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Predators of *Myzus persicae* aphid in Kolhapur district, Maharashtra

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Abstract
Aphids are economically important sucking insect pest of important crops. Aphids (Homoptera: Aphididae). Aphididae includes about 4700 species of aphids of which more than 1000 species are injurious to crops throughout the world. In India,to crops throughout the world. In India, especially in Maharashtra many species of aphid infest different crop plant plant. Some species of aphid having higher pest potential includes *Aphis craccivora*, *A. gossypi*, *Aphis nerii*, Mustard aphid, *A. acacea*, *Toxoptera aurantii*, *Aphis fabae*, *Myzus persicae* etc. *Myzus persicae* attacks different host plant of families Solanaceae, Brassicaceae, Rutaceae, Moraceae, Asteraceae etc. Infestation of *M. persicae* causes declining crop yield, it transmits plant viruses which results into severe crop loses. *M. persicae* predated by more than 20 predators species such as Coccinellid beetle, Syrphid flies, Green lacewing, Brown lacewing, Predatory midge, Spiders etc. In present study predators of *M. persicae* have been reported from Kolhapur district, Maharashtra.

Keywords *Myzus persicae*, insect pest, predators, lady bird beetle, syrphid fly, lacewing

Introduction
Aphids belongs to class Insecta (Order: Homoptera, Family: Aphididae) this are popularly known as plant lice and are considered as most important economical insect pest through out the world. Aphids mostly feed on young and tender parts of plant such as leaves, flower, young fruits, stem etc [10, 53]. The plant belongs to family Solanaceae, Asteraceae, Fabaceae, Moraceae, Rutaceae, Amaranthaceae etc. are attacked by aphid species [7, 8]. *M. persicae* is most infection spreading aphid among the aphid's species. *M. persicae* infecting more than 293 plants belongs to 64 families [49]. *M. persicae* infecting wide range of host plants like cauliflower, corn, beets, bean, spinach, cabbage, carrot, lettuce, mustard, okra, pea, pepper, potato, tomato, turnip, watermelon therefore it is economically important pest for vegetable crop. It affects field crops like tobacco, sunflower, wheat [48] from Kolhapur district, Maharashtra. The severity of plant infection is enhanced due to transmission of viruses by by *M. persicae*. They spread number of viruses like potato mosaic virus [9, 10, 20, 48].
M. persiace reproduce by sexually as well as +parthenogenetically, twice in year producing heavy population [6]. use of chemical pesticides in controlling *M. persicae* is not adequate hence biological control i.e. use of predatory species becomes a good alternative. Chemical pesticide causes severe damage to other beneficial insects, causes pollution and have hazardous effect on human health. [54]. More than 20 different predators belongs to order Coleoptera, Neuroptera, Diptera, Hemiptera, Hymenoptera naturally reduces aphid population. [52] In ecosystem, predators such as Coccinellid beetle, Syrphid flies, Green lacewing, Brown lacewing, Predatory midge & Spiders are reported from Kolhapur district, Maharashtra *on M. persicae*.

Material and method
Survey on predators of *M. persicae* have been carried out from selected areas of Kolhapur district, Maharashtra from December 2019 – December 2021. Survey studies were carried out on various such as cauliflower, corn, beets, bean, spinach, cabbage, mustard, okra, pea, pepper, potato, tomato, turnip, tobacco, wheat, watermelon by weekly collection method.
Predators were collected by using insect collection net, and the stages like eggs, grubs, larvae, were collected in polythene bags and plastic bottles and brought into the laboratory for life cycle studies. Adult and larvae, egg stored 70% alcohol in plastic bottles for further studies. The predators were identified by consulting appropriate literature Predatory specimens were identified by key of Poorani, Janaki Raman. (2002). An annotated checklist of the Coccinellidae (Coleoptera) (excluding Epilachninae) of the Indian Subregion. Oriental Insects. 36. 307-383. 10.1080/00305316.2002.10417335. and for syrphid fly 1) Isolation, identification and occurrence of major syrphid fly species of various agricultural, horticultural, medicinal and oil seed crops in Western Uttar Pradesh. (Deepak Kumar 2017).2) An Updated Distributional Account of Indian Hover flies (Insecta: Diptera: Syrphidae) (Jayita Sengupta, 2016) referred. 1)T. S. Bellows; T. W. Fisher (1999). Handbook of biological control: principles and applications of biological control 2) Check-List of Indian Planipennia (Order Neuroptera) (S. K. Ghosh, S. Sen,1977) 3) Neuropterida species of the world by John Oswald (2007)

