JBS
Research Article

Journal of Biological Studies

eISSN: 2209-2560

V. 7, N. 4:203-213, 2024

https://doi.org/10.62400/jbs.v7i4.11537

Predator and parasitoid insects associated with tea (*Camellia sinensis*) plantations in Iran

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Received 01 September 2024|Accepted 15 October 2024|Published 15 December 2024

Abstract

An extensive survey was carried out during 2022-2023 for the collection and identification of predator and parasitoid insects associated with tea plants in Guilan province, North of Iran. A total of 17 species belonging to 16 genera and seven families were identified. Considering the species spectrum, the order Coleoptera has been reported as the most prevalent insect order with 14 species followed by Mantodea (with one species), Hymenoptera (with one species) and Neuroptera (with one species). All identified species except *Cryptolaemus montrouzieri* Mulsant appeared new to the tea gardens of Iran. An alphabetic list of the identified insect species and collection information has been provided.

Key words: Guilan, tea garden, arthropods, natural enemies, new record

1. Introduction

Tea plant, *Camellia sinensis* (L.) O. Kuntze is an evergreen plant that can live for 80–100 years (Zargari, 1990). As well as being used to make the oldest and most popular drink in the world, the leaves of the tea plant have important uses in medicine and pharmacology. Tea plantations are distributed in 58 countries of the world. However, today they are mainly grown in Asia, Africa, South America, and around the Black and Caspian Seas, which is related to specific climate and habitat requirements (Phong *et al.*, 2016; Wolski *et al.*, 2021). In China (as an important producer of tea) biological control measures within the context of integrated pest management (IPM), have been widely popularized to secure tea production and its quality. Integrated pest management programs provide better control of arthropod pests on tea with less chemical insecticide usage and minimal impact on the environment. More than 1100 species of natural enemies, including about 80 species of viruses, 40 species of fungi, 240 species of parasitoids and 600 species of predators, as well as several species of bacteria, have been recorded in tea ecosystems in China (Ye *et al.*, 2014).

Iran has 18,493 hectares of tea plantations (95% in Guilan province and 10% in Mazandaran province). The annual production of dry tea in the country is 109,357 tons. Iran is the ninth producer of tea in the world (Ghaderi *et al.*, 2019). Although some studies have

been conducted for identification of pest insects and mites associated with tea plants in Iran, there are very few studies on identifying beneficial insects (predator and parasitoid) in tea gardens (Habibian, 1989; Taghavi *et al.*, 1998; Abbasipour & Taghavi, 2007; Abbasipour *et al.*, 2007; Ramzi, 2017; Ramzi *et al.*, 2019; Hajizadeh *et al.*, 2020; Saber Hamishegi *et al.*, 2024). Only one predatory insect *Cryptolaemus montrouzieri* Mulsant has been reported from tea gardens in Iran (Shojai, 1989). Although predatory and parasitoid insects are important in biological control, the review of sources shows that no detailed studies have been done for the identification of beneficial insects in tea gardens in Iran.

The purpose of this research is to identify beneficial insects in tea gardens in Guilan province, northern Iran, the province where 95% of Iran's tea gardens are located. In this article, a list of the identified beneficial insects and their collection information has been provided.

2. Materials and Methods

For collection and identification of predator and parasitoid insects associated with tea plants in Lahijan City, Guilan province, sampling was done during 2022 - 2023. Insects were collected using insect nets, light traps, pit traps, and direct observation. The insect samples were transferred to the laboratory and examined under a stereomicroscope. Microscopic slides were prepared from the small insects such as parasitic Hymenoptera. The small insects were cleared by KOH 10% or Nesbitt's fluid and mounted on microscopic slides using Hoyer's medium. Middle size insects such as bugs and ladybugs were mounted on cardboard points. Large insects such as ground beetles, were pinned by insect needles.

