



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 328-338

© 2018 JEZS

Received: 16-01-2018

Accepted: 19-02-2018

Deen Mohd Bhat

Department of Zoology, Govt.
Degree College Ganderbal,
Jammu and Kashmir, India

Fayaz Ahmad Ahangar

Department of Zoology, Govt.
College for Women, M. A. Road,
Srinagar, Jammu and Kashmir,
India

A Systematic checklist and species richness of insect pests associated with vegetable crops in Jammu & Kashmir State (India)

Deen Mohd Bhat and Fayaz Ahmad Ahangar

Abstract

The present study aimed at providing an up-to-date and systematic checklist of Insect pests of vegetable crops of the State of J&K (India). The study was based on the survey and documentation of the literature published, from time to time, pertaining to Insect Pests of vegetable crops in this region. The checklist presented in this paper recorded 102 insect pest species associated with 39 species of cultivated and wild type of host vegetable crops in the state of J&K (India). These insect pest species belonged to 34 insect families under 9 insect orders and 76 Insect genera. The order and family wise species richness of these pests were encapsulated. It was observed that out of the total insect pests recorded on the checklist, 24 species each belonged to orders Coleoptera & Lepidoptera, 15 species belonged to order Hemiptera, 13 species belonged to order Homoptera, 11 species each belonged to orders Diptera & Thysanoptera, 2 species belonged to order Orthoptera, and 1 species each belonged to orders Dermoptera & Hymenoptera. It was also evident from this study that the highest number of insect pest species belonged to family Aphididae (Homoptera) representing 12 species, followed by families, Thripidae (Thysanoptera) with 11 species, Scarabidae (Coleoptera) with 9 species and Noctuidae (Lepidoptera) with 8 species.

Keywords: Checklist, insect pest, vegetable, Noctuidae, Lepidoptera, J&K

1. Introduction

Vegetables make up a major portion of the diet of humans in many parts of the world and play a significant role in human nutrition, especially as sources of phytonutrients: vitamins (C, A, B1, B6, B9, E), minerals, dietary fiber and phytochemicals [56]. The agro-climatic diversity of the J&K state vary from sub-tropical in Jammu, temperate in Kashmir and cold arid in Ladakh, which makes it ideal for varied cultivation including that of vegetables [<http://www.jkapd.nic.in>]. Moreover, large varieties of wild vegetables grow in this region, which are being consumed especially by tribal people [87]. The cultivation of vegetables is also an important source of income generation for the farming communities of the State of J&K, as the commercial cultivation of vegetables not only fetch higher income, but also provides employment opportunities to the farming labour [92]. Insect pests are the major biotic constraints to vegetables production in India given that they not only inflict direct damage to host crops, but also many of them act as vectors for several viral diseases. The crop losses to the tune of 30-40 per cent have been reported in vegetable crops due to insect pest in the country [86]. In J&K at least 50-80% losses in the marketable yield have been reported under severe infestation [92].

Some of the insect associated with vegetable crops have become major pests for the host crop, and are some are gradually attaining the major pest status in different regions of the country, due to changes in the ecosystems and habitats [86]. *Helicoverpa armigera* on tomato, whitefly *Bemisia tabaci* and serpentine leaf miner *Liriomyza trifolii* on tomato and cucurbitaceous crops, fruit fly on cucurbits, gall midge on brinjal, okra stem fly and bitter gourd leafhoppers are some of the examples of such pests prevalent in the country [86]. Likewise, Diamondback moth (DBM), *Plutella xylostella* is an important pest of cruciferous crops, particularly cabbage and cauliflower [54]. The cabbage butterflies, *Pieris brassicae*, *P. canidia* and *P. rapae* have been found to be major pests of cabbage and cauliflower in India [46, 49, 57, 69]. In the State of J&K, the first major attempt to study insect pests on vegetables crops was made by Simmonds & Rao [98] who observed *P. xylostella* on cabbage. Rishi [89] studied four important pests on vegetable crops viz., cabbage saw fly, *Athalia colibri*, greasy cut worm, *Agrotis*

Correspondence

Deen Mohd Bhat

Department of Zoology, Govt.
Degree College Ganderbal,
Jammu and Kashmir, India

ypsilon (= *ipsilon*), cabbage butterfly, *Pieris rapae* and cabbage semilooper, *Plusia signata*. Later on, Zaka-ur-Rab [107 & 108] studied the agromyzid, leaf miner flies on some vegetable crops. A detailed general survey of insect pests damaging vegetable crops in Kashmir region was carried out by Bhat *et al.* [38], while as in Ladakh region similar kind of work was done by Pandey *et al.* [81]. A number of other key research papers published, have been published, from time to time, reporting different insect pests on various vegetable crops, pertaining to J&K State [3, 13, 15, 40, 42, 45, 58, 66, 73, 79, 82, 95, 100, 110]

Since these research papers, and other literature carrying relevant information of insect pests of vegetable crops of this region, remained scattered in different journals, therefore, there was a dire need to document all such previous works and to present a consolidated checklist of insect pests of vegetable crops from the state of J&K. The database provided in this paper will serve as ready references and can be helpful in future studies of insect pests and for devising their pest management strategies, especially in this region.

2. Materials and methods

The present study brings together scattered information about Insect pests associated with various kinds of vegetable crops in the state of J&K. Based on the literature Survey, all the previously published available research papers, pertaining to insect pests of vegetable crops of J&K state, were examined and the information obtained about insect pests was documented. The data base was generated with special reference to Insect pest, their host-vegetable plants and the authors reporting them. Pertinently, the data obtained was presented in the tabulated form in the form of Insect pest-host vegetable plant catalogue-cum-checklist. In order to generate above said database, apart from examining the said research papers, other vital e-resources and abstracting services, particularly, CABI, NISCAIR, AGRICOLA, Biological abstracts, Inflib net, etc., were also consulted. In the catalogue-cum-checklist of Insect pests of vegetables of J&K, prepared during this study, the list of insect pests was arranged Order and family wise, systematically and alphabetically. Moreover, order and family wise species richness of the enlisted pests was presented in tabulated form and highlighted graphically.

3. Results

3.1 Catalogue-cum-checklist of Insect pests of vegetable crops of the state of J&K (India)

The present study upon literature survey recorded 102 insect pest species associated with approximately 39 species of cultivated and wild type of vegetable crops, pertaining to the state of J&K (India). These pest species belonged to 76 genera under 9 insect orders and 34 families. With reference to these pests, an up-to-date insect pest-host vegetable crop Catalogue-Cum-Checklist of J&K, was compiled and presented here in Table 1.

3.2. Insect pests of Vegetable crops reported in J&K

The order and family wise brief summary of the insect pests recorded in the catalogue-cum-checklist (Table 1) was provided as under:-

Order I: Coleoptera

Family 1: Bruchidae: *Callosobruchus chinensis* (Linnaeus) (P1)

Family 2: Chrysomelidae (Flea beetles): *Altica himensis* Shukla (P2); *Chaetocnema* sp. (P3); *Galerucella placida* Baly (P4); *Monolepta signata* Olivier (P5); *Phyllotreta cruciferae* (Goeze) (P6); *Phyllotreta* sp. (P7)

Family 3: Coccinellidae (lady-bird beetles): *Epilachna vigintioctopunctata* (Fabricius) (P8); *Henosepilachna vigintioctopunctata* (Fabricius) (P9)

Family 4: Curculionidae (true weevils): *Alcides affaber* L. (P10); *Alcidodes collaris* (Pascoe) (P11); *Alcidodes signatus* Boheman (P12); *Cylas formicarius* (Fabricius) (P13),

Family 5: Elateridae (Wireworm): *Melanotus horticornis* Blyth (P14)

Family 6: Meloidae (blister beetles): *Cyaneolytta coerulea* (Pfafl) (15)

Family 7: Scarabaeidae (White grubs): *Adoretus* sp.(P16); *Anomala rufiventris* (P17); *Anomala* sp. (P18); *Brahmina coriacea* Hope (P19); *Brahmina poonensis* Frey (P20); *Holotrichia consanguinea* (Blanchard)(P21); *Holotrichia longipennis* (Blanchard)(P22); *Holotrichia* spp. (P23); *Pachymadoretus reguipennis* (P24)

Order II: Dermoptera

Family 1 Anisolabididae: *Euborellia annulipes* (Lucas) (P25)

Order III: Diptera

Family1: Agromyzidae (Lead miner flies): *Chromatomyia* (= *Phytomyza*) *horticola* Goreau leaf miner (P26), *Liriomyza congesta* (P27); *Liriomyza trifolii* (Burgess) (P28);

Family2: Anthomyiidae: *Delia platura* (P29), *Hylemya antiqua* (= *Delia antique*) (P30); *Pegomya solennis* (Meigen) (P31)

Family 3: Cecidomyiidae: *Cystiphora taraxaci* kieffer (P32)

