, PP,
40. *Adoretus* sp. [Bhat et al., 2005; Pandey and Dwivedi, 2005]
Hosts: Polyphagous pest feeding on foliage and developing fruits in Ladakh and nursery plants of horticultural importance in Kashmir region.

Tribe 2. Anomalini

41. *Anomala rufiventris* Redenbacher [Bhat et al., 2005]
Hosts: Nursery plants of horticultural importance
42. *Exomala orientalis* (Waterhouse) [Alm et al., 1995; Choo et al., 2002]
(= *Anomala orientalis* Heyden) [Rishi, 1968]
Hosts: MD, PA, PC, PAR, PP

Family10. Scolytidae

Subfamily 1. Ipinae

Tribe 1. Dryocoetini

43. *Dryocoetes himalayensis* Strohmeyer [Strohmeyer, 1908; Maiti and Saha, 2009]
Host: JR

Tribe 2. Ipini

44. *Pityogenes scitus* Blanford [Bhat, 1987]
Host: JR

Tribe 3. Scolytini

45. *Scolytus nitidus* Schedl [Rishi, 1968; Buhroo et al., 2004; Buhroo and Lakatos, 2007; Buhroo and Ramamurthy, 2008; Wani et al., 2009]
Hosts: CO, MD, PA, PD
46. *Scolytoplatypus* sp. [Mir and Wani, 2005; Khan et al., 2016]
Host: JR

Family11.Tenebrionidae

Subfamily: Diaperinae

47. *Crypticus* sp. [Bhat, 1987]
Host: PG

Keys to the abbreviations given in the Checklist:

CO= *Cydonia oblonga* (Quince); FV= *Fargaria vesca* (Strawberry); JR= *Juglans regia* (Walnut); MD= *Malus domestica* (Apple); MP= *Musa paradisiaca* (Banana); PA= *Prunus savium* (Sweet cherry); PAR= *Prunus armeniaca* (Apricot); PC= *Pyrus communis* (Pear); PD= *Prunus dulcis* (Almond); PDO= *Prunus domestica* (Plum); PG= *Prunus granatum* (Pomegranate); PM= *Physalis minima* (Cape gooseberry /Ground cherry); PP= *Prunus persica* (Peach); VV= *Vitis vinifera* (Wine grape);; Z= *Zizyphu*s (Ber); ZM = *Zizyphus mauritiana* (Indian date'ber').

The above given Systematic Checklist shows that a total of 47 species of Coleopterans, under 37 genera, distributed over 11 families, are associated with fruit tree and crops. These fruit trees / crops of various types *viz.*, aggregate, berries, drupaceous, pome fruits, belonging to seven families *viz.*, Juglandaceae, Muscaceae, Punicaceae, Rhamnaceae, Rosaceae, Solanaceae and Vitaceae.

The Coleopteran families of horticultural importance, each with total number of species are: Anobiidae (1 sp.), Buprestidae (4 spp.), Cerambycidae (5); Chrysomelidae (4), Coccinellidae (1); Curculionidae (10); Meloidae (1); Nitulidae (1); Scarabaeidae (15); Scolytidae (4) and Tenebrionidae (10. The previous checklist of insect pests, including those belonging to order Coleoptera of horticultural importance in Kashmir region, has been provided by Rishi (1968).

II. The Diversity of Coleopteran-fauna damaging fruit plantations:

(a) Drupaceous fruit plantations (apricot, almond, ber, cherries, peaches, plum and walnut): In J & K State, a total of 26 species of Coleopterans, belonging to various families are known to be associated with drupaceous trees /fruits. These accounts for 55.31 % of total Coleopterans of horticultural importance studied. Excepting Ber (Indian date) and walnut, all the fruit crops of drupaceous type come under the family Rosaceae, under genus *Prunus*. 'Ber' or Indian date and walnut are belonging to the family Rhamnaceae and Juglandaceae respectively.

The drupaceous nut fruit trees- almond and walnut, have shown association with 1 species (02.12%) (Scolytid) and 12 sp. (25.53%) of different families of Coleopterans respectively. The Coleopterans of various families on walnut plantations include Curcullionids (5 spp.), Scolytids (3 spp.) and 2 spp. each of Cerambycid and Scarabaeid. After walnut, the highest number of Coleopteran species, has been found in case of fruits: peach, with 7 spp. (2 spp. of Cerambycid, 1 sp. of Chrysomelid and 4 spp. of Scarabaeids); apricot, with 6 spp. (2 spp. each of Curculionid and Scarabaeid and 1 sp. each of Buprestid and Chrysomelid. Plum tree showed association with 3 spp. of Curculionidae, belonging to genus *Myllocerus* and *Phyllobius* (*see* Checklist and Table 1).

Table 1. Percentage of Coleopteran-fauna, belonging to various families affecting fruit trees / crops of different families in Jammu and Kashmir State.