Result
In the present investigation 18 species of predators are observed in study period *viz*. a) *Cheilomenes sexmaculata* (Fabricius), b) *Coccinella transversalis* (Fabricius), c) *Harmonia octomaculata* (Fabricius), d) *Scymnus latemaculatus* (Motsch), e) *Scymnus nubilus* Mulsant f)*Scymnus loewii* (Mulsant), g) *Scymnus coccivora* (Ayyar), h) *Propylea dissecta* (Mulsant), i)*Illeis cincta* (Fabricius), j) *Chilocorus nigrita* (Fabricius), k) *Scymnus* (Pullus) *castaneus* Sicard l) *Pseudaspidimerus trinotatus* (Thunberg), m) *Pseudaspidimerus flaviceps* (Walker). n) *Episyrphus balteatus* o) *Ischiodon scutellaris* p) *Betasyrphus serarius* q) *Chrysoperla carnea* r) Brown

lacewing s) Predatory midge Most common natural enemies of *M. persicae* are syrphid flies, Coccinellidae, Scymnus beetle, Chrysopidae and hemerobiidae.

In the present study, syrphid flies observed mostly as predator of *M. persicae*, Syrphid flies mostly observed in brassicacae family, different ornamental plants and field crops like tobacco. Different types of syrphid flies are observed in this present study. Study shows that larvae have predatory potential than adult. adult mostly feeds on nector. Syrphid flies mostly present in vegetable crops. Syrphid flies are most diverse group in species manner. Number of different species are observed in this investigation.

Coccinellid also proved to be effective predator in field crop like tobacco, wheat. Coccinellid present everywhere like field crops, vegetable crops, garden plant. Lady bird beetle has huge host diversity. Lady bird beetle also found in different crop fields like Brinjal, Chilly, Pepper different beans like green peas. Both larvae and adult have effective predatory potential. Both feeds on *myzus persicae*. Number of different types of lady birds are observed in this study.

As we seen in result that Chrysopidae and Hemerobiidae family also act as predators from that *Chrysoperla carnea* i.e., green lacewing mostly observed and larvae are mostly observed in aphid colonies.4 to 5 larvaes are found in aphid colonies. In Hemerobiidae, only one individual found as predators, that is brown lacewing. Brown lacewing observed in less frequency. Predotory midge larva also found in different vegetable crops they mostly found on cabbage and tobacco. They singnificantly reduces the aphid population field. Spiders also play role as predator of *myzus persicae*. but species are not identified by any sources.

Discussion

Coccinellidae

Coccinellid beetles or lady bird beetle are most observed familiar predatory insect group. Mostly they are feed on aphids, mealy bugs, whitefly, mites, scale insects [43] Many species such as *Adalia bipunctata, Cheilomenus sexmaculata, Hippus converginis* attracted the biological practitioner for their potential for biological control [1]. In this investigation, for *myzus persicae* 13 lady bird beetle observed *viz. Cheilomenus, Coccinlla transversalis, Hormonia octamaculata* are observed.

- ***Cheilomenus sexmaculata* (Fig.1A):** It is very popular predator of aphid and other harmful insect. In India, it is widely distributed and abundantly observed, it is highly polyphagous and abundantly observed. It is highly polyphagous and feeds on aphids which infest agricultural and horticultural and weed crops. It is commonly known by the name as six spotted zig zag lady bird. It distributes Asian tropics and subtropical zones from India to Japan and Australian region. It has major potential to reduce aphid population. It present throughout the year [1, 45, 46, 29, 37,5].

- ***Coccinella transversalis* (Fig.1B):** Common name for *Coccinella transversalis* is transverse lady beetle.*Coccinella septempunctata* and *Coccinella Transversalis* togetherly reduced heavy aphid population.they are very similar to each other. Both adults and grub have predatory potentiall [44, 30]. Satpathi(2009) [43] gives list of 21 prey of *Coccinella transversalis* [43].

- ***Hormonia octamaculata* (Fig.1C):** Observed color pattern of this beetle is orange yellow or red having black impression on elytra and pronatum. It is not familiar predators like *Cheilomenus sexmaculata* and *Coccinella transversalis*.It has number of prey like *Aphis gossypi,Myzus persicae,Aphis craccivora.*Shantibala and Singh recoeded this predator from Manipur [45].