Family 4: Tephritidae: *Bactrocera* (*Zeugodacus*) *cucurbitae* (Coquillett)(P33), *Bactrocera* (*Bactrocera*) *dorsalis* Hendel (P34); *Bactrocera* (*Zeugodacus*) *scutellaris* (P35); *Bactrocera* (*Zeugodacus*) *tau* (Walker) (P36)

Order IV: Hemiptera

Family 1: Alydidae: *Riptortus linearis* Fabricius (P37)

Family 2: Aphrophoridae: *Poophilus costalis* (P38)

Family 3: Cicadellidae (Cic.): *Macrostelus quadripunctulatus* Kirschbaum (P39); *Macrostelus sexnotatus* (Fallén) (P40)

Family 4: Coreidae: *Cletus bipunctatus* (P41), *Cletus* spp. (P42)

Family 5: Dinidoridae: *Coridius* sp. (P43)

Family 6: Malcidae: *Chauliops* sp. (P44)

Family 7: Miridae: *Nisiodiocoris* sp. (P45)

Family 8: Pentatomidae (Stink bugs): *Bagrada criciferarum* painted bug (P46); *Dolycoris indicus* (P47); *Eurydema festivum* (P48); *Eurydema pulchrum* (Westwood) (Cabbage Shield bug) (P49); *Nezara viridula* Linnaeus (P50)

Family 9: Tingidae: *Urentius sentis* Distant (P51)

Order V: Homoptera

Family 1: Aleurodidae: *Bemisia tabaci* (P52) (white fly)

Family 2: Aphididae (Aphids): *Acyrtosiphon* (*Ac.*) *pisum*- (Harris) (P53); *Aphis* (*A.*) *craccivora* Koch (P54); *A. fabae* (55); *Aphis* (*A.*) *gossypii* Glover (cotton aphid) (56); *Brevicoryne brassicae* (L) (cabbage aphid)(P57); *Cavariella Aegopodii* (P58); *Dysaphis rumecicola* (Hori) (P59); *Lipaphis* (*Lip.*) *erysimi* (Kaltenbach) (mustard aphid) (P60); *Lipaphis pseudobrassicae* (Davis) (P61); *Macrosiphum euphorbiae* Thomas (P62); *Myzus* (*Nectarosiphon*) *persicae* (Sulzer)

(P63); *Semiaphis heraclei* (Takahashi) (P64)

Order VI: Hymenoptera

Family 1: Tenthredinidae : *Athalia colibri* F. (P65) (cabbage saw fly)

Order VII: Lepidoptera

Family 1: Hesperidae: *Parnara guttatus* Bremer & Gray (Common Straight Swift) (P66); *Pelopidas methias* (Fabricius) (Variable Swift) (P67)

Family 2: Lycaenidae: *Lycaena phlaeas* Linnaeus (Common Copper) (P68)

Family 3: Lymantridae: *Euproctis* sp. tussock moth (P69); *Orgyia* spp. (P70)

Family 4: Noctuidae (Noc.): *Agrotis ipsilon* (Hufnagel)(P71); *Argyrogramma signata* Fabricius

(=*Plusia signata*) (P72); *Thysanoplusia orichalcea* (= *Plusia orichalcea*) (Fabricius) slender burnished brass (P73); *Helicoverpa armigera* (Hubner) (= *Heliothis zea*) cotton bollworm, corn earworm (P74); *Spodoptera litura* (Fabricius) tobacco cutworm or cotton leaf worm (P75); *Spodoptera exigua* (P76); *Mamestra brassicae* (Linn.) Cabbage Moth (P77); *Trichoplusia ni* (P78) (Looper)

Family 5: Pieridae (Cabbage butterflies): *Pieris brassicae* (Linnaeus) (Large cabbage butterfly) (P79); *Pieris brassicae kashmirensis* Rishi (Large cabbage butterfly) (P80); *Pieris canidia* (Linnaeus) (Indian Cabbage White) (P81); *Pieris rapae* (Linnaeus) (Small white butterfly/ cabbage leaf web worm) (P82); *Pontia daplidice* (Linnaeus) (Bath White) (P83); *Pontia glouconome* (Klug) desert (Bath) white (P84)

Family 6: Plutellidae: *Plutella xylostella* (Linnaeus) diamondback moth (P85)

Family 7: Pyralidae: *Etiella zinckenella* (Treitschke) (P86); *Euzophera perticella* Zeller (P87); *Evergestis forficalis* (Linnaeus) (Garden Pebble Moth) (P88); *Hellula undalis* (P89); *Leucinodes orbonalis* Guenée (brinjal fruit and shoot borer) (P90);

Order VIII: Orthoptera

Family 1: Acrididae: *Chistocera gregaria* (P91)

Family 2: Tetigonidae: *Microcentum retinerve* (P92)

Order IX: Thysanoptera

Family 1: Thripidae (Thrips): *Aeolothrips meridionalis* (P93); *Frankliniella intosa* (Trybom)(P94); *Megalothrips peculiaris* (Bagnall) (P95); *Tenothrips alis* Bhatti (P96); *Thrips alatus* Bhatti (P97); *T. bukkieni* Priesner (P98); *T. flavus* Schrank (P99); *T. florum* Schmutz (P100); *T. garuda* Bhatti (P101); *T. palmi* Karny (P102); *T. tabaci* Lindmann (P103)

3.3. Categories of insect pests

The literature survey during this study revealed that the Insect pests associated with vegetable crops in J&K inflicted different kinds of damages to the host crop, and accordingly were categorized as under (for references see Table 1):-

Foliage feeder: P1 to P13, P65 to P92

Foliage sucker: P52 to P64, P93 to P103

Collar feeder/ Cutworm: P71

Tuber feeder/ root pests: P 14, P16 to P 25

Leaf miners: (P26 to P33)

Fruit flies: P34 to P 36

Both Sap suckers & Foliage eaters: P 37-P51

3.4. Species richness of Insect Pests of vegetable crops of J&K

Based on the literature survey, it was observed that out of the total (102) insect pests recorded in this paper (Table 2), 24 species each belonged to orders Coleoptera & Lepidoptera, 15 species belonged to order Hemiptera, 13 species belonged to order Homoptera, 11 species each belonged to orders Diptera & Thysanoptera, 2 species belonged to order Orthoptera, and 1 species each belonged to orders Dermaptera & Hymenoptera. It was also evident from this study that highest number of insect pest species belonged to family Aphididae (Homoptera) representing 12 species, followed by families, Thripidae (Thysanoptera) with 11 species, Scarabidae (Coleoptera) with 9 species and Noctuidae (Lepidoptera) with 8 species. The orders Coleoptera and Lepidoptera represented the highest number (24) of pest species, while as Dermaptera and Hymenoptera represented the least number (1) of species.

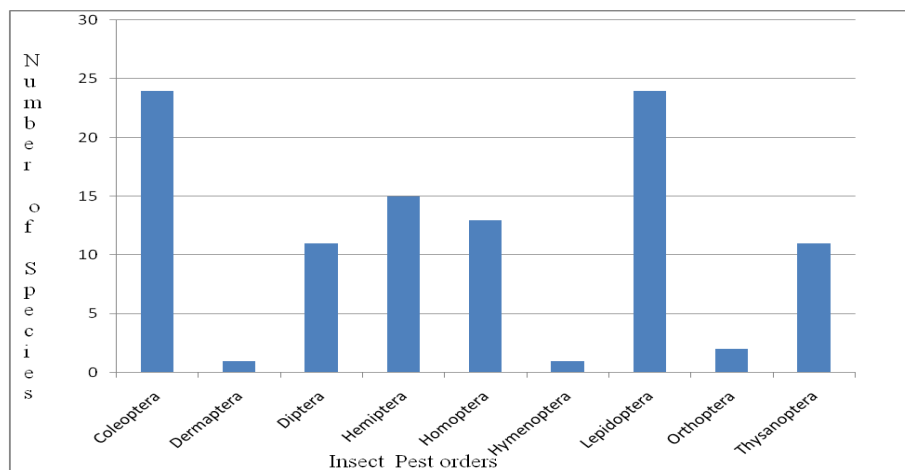


Fig 1: Order wise species richness of reported insect pest of vegetable crops in the state of J&K (India).