Fruit Tree/Crop (Family)	Number of the Coleopteran species under various families, associated with fruit trees / crops												Percentage of species
	AN	BU	CE	CO	CH	CU	ME	NI	SC	SO	TE	Total	
Almond (RO)	-	-	-	-	-	-	-	-	-	01	-	01	02.12%
Apricot (RO)	-	01	-	-	01	02	-	-	02	-	-	06	12.76%
Apple (RO)	01	02	04	-	04	04	-	01	04	01	-	21	44.68%
Banana (MU)	-	-	-	-	-	01		-	-	-	-	01	02.12%
Ground cherry (SL)	-	-	-	01		-	-	-		-	-	01	02.12%
Indian dates (RH)	-	-	-	-	-	02	-	-	-	-	-	02	04.25%
Peach (RO)	-	-	02	-	01	-	-	-	04	-	-	07	15.21%
Pear (RO)	-	02	-	-	-	03	-	-	03	-	-	08	17.39%
Plum (RO)	-	-	-	-	-	03	-	-	-	-	-	03	06.52%
Pomegranate (PU)	-	02	-	-	-	-	-	-	-	-	01	03	06.52%
Quince (RO)	-	-	01	-	-	-	-	-	-	01	-	02	04.25%
Strawberry (RO)	-	-	-	-	-	-	-	-	01	-	-	01	02.12%
Sweet cherry (RO)	-	-	01	-	-	-	01	-	02	01	-	05	10.63%
Vine grape (VI)	-	-	-	-	01	-	-	-	03	-	-	04	08.51%
Walnut (JU)	-	-	02	-	-	05	-	-	02	03	-	12	25.53%
Wild cherry (RO)	-	-	01	-	-	-	-	-	-	-	-	01	02.12%
Fruit trees/ crops	-	-	-	-	-	-	-	-	07	-	-	07	14.89%

\- = Coleopteran species absent.
Families of Coleopterans and their host plants/ crop species:
AN= Anobiidae; BU= Buprestidae; CE= Cerambycidae; CH= Chrysomelidae; CO= Coccinellidae; CU=Curculionidae; JU=Juglandaceae; ME= Meloidae; MU= Musaceae; NI= Nitulidae; PU= Punicaceae; RH=Rhamnaceae; RO= Rosaceae; SC=Scarabaeidae; SL= Solanaceae; SO= Scolytidae; TE= Tenebrionidae; VI=Vitaceae.

Sweet cherry and wild cherry, are found to be associated with 5 spp. (10.63%) and 1 sp. of Coleopterans respectively, belonging to families, *viz*. Cerambycidae, Meloidae, Scolytidae and Scarabaeidae. The Indian date 'Ber', *Zizyphus mauritia* and *Zizyphus* sp., is observed to be associated with Curculuionids, *viz*. *Myllocerus bicolor* and *Xanthochaelus faunus* (*see* Table 1).

b) Pome fruit plantations (apple, pear and quince): These fruit crops of great economic importance are found to be associated with 21 spp. of Coleopterans, under different families. It accounts for 44.68% of total species on fruit crops studied. Of these, apple trees infested highest number of species *i.e*., 21 (44.68%), under 17 genera, covering 8 families. On apple fruit trees, the highest number of species pertains to family Cerambycidae, Chrysomelidae, Curculionidae and Scarabaeidae, having 4 spp. each. These are followed by Buprestids (2 spp.) and, Anobiid, Nitulid and Scolytid, with single species each. The pear crop is damaged by 8 spp. of Coleopterans, belonging to families: Buprestidae (2 spp.); Curculionidae and Scarabaeidfae, having 3 spp. each. The Quince fruit tree showed association with single species each of Cerambycid (*A. sarta*) and Scolytid (*S. nitidus*) (*see* Checklist and Table 1).

c) The other fruit plantations (Berries and aggregate): In this region, the berry crops (Banana, cape gooseberry or ground cherry, pomegranate and vine grape), are affected, by 9 spp. of Coleopterans. This accounts for 9.14 % of total Coleopteran species of fruit plantations of this region.4 species of Coleopterans (1Chrysomelid, 3 Scarabaeids); 3 species (2 Buprestids, 1 Tenebrionid), 1sp. (Coccinellid), 1 sp. (Curculionid),

are associated with vine grape, pomegranate, cape gooseberry (ground cherry) and banana respectively. The percentage of Coleopteran species affecting different berry plantations are given in Table 1. Aggregate fruit crop (strawberry), is found to be associated with a single species of Scarabaeid, *viz*., *Macrodactylus subspinosus*. This accounts for 2.12% of the total Coleopteran species of fruit trees/ crops of J & K State (*see* Checklist and Table 1)

Conflict of interest statement

Author declares that there is no conflict of interest.

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