- ***Scymnus latemaculatus* Motsch (Fig.1D):** It was first recorded in *Aphis nerii* (B.d.Fonsc)as well as on *Aphis spireocola Patch,Myzus persicae(Sulzer),Aphis craccivora* but earlier it was recorded that it feed on *Aphis spiraecol*a Patch, *Capitophorus formosartemisiae* (Takashi), *Lipaphis erysmi* (Kalt) [24, 31]. In Kolhapur region it was observed on *Aphis nerii, Myzus persicae and Aphis craccivora, Aphis gossypii*

- ***Scymnus nubilus* Mulsant(Fig.1E):** It is aphidophagous species and predators of several mealy bugs and scale insects. This beetle found on various plant like brinjal, raddish, turnip, cabbage, okra, hibiscus, mustard, potato [2]. In Kolhapur region, it is observed on *Aphis gossypi, Myzus persicae, Aphis fabae.*

- ***Scymnus loewii* Mulsant (Fig1.F):** This ladybird beetle originated from central part and various regions of north America and described 1st time in 1941 in Auckland. They appear like wooly mealybug. Adult are black and brownish yellow in colour, upper surface black and brown on the lateral side of head, prothrax and elytra [19, 23, 25].

- ***Scymnus coccivora* (Ayyar) (Fig.1G):** It is commonly found in India, Bangladesh, Srilanka, Pakistan, Malaysia [34]. It feeds on mealybug, whitefly and different species of aphid like Myzus persicae, Aphis gossypi, Aphis fabae, *Lipaphis erysmi(Kalt), Aphis nerii, Aphis craccivora.* Adults are golden yellow to yellowish brown colored with two disc spot present in posterior half. It is found abundantly in mulberry ecosystem [2].

- ***Propyla dissecta*(Fig.1H):** In this present investigation, this ladybird beetle found to feeding on Myzus persicae on Raddish, Cabbage and Brinjal crops.It feeds on Aphis gossypi, Aphis craccivra [33] Adult is red or orange colored with cental black line.They have pale coloured morphs. It is recorded from from India, Bangladesh, Nepal, Srilanka [34].

- ***Ilies cincta*(Fig1.I):** This ladybird beetle mainly feed on powdery mildew in different crops like Okra, Shisam, Mulberry, Sunflower plants. *Phyllactinia corylea* and *Erysiphe cinchoracea* are the fungus causes powdery mildew on mulberry and sunflower plant. Inspite of that adult feed on Aphis gossypi, Myzus persicae. Adult are pale yellow in color with black spots. It is distributed throughout India, Srilanka [35, 42].

- ***Chilocorus nigritus* (Fig.1J):** It is commonly known as the Malaysian ladybird beetle. It distributed throughout the would like South Africa, Nepal, Italy, Srilanka,

Turkey, India [22, 34]. This beetle recorded from Srilanka feeding on Brinjal by S. Mayadunnage etal. Adults are black coloured, subcircular, head are yellowish brown [39].

- ***Scymnus (Pullus) castaneus Sicard*** **(Fig.1K):** *It* distributed throughout India, Pakistan, Bangladesh [34]. In present study, it feeds on *Aphis craccivora*, *Aphis gossypi*, *Myzus persicae*. It was found on bean plant, okra, *Cestrum nocturnum*, brinjal etc

- ***Pseudaspidimerus trinotatus (Thunberg)*** **(Fig.1L):** This species mainly found in India, Srilanka, Myanmar [34]. A color of adult and elytral spots on body. [39] Both larva and adults have predatory potential. Larval stages are looks like a bug. In this present study this beetle found to be feeding *Aphis nerii* and *Myzus persicae*.

- ***Pseudaspidimerus flaviceps (Walker)*** **(Fig.1M):** In this present study, this beetle observed in various aphid colony like *Aphis gossypi, Aphis nerii*, *Myzus persicae.* Described origin of this beetle is Sri Lanka. It is newly recorded from India by J. Poorani in 2001 [34]. ii Both larva and adult have predatory potential. Adult are bright yellow without any marking. This is smaller in size as compared to *Pseudaspidimerus trinotatus* (Thunberg)

Syrphidae

From Indian subcontinent there are 71 genera are known of syrphid and from those 312 species are observed in region of India; in all over world 4700 species are recorded [14]. Syrphid larvae are feed on aphid, they mostly present in aphid colony, adult syrphid fly need not aphid, it feeds on pollen and nector. Larvae feeds on aphid to complete their life cycle. [18, 41] Syrphid larvae abundantly present in *Myzus persicae* population; they reduced population of *Myzus persicae* notably. In this present study 3 species are observed.