3.5. Types of host Vegetables plants (V) of Insect pests of J&K

Upon literature survey, it was found that as many as 39 species of vegetable host plants (V), belonging to 12 plant families and 23 genera, were reported by various authors to be infested by Insect pests in the State of J&K (Table 1). The family wise botanical name of these vegetable plant species

(V) were encapsulated below, with respective common name and vegetable Serial number given in small brackets:-

Family 1, Alliaceae: *Allium cepa* L. (onion) (V1); *Allium sativum* L. (garlic) (V2); Family 2, Apiaceae: *Daucus carota* L. (carrot) (V3); *Raphanus sativus* L. (radish) (V4); Family 3, Asteraceae: *Lactuca sativa* L. (lettuce) (V5); *Taraxacum officinale* (L.) (Dandelion) (V6); Family 4, Brassicaceae:

Brassica campestris L. (mustard) (V7); *Brassica juncea* L. (brown Mustard) (V8); *Brassica napus* L. (rape) (V9); *Brassica* spp./ cole crops (V10); *Brassica oleracea* L. and its varieties, viz. *B. o.* var. *acephala* (Kale) (V11); *B. o.* var. *botrytis* (Cauliflower) (V12); *B. o.* var. *capitata* (Cabbage) (V13); *B. o.* var. *gongylodes* (knol-khol) (V14); *B. o.* var. *kashmiriana* (V15); *Brassica rapa* L. (turnip)(V16); Family 5, Chenopodiaceae: *Atriplex hortensis* L. (mountain spinach) (V27); *Spinacea oleracea* L. (spinach)(V28); Family 6, Convolvulaceae: *Ipomoea batatas* (Linn)Lam. (Sweet potato) (V29); Family 7, Cucurbitaceae: Cucurbits (V30a), *Cucurbita maxima* Duchesne (Red gourd/ Red pumpkin) (V30); *Cucurbita moschata* Duchesne. (Squash) (V31); *Cucurbita pepo* (V32); *Cucumis sativus* L. (cucumber) (V33), *Cucumis* sp. (V33a); gourds (V34a); *Lagenaria siceraria* (Mol.) Standl (bottle gourd) (V34); *Luffa acutangula* (Linn.) (luffa gourd) (V35); *Luffa cylindrica* M. Roem. (Spong gourd) (V36);

Momordica charantia Linn. (Bitter gourd) (V37), pumpkin (V37a); Family 8, Fabaceae: *Pisum sativum* (garden pea) (V38); *Phaseolus vulgaris* (French beans) (V39), *Trigonella foenum-graecum* L. (Fenugreek) (V40); Family 9, Lamiaceae: *Mentha arvensis* Linn. (Field mint) (V41); Family 10, Malvaceae: *Abelmoschus esculentus* (L.) Moench. (Okra) (V42); *Malva sylvestris* L. (mallow) (V43); Family 11, Polygonaceae: *Rumex acetosa* Linn. (Common Garden Sorrel) (V44); *R. hastatus* D. (V45); *Rumex nepalensis* Spreng (Rumex) (V46); Family 12, Solanaceae: *Capsicum annum* L. (capsicum/ bell pepper) (V47); *Capsicum frutescens* (V49); *Capsicum* sp. (V50); *Lycopersicon esculentum* Mill (=Solanum esculentum, Solanum lycopersicum) (Tomato) (V51); *Solanum melongena* Linn. (brinjal/ egg plant) (V52); *Solanum tuberosum* Linn. (potato) (V53)

Table 1: Insect Pest-Host Vegetable Plant Catalogue-Cum-Checklist of Insect Pests of J&K State

Ord.	Fam.	Name of insect pest (P=Pest S. No.)	Host plant/plants (V=Vegetable S. No. in the text)	Reference No. (Authors reporting)
Col.	Bru.	<i>Callosobruchus chinensis</i> (Lin.)(P1)	<i>Phaseolus vulgaris</i> (V39)	1, 20
	Chr.	<i>Altica himensis</i> Shukla (P2)	<i>Rumex acetosa</i> (V44)	29, 30
		<i>Chaetocnema</i> sp. (P3)	<i>Solanum tuberosum</i> (V53)	20, 79
		<i>Galerucella placida</i> Baly (P4)	<i>Raphanus sativus</i> (V4)	20, 76,103
		<i>Monolepta signata</i> Olivier (P5)	<i>Brassica</i> spp./ Cole crops (V10)	92
		<i>Phyllotreta cruciferae</i> (Goeze) (P6)	<i>Brassica oleracea</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>R. sativus</i> (V4)	20, 38, 92
		<i>Phyllotreta</i> sp. (P7)	<i>Brassica</i> spp. (V10)	81
	Coc.	<i>Epilachna vigintioctopunctata</i> (Fabricius) (P8)	<i>Luffa acutangula</i> (V35), <i>Lycopersicon esculentum</i> (V51), <i>Momordica charantia</i> (V37), <i>Solanum melongena</i> (V52), <i>Solanum tuberosum</i> (V53)	20, 61
		<i>Henosepilachna vigintioctopunctata</i> (Fabricius) (P9)	<i>L. esculentum</i> (V51)	20,80
	Cur.	<i>Alcides affaber</i> L. (P10)	<i>Abelmoschus esculentus</i> (V42)	20,96
		<i>Alcidodes collaris</i> (Pasoe) (P11)	<i>A. esculentus</i> (V42), <i>Capsicum</i> sp. (V50)	6, 20,104
		<i>Alcidodes signatus</i> Boheman (P12)	<i>Phaseolus vulgaris</i> (V39)	1, 20
		<i>Cylas formicarius</i> (Fabricius) (P13)	<i>A. esculentus</i> (V42), <i>Capsicum</i> sp. (V50), <i>Ipomoea batatas</i> (V29)	20,104
	Ela.	<i>Melanotus horticornis</i> Blyth (P14)	<i>S. tuberosum</i> (V53)	20, 79
	Mel.	<i>Cyaneolytta coerulea</i> (Pfaff) (15)	<i>P. vulgaris</i> (V39)	1,20
	Sca.	<i>Adoretus</i> sp. (P16)	<i>A. esculentus</i> (V42), <i>B. o.</i> var. <i>capitata</i> (V13), <i>Capsicum</i> sp. (V50), <i>L. esculentum</i> (V51), <i>S. melongena</i> (V52)	20, 45, 80, 81
		<i>Anomala rufiventris</i> (P17)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>botrytis</i> (V12), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>gongylodes</i> (V14)	42
		<i>Anomala</i> sp. (P18)	<i>L. esculentum</i> (V51)	20, 45
		<i>Brahmina coriacea</i> Hope (P19)	<i>S. tuberosum</i> (V53)	20, 77, 78, 79, 111 64
		<i>Brahmina poonensis</i> Frey (P20)	<i>S. tuberosum</i> (V53)	20, 79
		<i>Holotrichia consanguinea</i> (Blanchard) (P21)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>Capsicum</i> sp. (V50), <i>S. melongena</i> (V52)	20, 80
		<i>Holotrichia longipennis</i> (Blanchard) (P22)	<i>S. tuberosum</i> (V53)	20, 64, 78
		<i>Holotrichia</i> spp. (P23)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>botrytis</i> (V12), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>Capsicum</i> sp. (V50)	20, 42, 81
		<i>Pachymadoretus reguipennis</i> (P24)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>botrytis</i> (V12), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>gongylodes</i> (V14)	42
Der.	Ani.	<i>Euborellia annulipes</i> (Lucas) (P25)	<i>S. tuberosum</i> (V53)	79
Dip.	Agr.	<i>Chromatomyia</i> (=Phytomyza) <i>horticola</i> Goureau (P26)	<i>Allium cepa</i> (V1), <i>Brassica campestris</i> (V7), rape (V9), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>gongylodes</i> (V14), turnip (V16), <i>Malva sylvestris</i> (V43), <i>P. sativum</i> (V38), <i>S. tuberosum</i> (V53)	12,13, 34, 38, 41, 43, 44, 52, 107
		<i>Liriomyza congesta</i> (P27);	<i>Pisum sativum</i> (V38), <i>Trigonella foenum-graecum</i> (V40)	52, 107
		<i>Liriomyza trifolii</i> (Burgess) (P28)	<i>Cucurbita maxima</i> (V30), <i>Lagenaria siceraria</i> (V34), <i>Luffa acutangula</i> (V35), <i>Cucumis sativus</i> (V33), <i>L. esculentum</i> (V51)	31, 37, 38, 92
	Ant.	<i>Delia platura</i> (P29)	Cole crops (V10)	92
		<i>Hylemya antiqua</i> (=Delia antiqua) (P30)	Cole crops (V10)	81
		<i>Pegomya solennis</i> (Meigen) (P31)	<i>Rumex acetosa</i> (V44)	29