The insects were identified using valid keys available in relevant books and scientific articles (Gordon, 1985; Lindroth 1985, 1986; Brooks, 1994; Yamada and Hirowatari, 2003; Hajizadeh *et al.*, 2003; Sorokina, 2009; Kavallieratos *et al.*, 2013; Hackston, 2019; Allegro *et al.*, 2022). For final confirmation, some samples were sent to relevant specialists. All collected insects are deposited in the collection of the Entomology laboratory in the Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht.

3. Results and Discussion

During this study, a total of 17 species, 16 genera and seven families were identified as predatory and parasitoid insects associated with tea gardens in Guilan province, northern Iran. An alphabetic list of the identified species and their collection information is provided. All species except *Cryptolaemus montrouzieri* have been reported for the first time from the tea gardens of Iran.

Predator insects
Order: Coleoptera
Family: Carabidae
Brachinus crepitans (Linnaeus) (Figure 1)
Material examined: Ten specimens, Lahijan, 37°12′15″N 50°00′17″E; September 2, 2022; collected in soil by pit traps.

Harpalus affinis (Schrank) (Figure 2)
Material examined: Seven specimens Lahijan, 37°12′15″N 50°00′17″E; August 27, 2022; collected in soil by pit traps.
Harpalus griseus (Panzer) (Figure 3)
Material examined: Nine specimens, Lahijan, 37°12′15″N 50°00′17″E; August 27, 2022; collected in soil by pit traps.

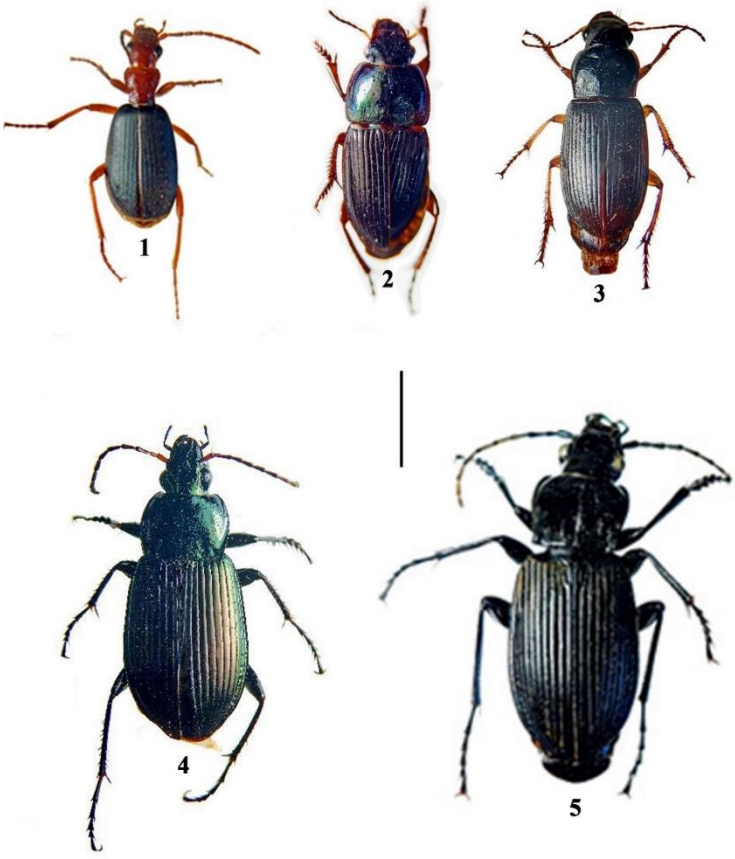
Poecilus lepidus (Leske) (Figure 4)

Material examined: Six specimens, Lahijan, 37°12′15″N 50°00′17″E; September 17, 2022; collected in soil by pit traps.

Pterostichus niger (Schaller) (Figure 5)

Material examined: Eight specimens, Bazkiagorab, 37°21′83.01″N 49°96′78.21″E; September 3, 2022; collected in soil by pit traps.