- ***Episyrphus balteatus*** **(Fig.1N):** Commomly found in garden, crop fields and various fields and known as Marmalade hoverfly () Abdomen having coloured band i.e., orange, black color and exclusive pattern. Faint strips on the body. It is polyphagous and feeding on various species of aphid. *Aphis craccivora* Koch, *Aphis fabae*, *Aphis gosypii*, *Aphis spireocola* Patch, *Brevicorynae*, *Rhopatosiphum maidis* (Fitch),*Sitobium rasaeiformis* [4]. It is mostly observed in Brassicacae family.

- ***Ischiodon scutellaris*** **(Linnaeus) (Fig.1O):** Adult found hovering around flowers and different plants in garden and vegetable like Cabbage, Mustard, Raddish, and Turnip. In present study larvae found in different plants like Cabbage, Hibiscus feed on Myzus persicae. Larvae present in aphid colony. It is potential predator of myzus persicae. Body is slender, black with yellow strips. Lingappa and Puttannavar (2004) reported this species in from Karnataka [23, 36]. In Iran, Ghahari *et al* (2008) recorded this species from rice field [11].

- ***Betasyrphus serarius*** **(Fig.1P):** It is small and common syrphid fly find in aphid colony. Agarwala *et al* recorded this species on *Aphis longisetosa* Basu, *Lipaphis erysmi(*Kalt) and *Uroleucon sonchi* from northest India [4].Singh recordes this syrphid fly on *Aphis craccivora* Koch, *Aphis fabae*, *Aphis gossypii* (Glover) on various host plant.[15]

Neuroptera

Neuroptera order having net wing. they include lacewing, mantid flies, ant lions. They have two families Chrysopidae and hemerobiidae. Neuroptera act as predators of some insect like aphids, mealybug, whitefly.

- **Chrysopidae**

- **Chrysoperla carnea (Fig.1Q):** Green lacewing or *Chrysoperla carnea* Staphes belongs to Chrysopidae. Chrysopidae have lot of individual but present study observed one individual i.e. green lacewing. Larva are predatory and knows as aphid lions. The larvae present on *Myzus persicae* on different plants like vegetable, flowering plants. Chrysopidae considered to be major role when release to vegetable crops, it feeds on aphids, whiteflies, mealybug on vegetable crops [40, 47, 55]. Effectiveness of *chrysoperla carnea* is observed in green house and fields also, they mean to be effective predator of *myzus persicae* [16].

- **Hemerobiidae**

- **Brown lacewing (Fig.1R):** Brown lacewing belongs to Hemerobiidae family, it is also known as predator of aphid, but in present study brown lacewing is less observed as compared to green lacewing. Both larvae and aphids are act as predators. Hemerobiidae and Chrysopidae are somewhat similar but wing venation are different [21].

Predatory midge (Fig.1S) and Spiders

They are also observed as predator of *myzus persicae*. Predatory midge larvae also play important role as predator. There are number of midge larvae was seen in fields during study. Predatory midge also effectively responsible for declining population of *Myzus persicae* in fields. Different types of spiders also seen during study but predatory potential is less and number also less.

Conclusion

M. persicae infested to number of vegetable and crop plant such as *Beta vulgaris* Linn, *Brassica campestris* Linn, *Brassica juncea* (Linn) *Brassica oleracea* Linn var. *botrytis*, *Brassica oleracea* Linn var. *capitata*, *Brassica oleracea* Linn var. *gongyloides*, *Cleome icsandra*, *Gynandropsis pentaphyll* (Linn)DC, *Nicotiana tabacum* Linn. *Pisum sativum* Linn. *Raphanus sativus* Linn., *Solanum melogena*, *Solanum nigrum*, *Solanum tuberosum*, *Sounchus* sp, *Spinacia oleracea.* Vegetables and crops plays vital in nutrition and development of body. Vegetable and crop farming is the main economical factor in society hence crop losses impact economy of respective region. In this investigation 18 species of predators observed in which syrphid flies and Scymnus beetle were found abundantly in *M. persicae* population in vegetable from Brassicacae, Fabaceae, Solanaceae but in crops such as wheat, tobacco coccinellid bettle such as *Cheilomenus sexmaculata*, *Coccinella transversalis* and predatory midges were most

observed. Neuroptera most observed in Brassicaceae, Solanaceae. In this predator *Cheilomenus sexmaculata*, *Coccinella transversalis*, *Episyrphus balteatus*, *Ischiodon scutellaris*, *Scymnus latemaculatus*, *Scymnus nubilus* Mulsant were proved to be most potential predator. In future, by culturing this predaors we can used as good biocontrol option instead of chemical control.