	Cec.	<i>Cystiphora taraxaci</i> kieffer (P32)	<i>Taraxacum officinale</i> (V6)	108
	Tep.	<i>Bactrocera cucurbitae</i> (Coquillett)	<i>L. siceraria</i> (V34), <i>C. sativus</i> (V33)	18,38, 58, 59, 66
		<i>B. dorsalis</i> Hendel (P34)	Cucurbits (V30a)	18, 58
		<i>B. scutellaris</i> (P35)	Cucurbits (V30a)	18, 58, 59
		<i>B. tau</i> (Walker) (P36)	Cucurbits (V30a)	18, 58, 59, 66, 92
Hem	Aly.	<i>Riptortus linearis</i> Fabricius (P37)	<i>Ipomoea batatas</i> (V29)	95
	Aphr	<i>Poophilus costalis</i> (P38)	<i>Rumex acetosa</i> (V44)	29
	Cic.	<i>Macrosteles quadripunctulatus</i> Kirschbaum (P39)	<i>Brassica rapa</i> (V16)	28
		<i>Macrosteles sexnotatus</i> (Fallen) (P40)	<i>Brassica rapa</i> (V16)	28
	Cor.	<i>Cletus bipunctatus</i> (P41)	Cucurbits (V30a)	95
		<i>Cletus</i> spp. (P42)	Cole crops (V10)	92
	Din.	<i>Coridius</i> sp. (P43)	<i>Luffa acutangula</i> (V35), <i>Cucumis</i> sp. (V33a), pumpkin (V37a), gourds (V34a), <i>S. melongena</i> (V52), <i>L. siceraria</i> (V34)	95
	Mal.	<i>Chauliops</i> sp. (P44)	<i>Phaseolus vulgaris</i> (V39)	27
	Mir.	<i>Nisiodiocris</i> sp. (P45)	<i>L. siceraria</i> (V34), <i>C. sativus</i> (V33)	38
	Pen.	<i>Bagrada criciferarum</i> (P46)	Cole crops (V10)	92
		<i>Dolycoris indicus</i> (P47)	<i>Brassica campestris</i> (V7), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13)	7, 8, 9, 19
		<i>Eurydema festivum</i> (P48);	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13)	9, 19
		<i>Eurydema pulchrum</i> (Westwood)	<i>Brassica rapa</i> (V16), <i>Brassica napus</i> (V9), <i>L. esculentum</i> (V51), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>R. sativus</i> (V4)	8, 9, 19, 38
		<i>Nezara viridula</i> Linnaeus(P50)	<i>B. o.</i> var. <i>capitata</i> (V13)	95
Tin.	<i>Urentius sentis</i> Distant (P51)	<i>S. melongena</i> (V52)	100	
Hom	Ale.	<i>Bemisia tabaci</i> (P52)	<i>C. maxima</i> (V30), <i>L. esculentum</i> (V51), <i>S. melongena</i> (V52)	33, 38, 63, 93
		<i>Acyrtosiphon pisum</i> (Harris) (P53)	<i>Pisum sativum</i> (V38)	
		<i>Aphis craccivora</i> Koch (P54)	<i>C. sativus</i> (V33), <i>L. esculentum</i> (V51), <i>P. vulgaris</i> (V39), <i>Rumex acetosa</i> (V44), <i>S. melongena</i> (V52)	
		<i>A. fabae</i> (55)	<i>R. acetosa</i> (V44), <i>Rumex nepalensis</i> (V46)	
		<i>Aphis gossypii</i> Glover (56)	<i>Capsicum annum</i> (V47), <i>C. maxima</i> (V30), <i>Cucurbita pepo</i> (V32), <i>Cucumis sativus</i> (V33), <i>L. siceraria</i> (V34), <i>S. melongena</i> (V52), <i>S. tuberosum</i> (V53)	
	Aph.	<i>Brevicoryne brassicae</i> (L) (P57)	Cole crops (V10), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongyloides</i> (V14), <i>B. o.</i> var. <i>kashmiriana</i>	2,14, 15, 17, 25, 44, 29, 31, 36, 38, 52, 64, 79, 81, 88, 92, 109, 113,
		<i>Cavariella Aegopodii</i> (P58)	<i>Daucus carota</i> (V3)	
		<i>Dysaphis rumecicola</i> (Hori) (P59)	<i>Rumex hastatus</i> (V45)	
<i>Lipaphis erysimi</i> (Kaltenbach) (P60)		<i>Brassica campestris</i> (V7), <i>Brassica napus</i> (V9),		
<i>L. pseudobrassicae</i> (Davis) (P61)		<i>Brassica juncea</i> (V8)		
<i>Macrosiphum euphorbiae</i> Thomas (P62)		<i>S. tuberosum</i> (V53)		
<i>Myzus persicae</i> (Sulzer) (P63)		<i>Capsicum annum</i> (V47), <i>Cucurbita maxima</i> (V30), <i>L. esculentum</i> (V51), <i>Solanum tuberosum</i> (V53)		
	<i>Semiaphis heraclei</i> (Takahashi) (P64)	<i>Daucus carota</i> (V3)		
Hym	Ten.	<i>Athalia colibri</i> F. (P65)	<i>P. sativum</i> (V38), <i>Brassica rapa</i> (V16), <i>B. o.</i> var. <i>capitata</i> (V13), <i>R. sativus</i> (V4)	38, 52, 88
Lep.	Hes.	<i>Parnara guttatus</i> Bremer & Gray (P66)	<i>Phaseolus vulgaris</i> (V39)	21, 62
		<i>Pelopidas methias</i> (Fabricius) (P67)	<i>Brassica</i> spp.(V10), <i>R. sativus</i> (V4)	5, 21, 85
	Lyc.	<i>Lycaena phlaeas</i> Linnaeus (P68)	<i>R. acetosa</i> (V44)	29
	Lym	<i>Euproctis</i> sp. (P69)	<i>Brassica rapa</i> (V16), <i>Solanum melongena</i> (V52)	38
		<i>Orgyla</i> spp.(P70)	Cole crop(V10)	92
	Noc.	<i>Agrotis ipsilon</i> (Hufnagel) (P71)	<i>Allium cepa</i> (V1), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongyloides</i> (V14), <i>Capsicum annum</i> (V47), <i>C. frutescens</i> (V49), <i>C. maxima</i> (V30), <i>Cucurbita pepo</i> (V32), <i>Brassica rapa</i> (V16), <i>S. tuberosum</i> (V53)	3,45,38, 52,64, 68, 79, 88,110, 112
		<i>Argyrogramma signata</i> Fabricius (=Plusia signata) (P72)(P72)	<i>B. compestris</i> , <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongyloides</i> (V14), <i>Brassica rapa</i> (V16), <i>P. sativum</i> (V38), <i>L. esculentum</i> (V51), <i>S. tuberosum</i> (V53), <i>Spinacea oleracea</i> (V28)	38, 52, 88
		<i>Thysanoplusia orichalcea</i> (=Plusia orichalcea) (Fabricius) (P73)	<i>Allium cepa</i> (V1), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongyloides</i> (V14), <i>Brassica rapa</i> (V16), <i>Daucus carota</i> (V3), <i>Mentha arvensis</i> (V41), <i>Pisum sativum</i> (V38), <i>Phaseolus vulgaris</i> (V39), <i>R. acetosa</i> (V44), <i>R. nepalensis</i> (V46), <i>S. oleracea</i> (V28), <i>S. tuberosum</i> (V53), <i>T. foenum-graecum</i> (V40)	29, 38,52, 79, 68

