



## Predatory spider fauna in fruit crops of Punjab, India along with new records

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### ABSTRACT

Spiders are important predatory organisms in the orchards. Keeping in view their role in the natural biological control, the present studies were conducted from May 2012 to October 2019 in orchards belonging to 21 fruit crops, viz. apple (*Malus* sp.), amla (*Phyllanthus emblica*), citrus (*Citrus* spp.), banana (*Musa* spp.), ber (*Zizyphus mauritiana*), fig (*Ficus carica*), grapes (*Vitis vinifera*), guava (*Psidium guajava*), jamun (*Syzygium cumini*), litchi (*Litchi chinensis*), loquat (*Eriobotrya japonica*), mango (*Mangifera indica*), olive (*Olea europaea*), papaya (*Carica papaya*), peach (*Prunus persica*), pear (*Pyrus communis*), plum (*Prunus domestica*), pomegranate (*Punica granatum*), phalsa (*Grewia asiatica*), rasbhari (*Physalis peruviana*) and sapota (*Manilkara zapota*) in 13 districts of the Punjab, India, with an objective to record the prevalence of different families of spider fauna. The study revealed the presence of several predatory spiders involved in controlling various insect-pests of fruit crops. The 43 species of spiders belonging to 23 genera and 13 families were recorded during the study. Families like Salticidae, Araneidae and Oxyopidae exhibited more diversity. Salticidae family showed maximum diversity. High genetic diversity was found in Salticidae, Araneidae, Oxyopidae and Tetragnathidae. Study highlights the importance of protecting natural predators in controlling the insect pests in orchards. *Epeus flavobilineatus* Doleschall, *Epocilla calcarata* (Karsch) (Family: Salticidae); *Gasteracantha cancriformis* (Linnaeus) and *Neoscona punctigera* (Doleschall) (Family Araneidae) are new species records for India.

**Key words:** Biocontrol agents, Fruit crops, Punjab, Spider fauna

There is increasing concern worldwide regarding pesticide pollution due to increasing use of pesticides to control various pests in various agro-ecosystems. Application of biological control agents for management of insect-pests is another alternative method. Nature has provided us a number of predators, parasitoids and pathogens, that naturally reduces population of insect-pests. Among the predators, spiders are very useful because of their carnivorous and polyphagous nature. The evolution of spiders went back to 400 million years ago. Primitive spiders had large body size and segmented body, but now almost all spiders have unsegmented body except the Suborder Mesothelae which has segmented abdomen. Now, majority of the studies are being conducted to use spiders as biological pest control agents and many scientists agree that they are more efficient to control the pests than the pesticides (Symondson *et al.* 2002).

Spiders (Phylum Arthropoda; Class Arachnida: Order Araneae) is one of the most ubiquitous groups of generalist predaceous organisms in the animal kingdom (Riechert and Lockley 1984). They are air-breathing arthropods that have eight legs and chelicerae with fangs able to inject venom. They are the largest order of arachnids and ranked seventh in total species diversity among all orders of organisms. Spiders are found worldwide on every continent except for Antarctica, and have become established in nearly every habitat with the exceptions of air and sea colonization. Anatomically, spiders differ from other arthropods in that the usual body segments are fused into two tagmata, the cephalothorax and abdomen, and joined by a small, cylindrical pedicel. Unlike insects, spiders do not have antennae. At present, there are 48386 species of spiders from 120 families described in the world (World Spider Catalog 2019). Siliwal *et al.* (2005) reported 1442 species of spiders from India. According to Keswani *et al.* (2012), a total of 1686 species of spiders are recorded from India, belonging to 60 families and 438 genera.

In spite of the polyphagous and carnivorous nature of spiders, very little efforts have been made to evaluate their potential as biocontrol agent (Sadana 1978). Very good work had been carried out during 1970s in the Punjab, India to document biodiversity of spiders in the orchards. However, after that, there was a long gap in any systematic

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studies on spiders in the orchards of Punjab. Keeping this in view, the present study on diversity of spiders in fruit crops of Punjab was initiated in May 2012 and carried out till October 2019. The present study includes the description of the spider species observed during the surveys of 13 districts of the Punjab, India.