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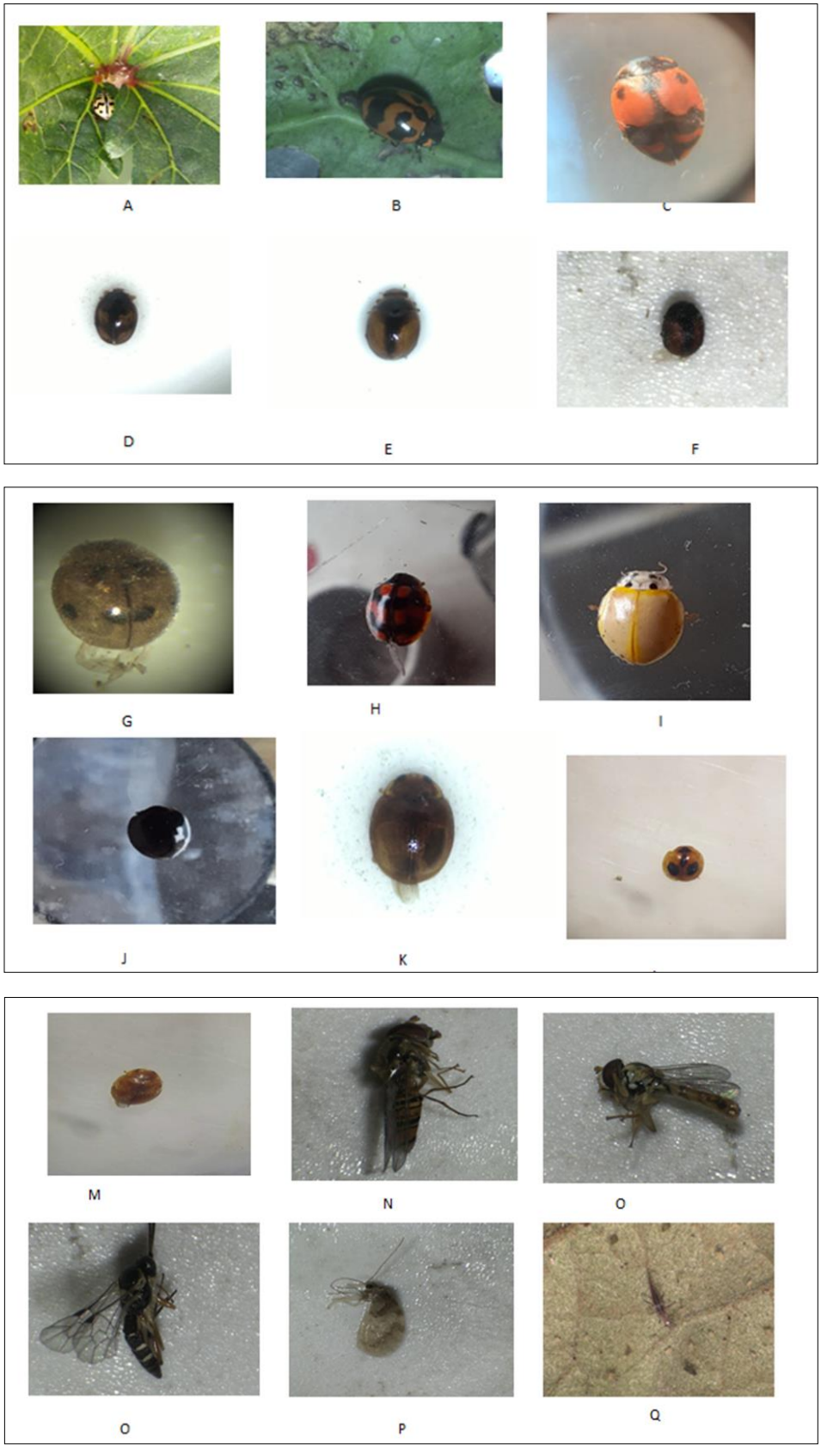