		<i>Helicoverpa armigera</i> (Hubner) (= <i>Heliothis zea</i>) (P74)	<i>Atriplex hortensis</i> (V27), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>C. pepo</i> (V32), <i>L. siceraria</i> (V34), <i>L. esculentum</i> (V51), <i>M. arvensis</i> (V41), <i>P. sativum</i> (V38), <i>S. tuberosum</i> (V53)	38, 52, 92, 68
		<i>Spodoptera litura</i> (Fabricius) (P75)	<i>Allium cepa</i> (V1), <i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14)	38, 39, 92
		<i>Spodoptera exigua</i> (P76)	Cole crops (V10)	92
		<i>Mamestra brassicae</i> (Linn.) (P77)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>gongylodes</i> (V14)	40
		1. <i>Trichoplusia ni</i> (P78)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>P. sativum</i> (V38),	41, 92
		<i>Pieris brassicae</i> (Linnaeus) (P79)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. napus</i> (V9), <i>Brassica rapa</i> (V16), <i>R. sativus</i> (V4)	21, 38, 51, 52, 75, 80, 81, 92
		<i>P. brassicae kashmirensis</i> Rishi (P80)	<i>Brassicacae</i> spp. (V10), <i>Brassica juncea</i> (V8)	21, 89
	Pie.	<i>P. canidia</i> (Linnaeus) (P81)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>R. sativus</i> (V4)	10, 21, 42, 48, 84
		<i>P. rapae</i> (Linnaeus) (P82)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>B. napus</i> (V9), <i>B. rapa</i> (V16)	21, 35, 38, 52, 80, 89, 92, 103, 105
		<i>Pontia daplidice</i> (Linnaeus) (P83)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>B. rapa</i> (V16), <i>B. napus</i> (V9), <i>R. sativus</i> (V4)	21, 38, 48, 52, 74, 85, 105, 106
		<i>Pontia glouconome</i> (Klug.) (P84)	<i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>botyrtis</i> (V12),	2, 42
	Plu.	<i>Plutella xylostella</i> (Linnaeus) (P85)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>botyrtis</i> (V12), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>B. rapa</i> (V16), <i>B. napus</i> (V9), <i>R. sativus</i> (V4)	43, 32, 38, 92, 98
		<i>Etiella zinckenella</i> (Treitschke) (P86)	Vegetable crops (V)	81
	Pyr.	<i>Euzophera perticella</i> Zeller (P87)	<i>S. melongena</i> (V52)	100
		<i>Evergestis forficalis</i> (Linnaeus) (P88)	<i>B. o.</i> var. <i>acephala</i> (V11), <i>B. o.</i> var. <i>capitata</i> (V13), <i>B. o.</i> var. <i>gongylodes</i> (V14), <i>B. rapa</i> (V16),	38
		<i>Hellula undalis</i> (P89)	Cole crops (V10)	92
		<i>Leucinodes orbonalis</i> Guenée (P90)	<i>S. melongena</i> (V52)	38
Ort.	Acr.	<i>Chistocera gregaria</i> (P91)	Cole crops (V10)	92
	Tet.	<i>Microcentum retinerve</i> (P92)	Cole crops (V10)	92
		<i>Aeolothrips meridionalis</i> (P93)	<i>Brassica</i> spp. (V10), <i>Daucus carota</i> (V3)	
		<i>Frankliniella intosa</i> (Trybom) (P94)	<i>Capsicum annum</i> (V47)	
		<i>Megalothrips peculiaris</i> (Bagnall) (P95)	<i>P. vulgaris</i> (V39)	
	Thr.	<i>Tenothrips alis</i> Bhatti (P96)	<i>C. maxima</i> (V30), <i>T. officinale</i> (V6)	
		<i>Thrips alatus</i> Bhatti (P97)	<i>S. melongena</i> (V52)	
		<i>T. bukkieni</i> Priesner (P98)	<i>T. officinale</i> (V6)	
		<i>T. flavus</i> Schrank (P99)	<i>Allium cepa</i> (V1), <i>M. arvensis</i> (V41)	
		<i>T. florum</i> Schmutz (P100)	<i>T. officinale</i> (V6)	
		<i>T. garuda</i> Bhatti (P101)	<i>S. melongena</i> (V52), <i>C. annum</i> (V47), <i>Capsicum</i> sp. (V50)	
		<i>T. palmi</i> Karny (P102)	<i>S. melongena</i> (V52)	
		<i>T. tabaci</i> Lindmann (P103)	<i>A. cepa</i> (V1), <i>A. sativum</i> (V2)	
Thy.				16, 22, 23, 24, 26, 47, 52, 70, 71, 72, 81, 99

Keys/ Abbreviations used in table 1: Ord. = Order, Fam. = Family, Col. = Coleoptera (Bru. = Bruchidae; Chr. = Chrysomelidae; Coc. = Coccinellidae; Cur. = Curculionidae; Ela. = Elateridae; Mel. = Meloidae; Sca. = Scarabaeidae; Der. = Dermaptera (Ani. = Anisolabididae), Dip. = Diptera (Agr. = Agromyzidae; Ant. = Anthomyiidae; Cec. = Cecidomyiidae; Tep. = Tephritidae), Hem. = Hemiptera (Aly. = Alydidae; Aphr. = Aphrophoridae; Cic. = Cicadellidae; Cor. = Coreidae; Din. = Dinidoridae; Mal. = Malcidae; Mir. = Miridae; Pen. = Pentatomidae; Tin. = Tingidae), Hom. = Homoptera (Ale. = Aleurodidae; Aph. = Aphididae), Hym. = Hymenoptera (Ten. = Tenthredinidae), Lep. = Lepidoptera (Hes. = Hesperidae; Lyc. = Lycaenidae; Lym. = Lymantridae; Noc. = Noctuidae; Pie. = Pieridae; Plu. = Plutellidae; Pyr. = Pyralidae), Ort. = Orthoptera (Acr. = Acrididae; Tet. = Tetigonidae), Thy. = Thysanoptera (Thr. = Thripidae)

Table 2: Order & family wise species richness of recorded Insect pests of vegetable crops in the state of J&K (India)

Order	No. of Families	Family name	No. of species	No. of Species/ order
Coleoptera	7	Bruchidae	1	24
		Chrysomelidae	6	
		Coccinellidae	2	
		Curculionidae	4	
		Elateridae	1	
		Meloidae	1	
		Scarabaeidae	9	
Dermaptera	1	Anisolabididae	1	1
Diptera	4	Agromyzidae	3	11
		Anthomyiidae	3	
		Cecidomyiidae	1	
		Tephritidae	4	
Hemiptera	9	Alydidae	1	15
		Aphrophoridae	1	

		Cicadellidae	2	
		Coreidae	2	
		Dinidoridae	1	
		Malcidae	1	
		Miridae	1	
		Pentatomidae	5	
		Tingidae	1	
Homoptera	2	Aleurodidae	1	13
		Aphididae	12	
Hymenoptera	1	Tenthredinidae	1	1
		Hesperiidae	2	
		Lycaenidae	1	
		Lymantridae	2	
		Noctuidae	8	
		Pieridae	5	
		Plutellidae	1	
		Pyralidae	5	
	7	Acrididae	1	24
		Tetigonidae	1	
Orthoptera	2	Thripidae	11	2
Thysanoptera	1			11
Total				
9 (Insect orders)	34 (Insect families)			102 (Insect pest species)

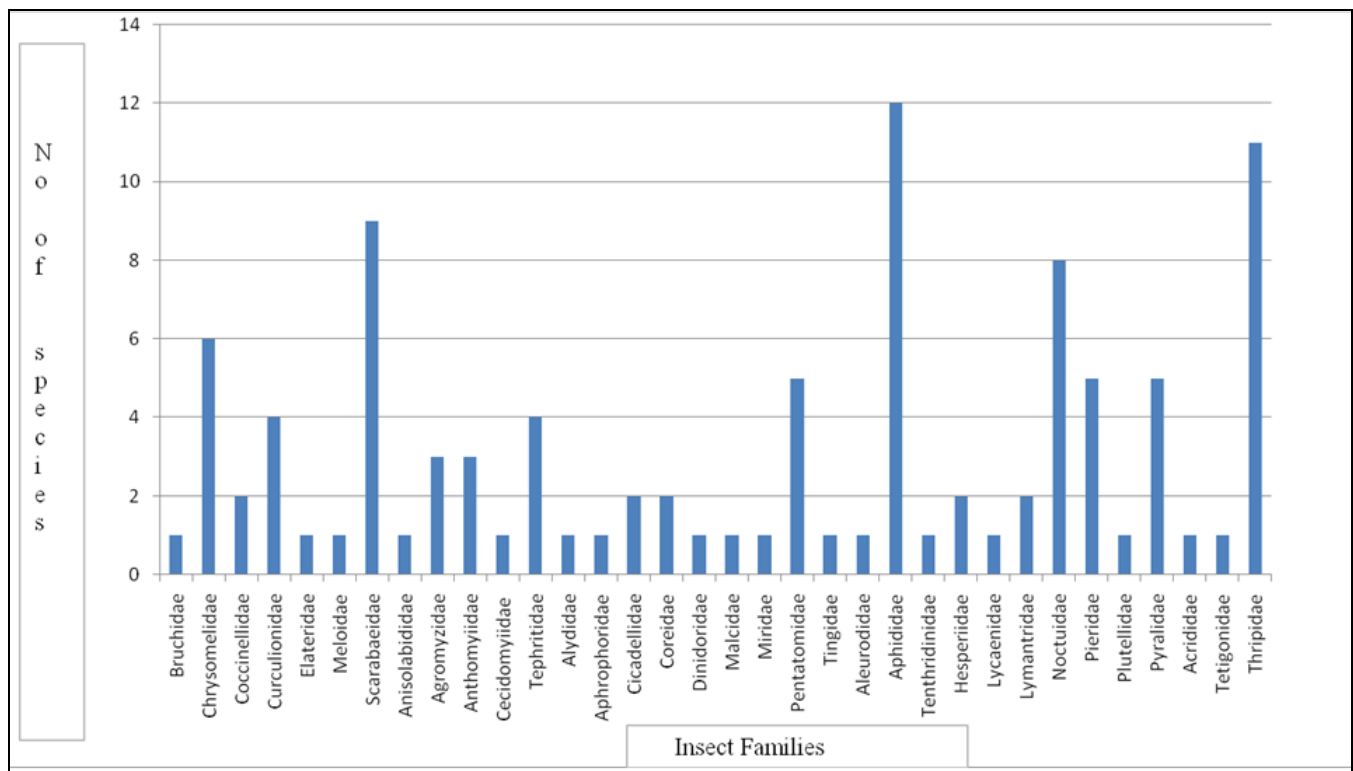


Fig 2: Family wise species richness of Insect pests of vegetable crops of J&K state India