## MATERIALS AND METHODS

### Study area

Punjab is in northwestern India with a total area of 50362 square km (19,445 sq miles). Bounded by Pakistan on the west, Jammu and Kashmir on the north, Himachal Pradesh on the northeast and Haryana and Rajasthan on the south, most of the Punjab lies in a fertile, alluvial plain with many rivers and an extensive irrigation canal system. A belt of undulating hills extends along the northeastern part of Punjab at the foot of the Himalayas, which is commonly known as *Kandi* belt. Average elevation is 300 m (980 ft) above sea level. The southwest of the state is semiarid, eventually merging into the Thar Desert of Rajasthan. The Shiwalik Hills extend along the northeastern part of the state at the foot of the Himalayas. The soil characteristics are influenced to a limited extent by the topography, vegetation and parent rock. The geography and subtropical latitudinal location of Punjab lead to large variations in temperature from month to month. The maximum temperatures usually occur in mid-May and June. The collected spiders were identified at the Arachnology Laboratory, Deva Matha College, Kottayam, Kerala by referring to relevant literature.

### Collection of spiders

The spiders were collected four times in a year from orchards of different districts of Punjab during May 2012 to October 2019. Methods suggested by Tikader (1987) were employed for collection of the spiders. Spider resting on the orb webs or plants parts were collected by keeping a jar containing the spirit below the spider and tapping the spider into it. The observations on population of spiders were made from the lower branches from the four geographical sides of the plant selected at random. The collections were usually made in the early hours of the mornings or in the evenings as the spiders are less active during this time. Fast moving spiders were captured in plastic vials of 7.5 × 2.5 cm size. The collection data, such as place and date of collection, colouration of spider, name of the host plant and name of the collector were recorded. The collected spiders were preserved in 75% ethyl alcohol.

Spiders were examined under stereomicroscope Labomed CZM6. Identification of spiders was done with the help of taxonomic keys. Status of distribution of each species is indicated as 'rare' or 'common'. Arrangement of family and data regarding the general distribution was taken. Map the locations of the orchards surveyed was prepared by using online tool available at [www.mapcustomizer.com](http://www.mapcustomizer.com).

Fruit crops surveyed: Apple (*Malus* sp.), *amla* (*Phyllanthus emblica*), citrus (*Citrus* spp.), banana (*Musa*

spp.), *ber* (*Zizyphus mauritiana*), fig (*Ficus carica*), grapes (*Vitis vinifera*), guava (*Psidium guajava*), *jamun* (*Syzygium cumini*), litchi (*Litchi chinensis*), loquat (*Eriobotrya japonica*), mango (*Mangifera indica*), olive (*Olea europaea*), papaya (*Carica papaya*), peach (*Prunus persica*), pear (*Pyrus communis*), plum (*Prunus domestica*), pomegranate (*Punica granatum*), *phalsa* (*Grewia asiatica*), *rasbhari* (*Physalis peruviana*) and sapota (*Manilkara zapota*).

## RESULTS AND DISCUSSION

Spiders are polyphagous predators and feed on a variety of available preys. Predation is not limited to adult stage of insects only, but it also include the egg, larval/nymphal stages as well. As predators, spiders have a two-fold function as they not only do feed directly on their prey, but their presence causes indirect mortality. The presence of spiders could disturb larvae who then drop from the plant and die, while the webs spun over the leaves also seem to make them less suitable for oviposition and feeding. With increased interest in non-chemical control strategies, the need to understand the diverse group of organisms that might play a role in fruit agro-ecosystems is increasing. It is predicted that many potentially useful biological control agents are still unknown to man. Thus before they can be economically used, these useful organisms must be collected, studied and integrated into our information systems.

The results of the present study are presented below:

### Taxonomic diversity

**Family diversity:** The analysis of the spider collection revealed that out of 59 families recorded in the Indian region, 12 (20.33%) families are recorded from our study area. Families like Salticidae, Araneidae and Oxyopidae exhibit more diversity and families like Tetragnathidae, Thomisidae, Clubionidae, Heteropodidae, Hersillidae, Eutichuridae, Lycosidae, Sparassidae and Uloboridae exhibit minimum diversity. Salticidae (24.32%) family showed maximum diversity (Table 1).

**Generic diversity:** Out of the 252 genera from Indian region (Tikader 1987), 23 are recorded from our study area. High genetic diversity is found in Salticidae (8), Araneidae (4) and Oxyopidae (2). Sparassidae, Tetragnathidae, Thomisidae, Heteropodidae, Hersillidae, Clubionidae, Eutichuridae, Lycosidae and Uloboridae are represented by only one genus.