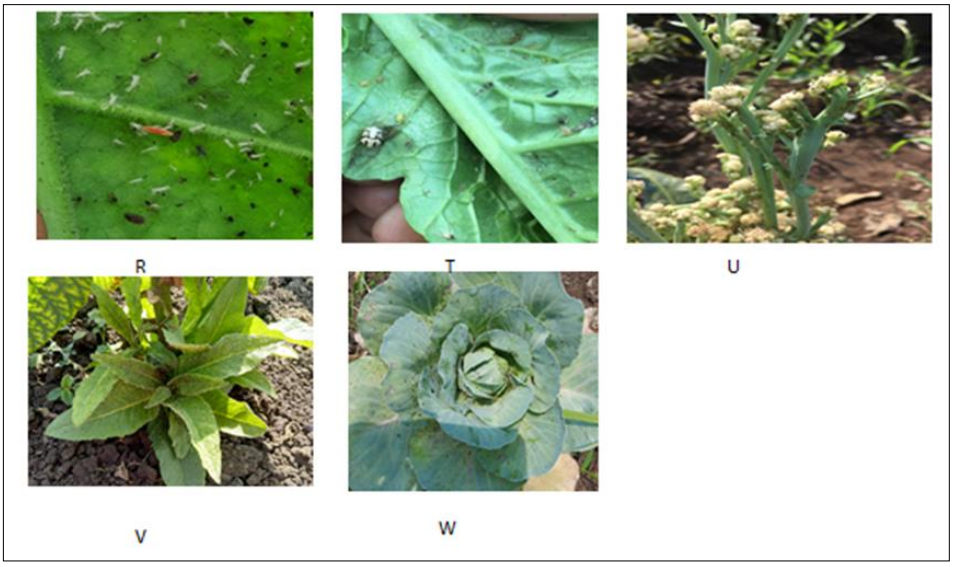

Fig 1: Photographs of Predators collected from Kolhapur district of Maharashtra, India.

a. *Cheilomenes sexmaculata* (Fabricius)
b. *Coccinella transversalis* Fabricius
c. *Harmonia octomaculata* (Fabricius)
d. *Scymnus latemaculatus* Motsch
e. *Scymnus nubilus* Mulsant
f. Scymnus *loewii* Mulsant
g. *Scymnus coccivora* (Ayyar)
h. *Propylea dissecta* (Mulsant)
i. *Illeis cincta* (Fabricius)
j. *Chilocorus nigrita* (Fabricius)
k. *Scymnus* (Pullus) *castaneus* Sicard
l. *Pseudaspidimerus trinotatus* (Thunberg)
m. *Pseudaspidimerus flaviceps* (Walker)
n. *Episyrphus balteatus*
o. *Ischiodon scutellaris*
p. *Betasyrphus serarius*
q. Larva of *Chrysoperla carnea*
r. Brown lacewing
s. Predatory midge
t. *Cheilomenus* pupa and lacewing larva feeding on aphid
u. *Myzus persicae* population on Cauliflower
v. Tobbaco infested with *Myzus persicae*
w. Population of *Myzus persicae* on Cabbage.

References

1. Agarwala BK, Ghosh AK. Prey records of aphidophagous Coccinellidae in India. A review and bibliography. Trop. Pest Management,1988:34(1):1-14
2. Muhammad Ali, Ahmed Khalil, Shaukat Ali, Ghulam Raza, Hussain, Ishtiaq Nafees *et al*. An annotated checklist of Coccinellidae with four new records from Pakistan (Coleoptera, Coccinellidae). Zoo Keys,2018:803:93-120.
3. Assour HR, Bahm JE. "First Occurrence of *Cheilomenes sexmaculata* (Coleoptera: Coccinellidae) on the Caribbean Island of Curaçao". Neotropical Entomology.2019:48(5):863-865. doi:10.1007/s13744-019-00699-0. ISSN 1519-566X. PMID 31140148
4. Agarwala BK, Bhaumik AK, Das S. Natural food range and feeding habits of aphidophagous insects in north-east India. J. Aphidol,1987:1:18-22.
5. BhattacharyaB, Dutta SK. Black citrus aphid, *Toxoptera aurantii* Boyer (Aphididae: Homoptera) in Assam. Insect Environ,1998:3:109.
6. Blackman Roger. Life-cycle variation of *Myzus persicae* (Sulzer) (Homoptera: Aphididae) in different parts of the world, in relation to genotype and environment. Bulletin of Entomological Research,1974:63:595-607. 10.1017/S0007485300047830.
7. Blackman RL, Eastop VF. Aphids on the World's Crops: An Identification and Information Guide. John Wiley & Sons, Chichester, England, 1984, 466.
8. Blackman RL, Eastop VF. Aphids on the world's crops: An Identification and Information Guide. Wiley Chichester,2000:2:1-466.
9. Castle SJ, Berger PH. Rates of growth and increase of Myzus persicae on virus-infected potatoes according to type of virus-vector relationship. Entomology. Exp. Appl,1993:69:51-60.
10. Eastop VF. A Study of Aphididae (Homoptera) of East Africa. H.M.S.O, London, 1958, 126.
11. Ghahari H, Hayat R, Tabari M, Ostovan H. Hover flies (Diptera: Syrphidae) from rice fields and around grass lands of Northern Iran. Munis Enzymology &Zoology,2008:3:275-284.
12. Gupta BM, Yadava CPS. Role of coccinellid predators in regulating the aphid Myzus persicae (Sulzer) population on cumin in field. Indian Journal of Entomology,1989:51(1):24-28.
13. Gilkeson LA, Hill SB. Release rates for control of green peach aphid (Homoptera: Aphididae) by the predatory midge *Aphidoletes aphidimyza* (Diptera: Cecidomyiidae) under winter greenhouse conditions. Journal of Economic Entomology,1987:80:47-150.
14. Ghorpadé KD. Insect prey of Syrphidae (Diptera) from India and neighboring countries: a Review and Bibliography. Tropical Pest Manag,1981:27:62-82.
15. Chaudhary HC, Rajendra Singh. records of The Predators of Aphids (Homoptera: Aphididae) In Eastern Uttar Pradesh Journal of Aphidology, 25 & 26: 13-30The Aphidological Society, India ISSN, 2012, 0970-3810.