Remark: The family Carabidae is one of the largest families among the beetles. This family is generally a soil family; hence they are known as ground beetles (Hangay and Zborowski, 2010). The carabids (Coleoptera: Carabidae) are recognized as polyphagous predators and important natural enemies of insect pests and play an important role in agricultural ecosystems by hunting a wide range of pests, including aphids, butterfly larvae, beetle larvae, mites and springtails. They have also been used effectively to control snails and slugs in the greenhouses (Kromp, 1999). *Brachinus crepitans*, *Harpalus affinis*, *Harpalus griseus* and *Pterostichus niger,* recorded from northern provinces (Guilan and Mazandaran) in Iran (Azadbakhsh and Nozari, 2015; Ghahari *et al*., 2010; Salari, 2012).



Figures 1-5. 1. *Brachinus crepitans* (Linnaeus), 2. *Harpalus affinis* (Schrank), 3. *Harpalus griseus* (Panzer), 4. *Poecilus lepidus* (Leske), 5. *Pterostichus niger* (Schaller). Scale bar 4.5 mm for 1, 5 mm for 2, 7 mm for 3, 4.5 mm for 4, 5 mm for 5.

Family Coccinellidae

Adalia bipunctata (Linnaeus) (Figure 6)

Material examined: Twenty specimens, Amirkalayeh, 37°18'48.64"N 50°03'69.16"E; September 28, 2022; collected from the aerial part of the plant by an insect net and direct observation.

Chilocorus bipustulatus (Linnaeus) (Figure 7)

Material examined: Ten specimens, Ahandan, 37°17'51.94"N 49°98'59.87"E; August 3, 2022; five specimens, Lahijan, 37°12′15″N 50°00′17″E; August 27, 2022; collected from the aerial part of the plant by an insect net and direct observation.

Coccinella septempunctata (Linnaeus) (Figure 8)

Material examined: Thirty specimens, Lahijan, 37°12′15″N 50°00′17″E; October 27, 2022; 10 specimens, Lafmejan, 37°19'22.75"N 49°87'46.03"E; October 29, 2022; 12 Ahandan, 37°17'51.94"N 49°98'59.87"E; October 3, 2022; collected from the aerial part of the plant by an insect net, direct observation and light trap.

Cryptolaemus montrouzieri Mulsant (Figure 9)

Material examined: Six specimens, Ezbaram, 37°13'89.29"N 49°91'95.12"E; October 16, 2022; collected from the aerial part of the plant by an insect net and direct observation.

Exochomus nigromaculatus (Goeze) (Figure 10)

Material examined: Ten specimens, Lahijan, 37°12′15″N 50°00′17″E; October 2, 2022; five specimens, Sarcheshmeh, 37°14'65.17"N 50°08'19.47"E; October 16, 2022; four specimens Ezbaram, 37°13'89.29"N 49°91'95.12"E; October 12, 2022; collected from the aerial part of the plant by an insect net and direct observation.

Harmonia axyridis (Pallas) (Figure 11)