**Species richness:** The 43 species belonging to 12 families were reported from this study. Considering this, we believe that the study area has higher diversity of spiders. A detailed systematic and extensive survey will reveal much greater species diversity from the area. 39 species recorded from study area are widely distributed in many parts of India.

**New records from India:** *Epeus flavobilineatus* (Doleschall), *Epocilla calcarata* (Karsch) (Family: Salticidae); *Gasteracantha cancriformis* (Linnaeus) and *Neoscona punctigera* (Doleschall) (Family Araneidae) are new species records for India.

Spiders are extremely abundant in the Indian Punjab

Table 1 Spiders observed in orchards of Punjab, India

| Species                                              | Distribution                                | Host plant observed in Punjab | Period of observation              | District               | Status |
|------------------------------------------------------|---------------------------------------------|-------------------------------|------------------------------------|------------------------|--------|
| <i>Family Araneidae (Orb-weaving spiders)</i>        |                                             |                               |                                    |                        |        |
| 1. <i>Araneus ellipticus</i> (Tikader & Bal 1981)    | Ba, In, Ch, Laos                            | Plum                          | April, May                         | Ho, Lu                 | Common |
| 2. <i>Araneus</i> sp.1                               | In                                          | Plum                          | April, May                         | Ho, Lu,                | Common |
| 3. <i>Argiope</i> sp.1                               | In                                          | Citrus, plum                  | August-September                   | Bt, Fe, Ho, Lu, Ma     | Common |
| 4. <i>Argiope</i> sp.2                               | In                                          | Citrus, plum                  | August-September                   | Bt, Fe, Ho, Lu, Ma     | Common |
| 5. <i>Gasteracantha cancriformis</i> (Linnaeus 1767) | NA, CA, Caribbean, SA, Hawaii               | Citrus                        | October                            | Bt, Fe, Ho             | Rare   |
| 6. <i>Neoscona bengalensis</i> (Tikader & Bal 1981)  | In, Pak, Ba                                 | Citrus, ber, fig, mango       | March to November                  | Bt, Fe, Lu             | Common |
| 7. <i>Neoscona mukerjei</i> (Tikader 1980)           | In, Pak, Ba                                 | Citrus, ber, jamun            | March to November                  | Bt, Fe, Ho, Lu, Pa     | Common |
| 8. <i>Neoscona punctigera</i> (Doleschall 1857)      | Reunion, In, My, Ch, Ko, Ja, Ind, Ph, NG,Au | Citrus, ber                   | March to November                  | Bt, Fe, Ho, Lu         | Common |
| 9. <i>Neoscona</i> sp.1                              | In                                          | Citrus, ber, fig, guava       | March to November                  | Bt, Fe, Fg, Ho, Lu, Pa | Common |
| 10. <i>Neoscona</i> sp.2                             | In                                          | Citrus, ber, fig, guava       | March to November                  | Bt, Fe, Fg, Ho, Lu, Pa | Common |
| 11. <i>Neoscona</i> sp.3                             | In                                          | Citrus, ber, fig, guava       | March to November                  | Bt, Fe, Fg, Ho, Lu, Pa | Common |
| 12. <i>Neoscona theisi</i> (Walckenaer 1841)         | In, Ph, Ind, Ch, Ja, Sey, P. Is             | Citrus, ber, peach            | March to November                  | Bt, Fe, Ho, Lu         | Common |
| 13. <i>Araneus mitificus</i> (Simon 1886)            | In, Ph, Ja, NG                              | Citrus                        | March to November                  | Fe, Ho, Lu             | Common |
| <i>Family Lycosidae (Wolf spider)</i>                |                                             |                               |                                    |                        |        |
| 14. <i>Pardosa</i> sp.                               | In                                          | Citrus                        | March-April                        | Lu                     | Common |
| <i>Family Clubionidae (Sac spiders)</i>              |                                             |                               |                                    |                        |        |
| 15. <i>Clubiona</i> sp.1                             | In                                          | Apple, grapes sapota          | January, May and September-October | Lu, Pa                 | Common |
| 16. <i>Clubiona</i> sp.2                             | In                                          | Apple, grapes sapota          | January, May and September-October | Lu, Pa                 | Common |
| <i>Family Eutichuridae (Sac spider)</i>              |                                             |                               |                                    |                        |        |
| 17. <i>Cheiracanthium</i> sp.                        | In                                          | Citrus                        | February-March                     | Lu                     | Rare   |
| <i>Family Hersillidae (Two-tailed spiders)</i>       |                                             |                               |                                    |                        |        |
| 18. <i>Hersilia savignyi</i> (Lucas 1836)            | SL, In, Ph                                  | Mango                         | May-June                           | Ho, Gu, Lu             | Common |
| <i>Family: Heteropodidae (Huntsman spider)</i>       |                                             |                               |                                    |                        |        |
| 19. <i>Heteropoda</i> sp.                            |                                             | Grapes                        | April-May                          | Lu                     | Common |
| <i>Family Oxyopidae (Lynx spiders)</i>               |                                             |                               |                                    |                        |        |
| 20. <i>Pecentia</i> sp.                              | In                                          | Amla                          | November                           | Lu, Pa                 | Rare   |
| 21. <i>Oxyopes</i> sp.1                              | In                                          | Ber, guava, litchi, Sapota    | April to November                  | Fg, Gu, Ho, Lu, Pa     | Common |
| 22. <i>Oxyopes shweta</i> (Tikader1970)              | Pak, In, Ch                                 | Citrus, litchi, ber, sapota   | April to November                  | Am, Lu, Ho, Gu         | Common |
| 23. <i>Oxyopes javanus</i> (Thorell 1887)            | In, Ba, Ind, Ph, Ch                         | Litchi, sapota                | April to November                  | Ho, Lu, Gu             | Common |