16. Hagley EAC, Miles N. Release of *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae) for control of *Tetranychusurticae* Koch (Acarina: Tetranychidae) on peach grownin a protected environment structure. Can. Ent,1987:119:205-206.
17. Hoffmann MP, Frodsham AC. Natural enemies of vegetable insect pest Cornell Cooperative Extension,1993:63:67-80.
18. Horn DJ. Effect of weedy backgrounds on colonization of collards by green peach aphid, Myzus persicae, and its major predators. Envir. Ent,1981:10:285-296.
19. Integrated Taxonomic Information System – Report." *Scymnus loewii*"
20. Kennedy JS, Day MF, Eastop VF. A Conspectus of Aphids as Vectors of Plant Viruses. Commonwealth Institute of Entomology, London, 1962, 114.
21. Klimaszewski J, McE DK, Kevan. The Brown Lacewing Flies of Canada and Alaska (Neuroptera:Hemerobiidae). Part 1. The Genus Hemerobius Linnaeus: Systematics, Bionomics and Distribution. Macdonald College, McGill University, Lyman Entomological Museum and Research Laboratory, Memoir No. 15. SteAnne de Bellevue, Quebec, 1985.
22. Leeper JR. A review of the Hawaiian Coccinellidae. Technical report No. 53. Hawaii national park library, 1975.
23. Lingappa S, Patil RK, Tippannavar PS, Balikai RA, Kumar P. Development strategies for the management ofwoolly aphid, C. lanigera Z. (Homoptera:Aphidiadae) on sugarcane. Project Report Submitted to the Department of Agriculture. Government of Karnataka, 2004, 46-53.
24. Mani M, Krishnamoorthy A. Natural enemies of *Siphonius phillyreae* (Homoptera: Aleurodidae) and *Aphis pipunicae* on pomegranate. Entomon,1995:20:31-34.
25. Martin NA. Loew's ladybird - *Scymnus loewii*. Interesting Insects and other Invertebrates. New Zealand Arthropod Factsheet Series Number, 2019, 172.
26. Neuenschwander P, Hagen KS. Role of the predator *Hemerobius pacificus* in a non-insecticide treated artichoke field. Environmental Entomology,1980:9: 492-495.
27. Nagaraja H, Hussainy. S.U.A study of six species of *Chilocorus* (Coleoptera: Coccinellidae) predaceous on San Jose and other scale insects. J. Oriental Insects,1967:1:249-256.
28. Obrycki JJ, KringT J. Predaceous Coccinellidae in biological control. Annu. Rev. Entomol,1998:43:295-321.
29. Omkar, Bind RB. Records of aphids-natural enemies complex of Uttar Pradesh. II. The Coccinellids. J. Adv. Zool,1993:14:96-99.
30. Omkar, Pervez A. Prey preference of a ladybeetle, *Micraspis discolor* (Fabricius). 7th Nat. Symp. Aphidol, at DDU Gorakhpur University, Gorakhpur, 2000, 11-13.
31. Parsana GJ, Kapadia MN, Butani PG. Association of groundnut aphid, *Aphis craccivora* Koch with coccinellid predators and their relation to abiotic factors. J. Aphidol,1997:11:199-200.
32. Pervez A, Omkar. Prey-dependent life attributes of an aphidophagous ladybird beetle, *Propylea dissecta* (Coleoptera: Coccinellidae). Biocontrol Sci. and Tech,2004:14:385-396.
33. Pervez A, Omkar, Richmond AS. The influence of age on reproductive performance of the predatory ladybird beetle, *Propylea dissecta*. J. of Insect Sci,2004:4(22):8.
34. the Indian subregion. Oriental Insects,2002:36:307-383. A review of the genus pseudaspidlmerus kapur (coleoptera: coccinellidae) from the indian subregion with description of a new species. Oriental insects,2001:35:299-310.