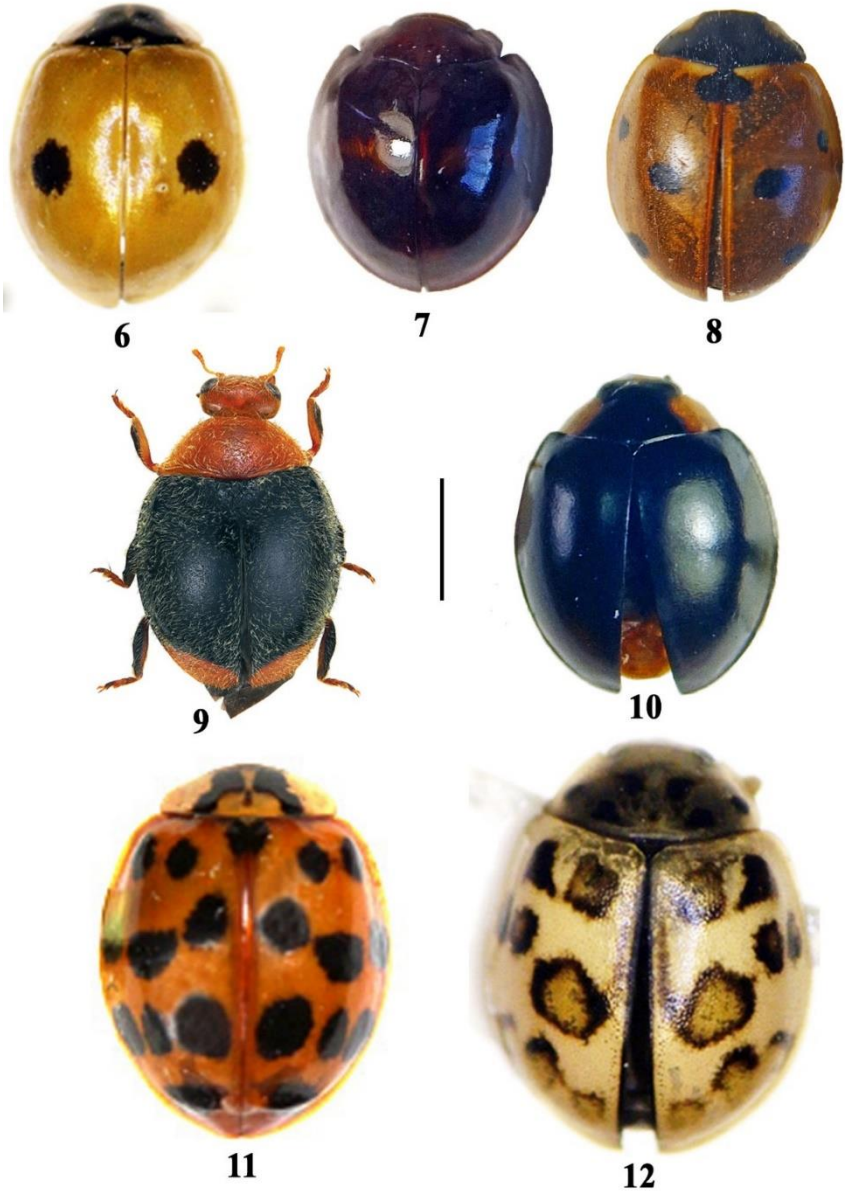
Material examined: Ten specimens, Sostan, 37°17'92.30"N 50°03'25.00"E; October 24, 2022; 20 specimens, Satlesar, 37°16'17.56"N 50°06'31.91"E; October 24, 2022; 10 specimens, Lahijan, 37°12′15″N 50°00′17″E; October 27, 2022; collected from the aerial part of the plant by an insect net, direct observation and light traps.

Oenopia conglobata (Linnaeus) (Figure 12)

Material examined: Five specimens, Lahijan, 37°12′15″N 50°00′17″E; August 9, 2022; collected from the aerial part of the plant by an insect net.

Remark: Coccinellidae is a family of Coleoptera with the largest number of species within the superfamily Coccinelloidea that evolved from a mycophagous to a predatory diet (Giorgi *et al.* 2009). Most species of this family are predators, feeding mainly on different groups of insects such as aphids (Aphididae), soft scales (Coccidae), armoured scales (Diaspididae), mealybugs (Pseudococcidae), whiteflies (Aleyrodidae), psyllids (Psyllidae), thrips (Thysanoptera), moth eggs (Lepidoptera) and other groups. Other favorite prey includes spider mites (Arachnida: Acari: Tetranychidae), (Giorgi *et al.* 2009; Hodek *et al.*, 2012). Although ladybugs are important natural enemies of harmful plant pests, no significant study has been done regarding their identification and use in tea gardens in Iran. Only *Cryptolaemus montrouzieri* Mulsant has been reported from tea gardens in Iran (Shojai, 1989). The *C. montrouzieri* recorded as a natural enemy of *Pulvinaria aurantii* (Cockerell), *Pulvinaria floccifera* (Westwood) and *Nipaecoccus viridis* (Newstead) in citrus gardens of Iran (Moghaddam, 2017). *P. aurantii* and *P. floccifera* are also important pests of tea plants in Iran

(Saber Hamishegi *et al.*, 2024). It is expected that in the future, with more studies, beneficial ladybugs will be used effectively in tea gardens of Iran to control insect and mite pests.