Cond.

Table 1 (Concluded)

| Species                                                           | Distribution                                        | Host plant observed in Punjab       | Period of observation | District   | Status |
|-------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------|-----------------------|------------|--------|
| 24. <i>Oxyopes birmanicus</i> (Thorell 1887)                      | In, Ch, Ind                                         | Litchi, sapota                      | April to November     | Gu, Ho, Lu | Common |
| 25. <i>Oxyopes ashae</i> (Gajbe 1999)                             | In                                                  | Citrus, fig, litchi, sapota, papaya | June to October       | Gu, Ho, Lu | Common |
| 26. <i>Oxyopes</i> sp.2                                           | In                                                  | Citrus, fig                         | June to October       | Lu         | Common |
| <i>Family Salticidae (Jumping spiders)</i>                        |                                                     |                                     |                       |            |        |
| 27. <i>Bianor</i> sp.                                             | In                                                  | Citrus                              | September             | Ho, Lu     | Common |
| 28. <i>Carrhotus</i> sp.                                          | In                                                  | Citrus                              | September-October     | Ho, Lu     | Common |
| 29. <i>Carrhotus viduus</i> (C. L. Koch 1846)                     | In, Ch                                              | Citrus, guava                       | September-October     | Ho, Lu     | Common |
| 30. <i>Epeus flavobilineatus</i> (Doleschall 1859)                | Ma, Ind                                             | Citrus and mango                    | September             | Ho, Lu     | Common |
| 31. <i>Epocilla calcarata</i> (Karsch 1880)                       | Ch, Ind, Sey, USA                                   | Mango                               | March                 | Gu, Ho, Lu | Common |
| 32. <i>Hylus semicuprius</i> (Simon 1885)                         | In, SL                                              | Citrus                              | August                | Ho, Lu     | Common |
| 33. <i>Phintella vittata</i> (C. L. Koch 1846)                    | In, Ph                                              | Citrus                              | August                | Ho, Lu     | Rare   |
| 34. <i>Plexippus paykulli</i> (Audouin 1826)                      | Af, USA, Eu, ME, In, Ch, Ja, Ko, Ph, NG, Au, P. Is. | Citrus                              | March to September    | Fe, Ho, Lu | Rare   |
| 35. <i>Telamonia dimidiata</i> (Simon 1899)                       | In, Bh, Ma, Ind                                     | Citrus                              | March to September    | Fe, Ho, Lu | Common |
| 36. <i>Telamonia elegans</i> (Thorell 1887)                       | My, Vt, Ind                                         | Guava                               | August-September      | Ho, Lu     | Common |
| <i>Family Sparassidae (Huntsman spider)</i>                       |                                                     |                                     |                       |            |        |
| 37. <i>Olios</i> sp.                                              | In                                                  | Banana                              | September             | Lu         | Common |
| 38. <i>Olios milletti</i> (Pocock, 1901)                          | In, SL                                              | Jamun                               | June                  | Lu         | Common |
| <i>Family Tetragnathidae</i>                                      |                                                     |                                     |                       |            |        |
| 39. <i>Leucauge decorata</i> (Blackwall 1864)                     | Pak, In, Ba, Th, Ph, Ch, Ja, Ind, Papua, NG, Au     | Mango                               | September             | Ho, Lu     | Rare   |
| 40. <i>Leucauge celebesiana</i> (Walckenaer 1841)                 | Ru, Ko, In, Ch, Vt, Laos, Ja, Ind, NG               | Litchi                              | August-September      | Ho, Lu     | Rare   |
| <i>Family Thomisidae (Crab spider)</i>                            |                                                     |                                     |                       |            |        |
| 41. <i>Thomisus lobosus</i> (Tikader 1965)                        | In                                                  | Ber, sapota                         | September             | Lu         | Common |
| 42. <i>Thomisus</i> sp.                                           | In                                                  | Ber, peach                          | September             | Lu         | Common |
| <i>Family Uloboridae (Grey house spider or venom less spider)</i> |                                                     |                                     |                       |            |        |
| 43. <i>Zosis geniculata</i> (Olivier, 1789)                       | USA, WA, Sey, In, Ind, Ph, - Ch, Ko, Ja, Au, Br     |                                     | September             | Lu         | Rare   |