35. "Population dynamics of *Illeis cincta* in relation to weather parameters". Indian Journal of Plant Protection,2016:44(1):153-155.
36. Puttannavar M. Bio-ecology and management of woolly aphid, *C. lanigera* Z (Homoptera: Aphididae). M. Sc.Thesis, University of Agricultural Sciences, 2004.
37. Radhakrishnan B, Muraleedharan N. Records of Natural enemies *Toxoptera aurantii* (Boyor de Fonsc.) (Homoptera:Aphididae) infesting tea plantations in South India. J. Aphidol,1995:9:87-91.
38. Raj BT. Seasonal abundance of natural enemies of aphids infesting potato crop. Journal of Aphidology,1989:3(1-2):157-161s.
39. Mayadunnage S, Wijayagunasekara1 HNP, Hemachandra KS, Nugaliyadde L. Predatory Coccinellids (Coleoptera: Cocinellidae) of Vegetable Insect Pests: A Survey in Mid Country of Sri Lanka, Tropical Agricultural Research,2007:19: 69-77.
40. Saminathan VR, Baskaran RKM. Biology and predatory potential of green lacewing, *Chrysoperla carnea* (Neuroptera: Chrysopidae) on different insect hosts. Indian Agric. Sci,1999:69:502-505.
41. Schneider E. Bionomics and physiologyof phytophagous Syrphidae. Annu. Rev.Ent,1969:14:103-104.
42. "Severity of powdery mildew infection and population of *Illeis cincta* F. on sunflower" (PDF). Insect Environment, 2013, 19(3).
43. Satpathi CR. List of predatory Coccinellidae (Coleoptera)of India and their preys: a review and bibliography. J. Aphidol,2009:23(1-2):11-42.
44. Shalaby FF, El-Heneidy AH, Hafez AA, Bahy IA, El Din, Seasonal abundances of common Coccinella species in some economic eld crops in Egypt. Egypt. J. Agric. Res,2008:86(1):303-317.
45. Shantibala S, Singh TK. Studies on varietal distribution of aphidophagous coccinellids (Coleoptera, Coccinellidae) of Manipur and Nagaland. J. Aphidol,1991:5:39-43.
46. Singh KC, Singh TK. The coccinellids of northeastern India Manipur-1. Entomon,1988:10(4):291-295.
47. Singh NN, Manoj K. Potentiality of Chrysoperla carnea in suppression of mustard aphid population. Indian J. Entomol,2000:62:323-326.
48. Singh R, Singh G, Tiwari AK, Sharma A, Patel S, Pratibha. *Myzus persicae* (Sulzer 1776) (Homoptera: Aphididae): Updated Check List of Host Plants in India. Internat. J. Zool. Investig,2015:1:8-25.
49. Tamaki G, Halfhill JE.Bands on peach trees as shelters for predators of the green peach aphid. Journa l of Economic Entomology,1968:61:707-711.

50. Tamaki G, Annis B, Weiss M. Response of natural enemies to the green peach aphid in different plant cultures. Environmental Entomology,1981:10:375-378.
51. Bellows TS, Fisher TW. Handbook of biological control: principles and applications of biological control. Academic Press. pp.1999, 418-ISBN 978-0-12-257305-7. Retrieved 21 January2011. (Green),
52. van Emden HF, Eastop VF, Hughes RD, Way MJ. The ecology of *Myzus persicae*. Annual Review of Entomology,1969:14:17-270.
53. van Emden HF, Harrington R. Aphids as Crop Pests. CABI North American Office, Cambridge, Massachusetts, 2007.
54. Wolfenbarger DO. Effects of temperatures on mortality of green peach aphids on potatoes treated with ethyl-methyl parathion. Journal of Economic Entomology,1972:65:881-882.
55. Yuksel S, Goemen H. effectiveness of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) as a predator on cotton aphid, Aphis gossypii (Glov) (Homoptera: Aphididae). Turk. Nat. Cong. Entomol,1992:2:209-216.