4. Discussion

In the State of J&K, the vegetables are grown over an area of 63.1 thousand ha with annual production of 1385.5 thousand MT^[91]. However, insect pests are the major biotic constraints to vegetables production, given that, they not only inflict direct damage to host crops, but also many of them act as vectors for several viral diseases^[86]. As mentioned earlier, a number of attempts have been made previously in order to study Insect pests of J&K State^[3, 13, 15, 40, 38, 42, 45, 58, 66, 73, 79, 81, 82, 89, 95, 98, 100, 101, 107, 108, 110]. In spite of such previous valuable works on the subject, there was a need of a general and well compiled documentation of all such previous works in the shape of a consolidated checklist of Insect pests of vegetable crops, pertaining to J&K State, and the present endeavor will surely serve said purpose to some extent. Among the pests enlisted and documented in the present

study, some have been reported in the literature as major pests, in terms of inflicting damage to the host crops, these included, *Adoretus* spp., *Agrotis ipsilon*, *Aphis gossypii*, *Anomala rufiventris*, *Bactrocera cucurbitae*, *Brevocoryne brassicae*, *Chromatomyia horticola*, *Etiella zinckenella*, *Evergestis forficalis*, *Helicoverpa armigera*, *Holotrichia* sp, *Hylemya antiqua*, *Liriomyza trifolii*, *Mamestra brassicae*, *Phyllotreta* spp., *Pieris brassicae*, *Plutella xylostella*, *Spodoptera litura*, *Trichoplusia orichalcea* and *Thrips tabaci*^[88, 13, 38, 42, 68, 81, 101, 110]. Firake *et al.*^[57] have also observed 15 insect pests on Brassicaceae vegetables, reporting *Pieris brassicae* as major pest in North East (India). The cabbage butterflies, *Pieris brassicae*, *P. canidia* and *P. rapae* have also been reported as major pests of cabbage and cauliflower in other Indian states^[46, 49]. The diamondback moth (DBM), *Plutella xylostella* have also reported as an important pest of

cruciferous crops, particularly cabbage and cauliflower in mid hill region of Himachal Pradesh^[54]. Srinivasan *et al.*^[102] have reported leaf miner fly, *Liriomyza trifolii* (Burgess) as a major pest of Tomato, Squash, Leafy vegetables, Cucurbits and French bean. Likewise, *Helicoverpa armigera* (Hubner) has been recorded as a serious pests of Tomato, Cabbage Peas, Chilli, Brinjal, Okra^[83]. Similar observations supporting the present study have been made in other regions of the world^[50, 60]. These reports support the present study and indicate that these pests need immediate attention for Control measures.

5. Conclusion

The Previous works, pertaining to Insect pests of vegetable crop, published by various workers in the J&K State were based on field surveys and were confined to studies on one or some individual vegetable crops. However, the current study was first of its kind, wherein all such previous studies pertaining to insect pests of various kinds of vegetable crops, were compiled and consolidated so as to provide a ready reference of insect pests with reference to vegetable crops, especially in this state. The overall database provided in this study will be useful for future studies of Insect pests of not only vegetables, but also, of other crops too, given that some of the pests covered in this study, being polyphgous in nature. Since, the complete knowledge of Insect pests is crucial for formulating proper management techniques and the present study in this connection will be helpful in the long run for understanding insect pest problems and devising pest management strategies against them, especially in vegetable ecosystems of this region. The data generated from the study would also be helpful in further understanding of the biodiversity of arthropod fauna associated with vegetable crops in other regions of the country

6. Acknowledgement

The author is highly thankful to Head, Department of Zoology, University of Kashmir; Chief Librarian, Sheri Kashmir Agriculture University of Science and Technology, Kashmir (SKAUST-K) and Chief Central Librarian, IARI, Pusa, New Delhi, for providing access to library journals and e-resources.

7. References

1. Abrol DP, Ramamurthy VV, Srivastava, JB. Bean gall weevil and Blister beetle as new pest on red kidney bean (*Phaseolus vulgaris*) in India. Journal of Asia Pacific Entomology. 2006; 9(41):317-320.
2. Ahmad D, Bhat MR. Distribution and host range of some aphidophagous Syrphid flies in Kashmir. Geobios New Reports. 1986; 5:165-166
3. Anonyms. *Cutworms*. Agri. Information Service, Directorate of Agriculture. J&K Govt. Srinagar, Kashmir, 1975, 5
4. Anonyms. Studies on collection and identification of vegetable pets and their natural enemis. Annual Report All India Coordinated Research Project on Biological Control. ICAR, 1997, 41-48
5. Atwal AS, Dhaliwal GS. Agricultural Pests of South Asia and their Management. Kalyani Publishers, New Delhi, 1999, 487.
6. Azam M. Diversity, Distribution and Abundance of Weevils (*Coleoptera*) of District Poonch and Rajouri (Jammu). PhD Thesis, University of Jammu, Jammu (J & K), 2007
7. Azim MN. Suprageneric significance of spermatheca in stink bugs (Heteroptera: Pentatomidae: Pentatominae). Oriental Science. 2000; 5(1):7-12
8. Azim MN. Taxonomic Survey of Stink bugs (Heteroptera: Pentatomidae) of India. Halteres. 2011; 3:1-10
9. Azim MN, Bhat MS. Preliminary survey of pentatomid bugs (Heteroptera: Pentatomidae). Journal of Entomological Research. 2010; 34(2):165-170
10. Bala A, Tara JS, Gupta M. Butterflies of family Pieridae reported from Jammu Region (Jammu and Kashmir). International Journal of Interdisciplinary and Multidisciplinary S Tudies. 2014; 1(7):24-34.
11. Bhagat KC, Bhat OK. Pest complex of okra, *Abelmoschus esculentus* (L.) Moench in Jammu and Kashmir. Insect Environment. 1999; 5(3):103.
12. Bhagat KC, Nehru RK. Attack of an agromyzid, *Phytomyza horticola* Gour (agromyzidae: Diptera) on Onion in Jammu and Kashmir. Insect Environment. 2000; 6(3):113-114
13. Bhagat KC, Masoodi MA, Bhat AK, Koul VK. Kale, *Brassica Oleracea* var. *acephala* DC, New host plant of *Chromatomyia horticola* Goureau from Kashmir. Journal of Insect Science. 1989; 2(2):173-174.
14. Bhagat RC. New records of aphids from Kashmir. Science & Culture. 1981; 47(4):134-136.
15. Bhagat RC. On aphid pests and their aphidoid parasitoids of agricultural importance. Indian Agriculturist. 1986; 30(3):229-235.
16. Bhagat RC. Systematic catalogue and host-plant range of Aeolothripids and Phlaethripids (Thysanoptera) of Jammu and Kashmir. Asian Journal of Animal Sciences. 2010; 4(2):248-250
17. Bhagat RC. Aphids (Insecta) of agricultural importance in J&K state, India: a checklist and biodiversity. International Journal of Food, Agriculture and Veterinary Sciences. 2012; 2(3):116-125
18. Bhagat RC. Fruit fly fauna (insect: Diptera) of Jammu & Kashmir Himalaya, India: check list and biodiversity. International Journal of Food, Agriculture and Veterinary Sciences. 2014; 4(1):18-23
19. Bhagat RC. An updated annotated checklist and biodiversity of pentatomoidea bugs (heteroptera: pentatomomorpha) of Jammu, Kashmir and Ladakh Himalayas (India). International Research Journal of Natural and Applied Sciences. 2015; 2(4):125-139
20. Bhagat RC. Biodiversity and Annotated Checklist of Coleopteran-Fauna (Insecta) Associated with Agricultural Crops (Cereals, Vegetables) and Medicinal Plants of Jammu & Kashmir State (India). International Journal of Current Research in Bioscience and Plant Biology. 2016; 3(7):95-103
21. Bhagat RC. An Update on the Systematic Checklist and Biodiversity of Caterpillars of Butterfly-Fauna on Food /Host Plant Species of Jammu & Kashmir State (India) - Papilionoidea: Hesperidae, Lycaenidae and Pieridae. International Journal of Current Research in Bioscience and Plant Biology. 2017; 4(7):81-87
22. Bhagat RC, Lone MA. Additions to the thrips fauna of Kashmir valley, India. Geobios New Reports. 1986; 5:111-113.
23. Bhagat RC, Lone MA. Additional records of thrips (Insecta:Thysanoptera) of Kashmir Valley, India. Zoologica Orientalis. 1991; 8,9(1,2):24-26.
24. Bhagat RC, Lone MA. Thrips damaging economically