but still our knowledge on these useful predators is quite poor. From the undivided Punjab, Dyal (1935) described the spider fauna of Lahore and gave keys for identification of 20 families and 65 genera together with the description of a large number of species. Jandu (1972) studied the food and feeding behaviour of spiders inhabiting citrus. She maintained that non-web spinners are better predators than web spinners. She further observed a positive correlation between with population of spiders and the citrus psylla,

*Diaphorina citri* (Kuwayama) on which they feed. Sadana and Jandu (1973; 1974a; b) gave a list of spider predaceous on insect-pests of citrus and described a new species of genus *Marpissa* Koch, i.e. *M. ludhianaensis* Sadana and Manjit Kaur from Ludhiana, Punjab. Mittal (1974) gave a list of spiders from district Hoshiarpur (Punjab). Sadana and Jandu (1974a) observed that out of 23 species observed in citrus orchards, two were voracious feeders on citrus psylla, *D. citri*. Sandhu (1974) studied the population

of spiders predacious on grape-vine pests and observed that Salticid spiders formed maximum population, i.e. 35.6% of total spider population while Thomisids formed minimum population. Sadana and Sandhu (1977) studied the feeding intensity of various developmental stages of *M. ludhianaensis* on the fulgorid pest of grape-vines. They reported that the adult spider was a voracious feeder. A total of 50 species of spiders were reported from Punjab by Sadana (1978). Sadana (1979) described a new species of the genus *Phlegra* Simon of family Salticidae. Sadana and Kaur (1980) studied the feeding intensity and food preference of *Marpissa tigrina* Tikader. They reported that it is a voracious feeder on citrus psylla, *D. citri*.

Kumaria (1981) reported Argiopid spiders, *Cyrtophora citricola* (Forsk.), *Araneus mitifica* (Simon) and *Cyclosa insulana* (Costa) on the citrus whitefly, *Dialeurodes citri* (Ashmead) from Ludhiana, India. Kaur (1991) surveyed guava orchards of Punjab, India and observed 16 species of spiders, viz. *Lyssomanes sikkimensis* Tikader, *Myrmarachne pateli* sp. nov., *Habrocestum* sp., *Evarcha hoyi* (Peckham), *Phidippus indicus* Tikader, *Zygoballus narmadensis* Tikader, *M. tigrina*, *Euophrys monadnock* Emerton, *Clubiona pallens* Hentz., *Micaria aurata* Hentz., *Thomisus shivajiensis* Tikader, *Olios obesulus* (Pocock), *Cyclosa conica* (Pallas), *Metazygia wuttefeldae* (McCook) and *Oxyopes pandae* Tikader belonging to seven families, i.e. Lyssomanidae, Salticidae, Clubionidae, Thomisidae, Sparassidae, Argiopidae and Oxyopidae, respectively. Gupta (1994) surveyed deciduous orchards, viz. jujube, peach, plum, pear and grapes in Punjab, India and reported 16 species of spiders, viz. *L. sikkimensis*, *Phlegra citri* Sidana, *M. tigrina*, *Synemosyna pateli* sp. nov., *Myrmarachne ludhianaensis* sp. nov., *C. pallens*, *M. aurata*, *T. shivajiensis*, *Tmarus angulatus* (Walck.), *O. obesulus*, *Olios fasciculatus* Simon, *O. pandae*, *Oxyopes* sp., *Metepeira labyrinthes* (Hentz.), *Neoscona nauticus* (Koch) and *Neoscona mukerjei* Tikader belonging to seven families, i.e. Lyssomanidae, Salticidae, Clubionidae, Thomisidae, Sparassidae, Oxyopidae and Argiopidae, respectively.