Figures 6-12. 6. *Adalia bipunctata*, 7. *Chilocorus bipustulatus*, 8. *Coccinella septempunctata*, 9. *Cryptolaemus montrouzieri*, 10. *Exochomus nigromaculatus*, 11. *Harmonia axyridis*, 12. *Oenopia conglobata*. Scale bar 2.4 mm for 6, 1.7 mm for 7, 2.9 mm for 8, 1 mm for 9, 1.5 mm for 10, 2.2 mm for 11, 2 mm for 12.

Order: Diptera

Family Syrphidae

Paragus tibialis (Fallén) (Figure 13)

Material examined: Eight specimens, Ahandan, 37°17'18.04"N 49°98'84.72"E; October 1, 2022; collected from the aerial part of the plant by an insect net.

Remark: Most species of the family Syrphidae are diurnal and very active, the adults of many species feed mainly on nectar and pollen, while the larvae show a huge spectrum of feeding habits, and include phytophages, mycophages, saprophages and zoophages. In the most predatory species, the larvae are insectivores, preying on aphids, thrips, and other plant-sucking insects. Predatory syrphid fly species provide natural pest control, known as biological control agents (Vockeroth and Thompson, 1987; Sommaggio, 1999; Price *et al.*, 2019). *Paragus tibialis* has been recorded from different parts of Iran (Dousti and Hayat, 2006; Gilasian and Sorokina, 2011). This is the first record of this species from Guilan province and in the tea gardens of Iran.

Order: Neuroptera

Family: Chrysopidae

Chrysoperla carnea (Stephens) (Figure 14)

Material examined: Ten specimens, Ahandan, 37°17'18.04"N 49°98'84.72"E; August 18, 2022; five specimens, Lahijan, 37°12′15″N 50°00′17″E; April 24, 2023; collected from the aerial part of the plant by an insect net.

Remark: Chrysopidae (green lacewings), is a large family of Neuroptera. The larvae of many chrysopid species feed on insect and mite pests of crops or horticultural plantings, and for this reason, they are important in biological control (Tauber *et al.*, 2009). *Chrysoperla carnea* is one popular species of lacewing used for the biological control of aphids and other small insects. This species was recorded from different parts of Iran (Farahi *et al.*, 2009). This is the first record of this species in the tea gardens of Iran.

Order: Hemiptera

Family Anthocoridae

Amphiareus obscuriceps (Poppius) (Figure 15)

Material examined: Ten specimens, Ezbaram, 37°13'89.29"N 49°91'95.12"E; September 27, 2022; collected by light trap.

Remark: The Family Anthocoridae mostly feed on other small soft-bodied arthropods. Anthocorids are often predacious both as nymphs and adults. They are beneficial as biological control agents. They can feed on plant material but mostly feed on other small soft-bodied arthropods (Lattin, 1999; Horton, 2008). For example, *Orius insidiosus* is often released in greenhouses against mites and thrips. Previously *Amphiareus obscuriceps was* recorded from Guilan provinces in Iran, this species feeds on small arthropods, probably including psocids, thrips, etc. (Linnavuori & Hosseini, 2000). This is the first record of this species in the tea gardens of Iran.