- important crops in Kashmir valley. Indian Agriculturists. 1991a; 35(1):55-57
25. Bhagat RC, Matta A. Host range and diversity of aphidophagous insect (predators) of Kashmir Himalaya, with new host aphid/plant records, *In: Khan, M. A. (Ed.). Environment Biodiversity and Conservation*. A. P.H. Publishing corporation New Delhi, 2002, 269-282.
 26. Bhagat RC, Qureshi AA. Species richness and host-plant diversity of genus *Thrips* (Thysanoptera: Insecta) in Kashmir valley. Asian Journal of Bioscience. 2010; 5(1):142-144
 27. Bhat AA. *Chauliops* sp. as a serious pest of beans, *Phaseolus vulgaris* in Kashmir. Geobios New Reports. 1988; 7:84-85
 28. Bhat AA, Sheikh BA. Leaf hoppers associated with turnip (*Brassica campestris* var. *rapa*) in Kashmir Valley. Pest Management and Economic Zoology. 1999; 7(1):85-86
 29. Bhat DM. First Report of Some Insect Pests Damaging *Rumex acetosa* L. in Kashmir Himalaya. Trends in Biosciences. 2017a; 10(12):
 30. Bhat DM. First report of *Rumex acetosa* L. as a host plant of *altica himensis* Shukla (coleoptera: chrysomellidae) from Kashmir. Journal of Advanced Zoology. 2017b; 38(1):79-81
 31. Bhat DM. Host range and diversity of Coccinellid (Coleoptera) predators of aphid pests in vegetable crop ecosystems of Kashmir, with new host aphid/ plant records. Journal of Entomological Research. 2017c; 41(2):183-186
 32. Bhat DM, Bhagat RC. Studies on parasitoids of cabbage diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) in Kashmir Valley. Journal of Entomological Research. 2008; 32(4):303-308.
 33. Bhat DM, Bhagat RC. Occurrence of natural enemies of the brinjal white fly, *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) in Kashmir Valley (India). Indian Journal of Applied and Pure Biology. 2009a; 24(2):271-272.
 34. Bhat DM, Bhagat RC. Natural Parasitism of Leaf Miner, *Chromatomyia horticola* (Goureau) (Diptera: Agromyzidae) on Vegetable Crops in Kashmir (India). World Journal of Agriculture Sciences. 2009b; 5(S):888-891.
 35. Bhat DM, Bhagat RC. Natural parasitism of *Pieris rapae* (L.) and *Pontia daplidice* (L.) (Lepidoptera: Pieridae) on cruciferous crops in Kashmir Valley (India). American-Eurasian Journal of Agriculture and Environmental Science. 2009c; 5(4):590-591.
 36. Bhat DM, Bhagat RC. Host Range and Diversity of Syrphid Predators (Insecta: Diptera) of aphids on Vegetable Crops of Kashmir, with New Host Aphid/ Plant Records. Trends in Biosciences. 2017; 10(6):1446-48
 37. Bhat DM, Bhagat RC, Qureshi A. Records of some hymenopterous parasitoids of serpentine leaf miner, *Liriomyza trifolii* in vegetable ecosystems in Kashmir. Indian Journal of Plant Protection. 2009a; 37(1, 2):188-189.
 38. Bhat DM, Bhagat RC, Qureshi AA. A survey of insect pests damaging vegetables crops on Kashmir valley (India), with some new records. Journal of Entomological Research. 2011; 35(1):85-91.
 39. Bhat DM, Bhagat RC, Qureshi A. Natural parasitisation of *Spodoptera litura* F. (Lepidoptera: Noctuidae) by *Zelexochlorophthalma* Nees (Hymenoptera: Braconidae) in vegetable ecosystems of Kashmir Valley, India. Halteres. 2011a; 3:88-90.
 40. Bhat DM, Bhagat RC, Qureshi AA. First report of cabbage moth, *Mamestra brassicae* (L.) (Lepidoptera: Noctuidae) attacking kale and knol khol vegetables from Kashmir, India. Annals of Entomology. 2016; 32-34:69-73
 41. Bhat DM, Bhagat RC, Qureshi AA. Parasitoid fauna associated with insect pests of vegetable crops of Kashmir Himalaya, India: check list and biodiversity. Munis Entomology and Zoology. 2017a; 12(1):
 42. Bhat MA. A report on insect pests associated with Cole crops in Kashmir. Applied Biological Research. 2008; 10:66-67.
 43. Bhat MR. Distribution and host range of some insect pests in Kashmir. Geobios new Repots. 1987; 6(2):176-178.
 44. Bhat MR. Distribution and host range of some insect pests in Kashmir. Geobios new Reports. 1991; 10(2):161.
 45. Bhat OK, Kaul V, Bhagat KC. Incidence of pests associated with rhizosphere of tomato in Jammu. Annals of Plant Protection Sciences. 1994; 2(2):23-26.
 46. Bhatia R, Verma AK. Insect pest complex of cabbage in Himachal Pradesh. Journal of Insect Sciences. 1993; 6(2):297-298.
 47. Bhatti JS. Species of the genus *Thrips* from India (Thysanoptera). Systematic Entomology. 1980; 5:109-166.
 48. Bingham CT. *The fauna British India, including Ceylon and Burma: Butterflies*. Taylor and Francis Ltd., London, 1907, 480
 49. Butani DK, Jotwani MG. Insects in Vegetables. Periodical Expert Book Agency, Delhi, 1984, 65-66.
 50. Capinera JL. *Handbook of vegetable pests*, Academic Press, California USA, 2001, 729.
 51. Chandra K, Sidhu AK. Insects of Ladakh. ENVIS Newsletter. 2009; 15(1, 2):5-10.
 52. Dar GH, Bhagat RC, Khan MA. *Biodiversity of Kashmir Himalaya*. Valley Book House. Srinagar, Kashmir (J&K): 2002, 399
 53. Debbarma A, Jayaraj J, Chandramani P, Senthil N, Ananthan M Prabakaran AK. Survey on Occurrence and Diversity of Insect Pests of Cauliflower in Dindigul and Theni Districts of Tamil Nadu, India. International Journal of Microbiology and Applied Science. 2017; 6(9):2495-2505.
 54. Devi N, Raj D. Biology and parasitization of diamondback moth, *Plutella xylostella* L. infesting cauliflower in mid hill region of Himachal Pradesh (India), Journal of Entomological Research. 1995; 19(1):83-89.
 55. Dhillon MK, Singh R, Naresh JS, Sharma HC. The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. Journal of Insect Science. 2005; 5:40.
 56. Dias SJ. Nutritional Quality and Health Benefits of Vegetables: A Review. Food and Nutrition Sciences. 2012; 3:1354-1374
 57. Firake DM, Lytan D, Behre GT. Biodiversity and seasonal activity of arthropod fauna in Brassicaceae crop ecosystems of Meghalaya, North-east India. Molecular Entomology. 2012; 3(4):18-22.
 58. Ganie SA, Khan ZH, Ahangar RA, Bhat HA, Hussain B. Population dynamics, distribution and species diversity of fruit flies on cucurbits in Kashmir valley, Indian Journal