Parveen *et al.* (2007) has generated a checklist of spiders of the Punjab in Pakistan. They captured a total of 14743 spiders belonging to 21 families, 58 genera and 157 species. Salticidae was the prominent family (31.09%) with 9 genera and 27 species. In the present studies, we have also observed that family Salticidae showed maximum diversity.

Jose (2010) studied diversity of spiders in the Wayanad plateau of Western Ghats, Kerala and reported a total of 82 species of spiders belonging to 43 genera of 15 families. This study represents 6% of the total spider families reported in India. Araneidae was the dominant family constituting 24 species from 10 genera.

Singh (2017) reported jumping spiders (*C. viduus*, *Carrhotus* sp., *H. semicupreus*, *E. flavobilineatus*, *P. paykkulli*, *E. flavobilineatus* and *Bianor* sp.), orb-weaving spiders (*N. bengalensis*, *N. theisi*, *N. punctigera*, *N. mukherjei*, *N. elliptica*, *Neoscona* sp., *Argiope* sp. and *Araneus* sp.), grey house spider (*Z. geniculatus*), lynx spiders

Table 2 Number of families, genera and species recorded in Punjab

| Family         | No. of specimens | No. of genera | No. of species |
|----------------|------------------|---------------|----------------|
| Araneidae      | 4154             | 4             | 13             |
| Lycosidae      | 15               | 1             | 1              |
| Clubionidae    | 51               | 1             | 2              |
| Eutichuridae   | 11               | 1             | 1              |
| Hersillidae    | 57               | 1             | 1              |
| Heteropodidae  | 5                | 1             | 1              |
| Oxyopidae      | 1056             | 2             | 7              |
| Salticidae     | 5133             | 8             | 10             |
| Sparassidae    | 15               | 1             | 2              |
| Tetragnathidae | 10               | 1             | 2              |
| Thomisidae     | 956              | 1             | 2              |
| Uloboridae     | 11               | 1             | 1              |

(*O. ashae*, *O. birmanicus*, *O. javanus*, *O. shweta*), huntsman spiders (*Heteropoda* sp. and *Olios* sp.), two-striped jumper (*T. dimidiata*), two-tailed hersiliid spider, *H. savignyi*, sac spiders (*Cheiracanthium* sp. and *Clubiona* sp.), crab spiders (*T. lobosus* and *Thomisus* sp.), *Tetragnathid* sp. and lycosid spider predating on different insect-pests of fruit crops from the Punjab, India.

In the present study, highest number of spiders was observed in August-September while lowest number of spiders was observed in November to January. The low population of spiders in January could be due to scarcity of host insects as insect-pests are not much active during winter months in Punjab. Similar observations have been reported by Kumari (1984) who studied population of Salticid spiders from mango orchards of district Ludhiana, Punjab.

The number of families, genera and species recorded in the present study have been given in Table 2. Pictures of some of the spiders observed in the present have been presented in Fig 2.

### Conclusion

Survey conducted in 21 fruit crops in 13 districts of Punjab, India revealed presence of 43 species of spiders belonging to 23 genera and 13 families. Families like Salticidae, Araneidae and Oxyopidae exhibited more diversity. Salticidae family showed maximum diversity. High genetic diversity was found in Salticidae, Araneidae, Oxyopidae and Tetragnathidae. This study highlights the importance of protecting natural predators in controlling the insect pests in orchards. *Epeus flavobilineatus*, *E. calcarata*, *G. cancriformis* and *N. punctigera* are new species records for India. Some species were restricted to a certain habitat and/or district only while other showed a wide range of distribution and overlapping pattern. Unlike other ecologically important zones of India, there is a gap in the study of spider fauna from Punjab. This indicates the need for further collections in this state.