- of Insect Science. 2013a; 13(65):1-7.
59. Ganie SA, Khan ZH, Padder SA. Identification and taxonomical studies of fruit flies on cucurbits in Kashmir valley. The Bioscan. 2013b; 8(1):263-269.
 60. Hoffmann H, Learmonth S, Wood P. Common insect pests and diseases on vegetables in the home garden. Department of Agriculture and Food, Western Australia, Perth. Bulletin, 2004, 4624
 61. Jamwal SVV, Ahmad H, Sharma D. Host biology interaction of *Epilachna vignitiopunctata* (Fabricius). Bioscan. 2013; 8(2):513-517.
 62. Kaul V, Kesar YK. Incidence and management of Lepidopteran fruit borers of guava (*Psidium guajava*) in Jammu. Journal of Asian Pacific Entomology. 2003; 6(2):201-205.
 63. Khan MA. Research and Development Reporter. 1987; 4(1):102.
 64. Khan SH, Chatto MA, Hussain M, Baba MY. Regional specific technologies for potato production in India. AICRP (Potato) Bullitin. 2009; 3:51-63.
 65. Kapoor VC. Indian fruit flies (Insecta: Diptera:Tephritidae). Oxford and IBH, Publishing Co. Pvt. Ltd. New Delhi, 1993, 228
 66. Koul VK, Bhagat KC. Biology of melon fly, *Bactrocera cucurbitae* Coquillet (Diptera: Tephritidae) on bottle gourd. Pest Management and Economic Zoology. 1994; 2(2):123-125.
 67. Krishnakumar NK. Bio-ecology and the management of the Serpentine leaf miner, *Liriomyza trifolii* on vegetable crops. Final report of ICAR AD-hoc scheme, IIHR, Bangalore, 1998.
 68. Kriti JS, Dar MA, Khan ZH. Biological and Taxonomic Study of Agriculturally Important Noctuid Pests of Kashmir. World Journal of Agricultural Research. 2014; 2(2):82-87
 69. Lal OP. A compendium of insect pest of vegetables in India. Bulletin of Entomological Research. 1975; 56:16-31.
 70. Lone MA, Bhagat RC. Thrips of Kashmir Valley new records and host-range. Geobios New Reports. 1984; 3:101-103
 71. Lone MA, Bhagat RC. Newly recorded species of genus *Thrips* Haliday (Thysanoptera: Insecta), with their host plant complex from Kashmir valley. Indian Zoologist. 1990; 14(1-25):11-13.
 72. Lone MA, Bhagat RC. New records of Aeolothrips and Thripids, with host plants from Kashmir Valley, India. Geobios New Reports. 1991; 10:54-57
 73. Malik RA, Punjabi AA, Bhat AA. Survey and study of insect and non-insect pests of Kasgmir. Horticulturist. 1972; 3:29-44
 74. Mani MS, Singh S. Entomological Survey of Himalaya. Part XXVI. A contribution to our knowledge of geography of the high-altitude insects of the naval Zones from the north-west Himalaya. Part 3. Journal of Bombay Natural History Society. 1962; 59(1):77-99.
 75. Mathew D, Ahmad Z. Carryover of cabbage butterfly, *Pieris brassicae* L through broad leaved pepper grass (*Lepidium latifolium* L.) in cold arid desert of Ladakh. Insect Environment. 2005; 11(1):15.
 76. Mathur AC, Srivastava JB. Record of some insect pests of medicinal and aromatic plants in Jammu and Kashmir. Indian Forestry. 1967; 93(9):663-667.
 77. Misra SS. White grubs. In: Diseases and Pests of Potato-A Manual (Ed.: Paul Khurana, S.M.). Central Potato Research Institute, Shimla, India. 2000; 57-60.
 78. Misra SS, Chandel RS. Potato white grubs in India. Technical Bulletin, Central Potato Research Institute (ICAR), Shimla, India, 2003, 60.
 79. Munib M, Wani RA, Khan SH, Abass A. Pest complex of potato (*Solanum tuberosum* L.), with special to management of white grubs in the Northern District of Kashmir Valley. Journal of Agriculture Science. 2016; 8(3):151-161.
 80. Pandey AK, Dwivedi SK. Insect Pests and Diseases of Cold Arid Regions, Ladakh. In: Chap.18. Crop Protection: Management Strategies (Ed.: Prasad, D.). Daya Publishing House, New Delhi. 2005, 276-287.
 81. Pandey AK, Namgyal D, Mehdi M, Mir MS, Shiekh BA. A case study: Major insect pests associated with different vegetable crops in cold and region Ladakh, of Jammu and Kashmir. Journal of Entomological Research. 2006; 30(2):169-174.
 82. Punjabi AA, Bhat AA, Masoodi MA. Insect pests of crops, vegetables, fruits and stored grain products prevailing in Kasmir. Information Bulletin Agriculture Department, J&K Govt. Kashmir, 1970, 16
 83. Puri SN, Murthy KS, Sharma OP. Integrated Pest management in vegetables: Issues and strategies. In. Kalloo, G. and Singh, K. (eds.) Emerging scenario in vegetable research and development. Research Periodicals and book publishing house, Texas, USA, 2000, 293-303
 84. Qureshi AA, Bhagat RC, Pathania PC. Rhopalocera diversity (Lepidoptera) of district Kupwara from Jammu and Kashmir State, India. Biol. Forum. 2013a; 5(1):100-106.
 85. Qureshi AA, Dar R, Ahmad T, Shahan I, Bhagat RC. Butterfly-fauna of Gulmarg, Kashmir, J & K State. Journal of Agricultural and Veterinary Science. 2013b; 2(5):40-45.
 86. Rai AB, Halder J, Kodandaram MH. Emerging insect pest problems in vegetable crops and their management in India: An appraisal. Pest Management in Horticultural Ecosystem. 2014; 20(2):113-122
 87. Rashid A, Anand VK, Sewar J. Less known wild edible plants used by Gujjar tribe of District Rajouri, Jammu and Kashmir State. International Journal of Botany. 2008; 4(2):219-224
 88. Rishi ND. Studies on insect pests of Kashmir Part III. Vegetables, major pests with their life -history and control measures. Kashmir Science. 1967; A62-78.
 89. Rishi ND. Studies on the comparative functional morphology of head capsule, mouth parts and alimentary canal of three Lepidopteran adults in relation to food and feeding habits. Journal of Science University of Kashmir. 1973; 1(1, 2):29-47.
 90. Sachan JN, Gangwar SK. Seasonal incidence of insect pests of cabbage, cauliflower and knolkhol. Indian Journal of entomology. 1990; 52:111-124.
 91. Samnotra RK, Chopra S, Kumar S, Kumar M, Sharma D. Package of Practices for vegetable crops, Directorate of Extension, SKAUST Jammu, 2016, 144.
 92. Shankar U, Kumar D, Singh SK, Gupta S. Pest complex of Cole crops and their management. Technical bulletin No. 1, SKAUST Jammu, 2016, 14
 93. Sharma D, Maqbool A, Jamwal VVS, Srivastava K, Sharma A. Seasonal dynamics and management of whitefly (*Bemesia tabaci* Genn.) in tomato (*Solanum esculentum* Mill.) Brazilian Arch. Biol. Technology.

- 2017; 60:e17160456
94. Sharma G, Kumar R, Pathania PC, Ramamurthy VV. Biodiversity of lepidopterous insects associated with vegetables in India: A study. *Indian Journal of Entomology*. 2008; 70(4):369-384
 95. Sharma S, Tara JS. Record of some hemipteran pests of cucurbits from Jammu region of Jammu And Kashmir State. *International Journal of Recent Scientific Research*. 2017; 8(7):18419-18422
 96. Sharma S, Tara JS, Kour RK, Ramamurthy VV. Bionomics of *Alcides affaber* Aurivillius (Coleoptera: Alcidodinae), a serious pest of Bhendi, *Abelmoschus esculentus* (L.) Moench. *Munis Entomol. Zool*. 2012; 7(1): 256-266.
 97. Shivalingaswamy TMS, Satpathy S, Rai AB, Rai M. Insect pests of vegetable crops: Identification and management. Technical Bulletin, IIVR, Varanasi, 2006; 30:15.
 98. Simmonds FJ, Rao VP. Record of *Plutella maculipennis* Cont. and some of its parasites in Kashmir India. *Canadian Entomologist*. 1960; 92(4):274.
 99. Singh S. Studies on the systematics of Indian Thysanoptera: Terebrantia. *Indian Journal of Entomology*. 1946; 7(1-21):147-188
 100. Singh JB, Abrol PD. Pest complex of brinjal, *S. melongena* L. in Jammu. *Insect Environment*. 2001; 6(4):172-173
 101. Singh N, Dhiman S. Quality and Quantity Loss by Aphid Infestation in Vegetables Grown under Protected Cultivation in Ladakh Region. *Defense Life Science Journal*, 2018; 3(1):71-74
 102. Srinivasan K, Virakmath CA, Gupta M, Tewari GC. Geographical distribution, host range and parasitoids of serpentine leaf miner, *Liriomyza trifolii* (Burgess) in South India. *Pest management in Horticultural Ecosystem*, 1995; 1(2):93-100.
 103. Srivastava JB, Saxena BP, Bhagat GL. *Galerucella placida* Bal. (Coleoptera: Chrysomelidae) as a pest of some polygonaceous medicinal plants. *Ind. Journal of Entomology*. 1966; 28(2):275-276.
 104. Tara JS, Sharma S, Kour R. A record of weevil (Coleoptera: Curculionidae) diversity from district Samba (J & K). *Bioscan*. 2010; 5(3):391-394.
 105. Varshney RK. Index Rhopalocera Indica. Part III. Genera of butterflies from Indian and neighbouring countries (Lepidoptera: Papilionidae, Pieridae, Danaidae). *Oriental Insects*. 1993; 27:347-372.
 106. Wynter Blyth MA. *Butterflies of Indian Region*. The Bombay natural History Society, Bombay, 1957.
 107. Zaka-ur-Rab. Studies on Agromyzidae (Diptera) of Kashmir. India, some interesting palaeartic species. *Bulletin de laboratorio di Entomologica Agaria*. (Filippo Silvestri). 1981a; 38:133-137.
 108. Zaka-ur-Rab. *Cystiphora taraxaci* kieffer (Diptera: cecidomyiidae) mining the leaves of *Taraxacum officinale* in Kashmir. *J. Bomb. Nat. His. Soc.* 1981b; 78:624-625
 109. Zaki FA. A note on some crop pests of cold arid zone of Ladakh (J&K). *Applied Biological Research*. 1999; (2):175-177.
 110. Zaki FA, Masoodi MA. Threatening diseases and pests of potatoes in Jammu and Kashmir. *Journal of Indian Potato Association*. 1990; 17(1-2):83-86.
 111. Zaki FA, Hussain Z, Wani AR. Field evaluation of some insecticides against cutworms and white grub in potato. *Indian Journal of Plant Protection*. 2007; 35(1): 121-122.
 112. Zaz GM. Incidence and biology of black cutworm *Agrotis ipsa* Uon (Hfn). *Applied Biological Research*. 1999; 1(1):67-70.
 113. Zaz GM. Incidence and population build-up of cabbage aphid, *Brevicoryne brassicae* on cabbage and cauliflower. *Applied Biological Research*. 2001; 3(1, 2):51-53.