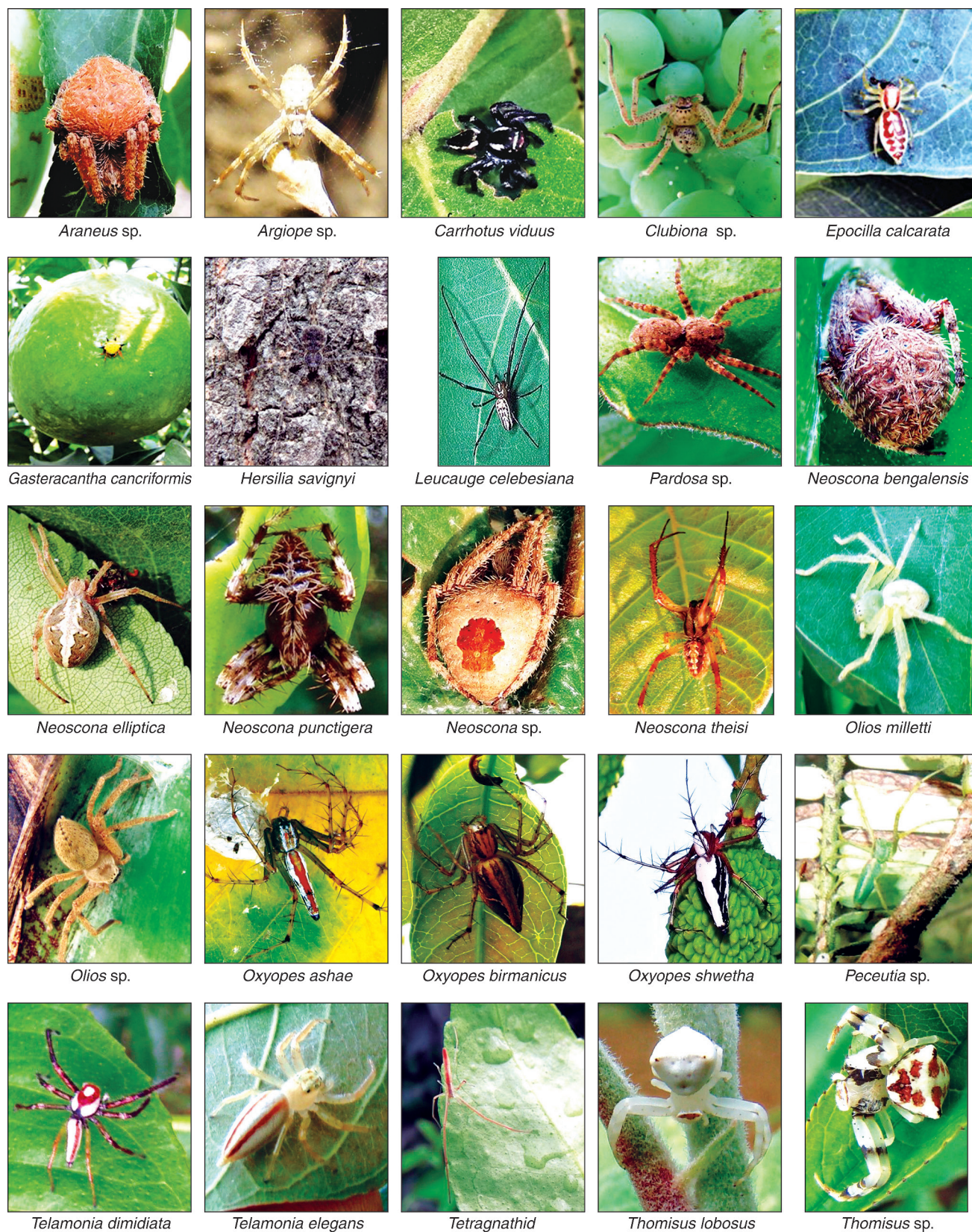


Fig 2 Important spiders observed in orchards of Punjab during May 2012 to October 2019.

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