Order: Mantodea

Family: Mantidae

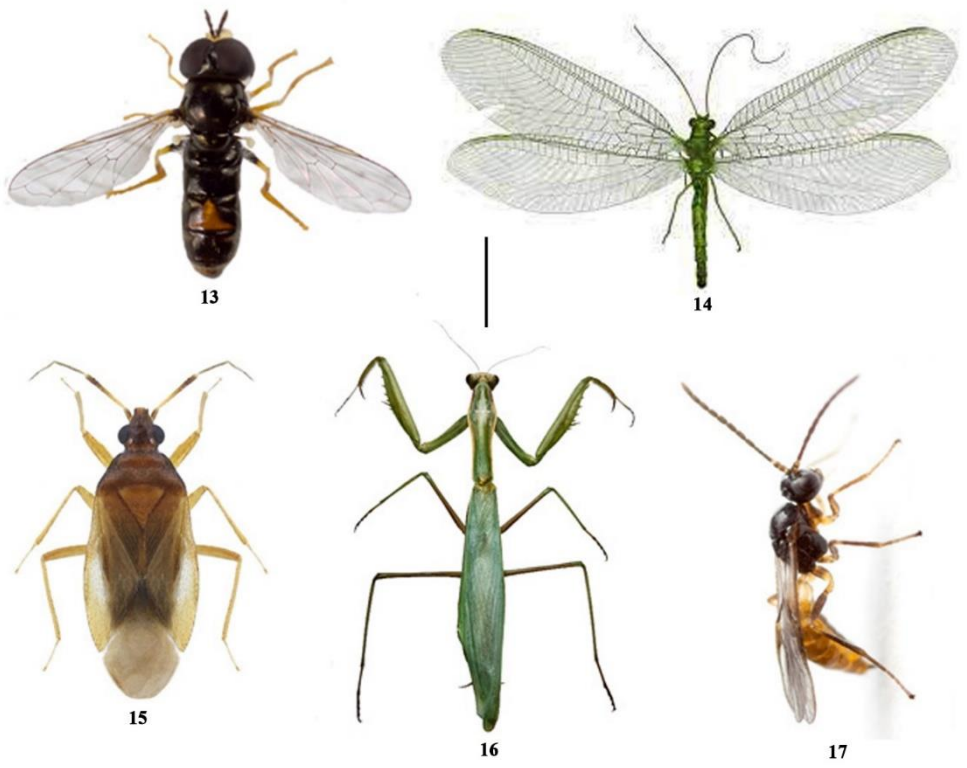
Mantis religiosa (Linnaeus) (Figure 16)

Material examined: Ten specimens, Bazkiagorab, 37°21'83.01"N, 49°96'78.21"E; September 9, 2022; collected by insect net.

Remark: Predatory insects of the family Mantidae play an important role in the population control of noxious insect pests. They are actively feeding on a variety of other insects like grasshoppers, moths, flies and aphids (Helmkampf *et al.*, 2007; Pashaie and Mirzaee, 2017; Panhwar *et al.*, 2020). *Mantis religiosa* recorded from different parts of Iran (Kolnegari, 2023). This is the first record of this species in the tea gardens of Iran.

Parasitoid insects
Order: Hymenoptera
Family: Braconidae
Lysiphlebus fabarum (Marshall) (Figure 17)
Material examined: Twenty specimens, Ezbaram, 37°13'89.29"N 49°91'95.12"E; October 14, 2022; collected from waxed black citrus aphid (*Toxoptera aurantii*) on tea leaves and stem.

Remark: The family Braconidae constitutes one of the largest groups of Hymenoptera with a large number of species worldwide (Yu *et al.*, 2005). Most species of this family are parasitoids, especially in the larval stages of insect pests in different orders, including Coleoptera, Diptera, Hymenoptera and Lepidoptera (Farahani *et al.*, 2016). *Lysiphlebus fabarum* is the most abundant and dominant parasitoid of different species of aphids in Guilan province (Rahimi Kaldeh *et al.*, 2012). This species *was* recorded from different parts of Iran (Yaghobi, 1997). This is the first record of this species in the tea gardens of Iran.



Figures 13-15. 13. *Paragus tibialis*, 14. *Chrysoperla carnea*, 15. *Amphiareus obscuriceps*, 16. *Mantis religiosa*, 17. *Lysiphlebus fabarum*. Scale bar 5.5 mm for 13, 0.4 mm for 14, 4.3 mm for 15, 0.2 mm for 16, 6 mm for 17.

4. Conclusion

The biodiversity of natural enemies in the tea ecosystem has a significant role in the biological control of tea pests. Hundreds of natural enemies have been recorded as parasitoids, predators and pathogens in tea ecosystems all over the world (Hazarika *et al.*, 2001, 2009; Ye *et al.*, 2014). Protection, maintenance, and enhancing the efficacy of the existing population of natural enemies through the use of ecofriendly operations or modification of pesticide practices constitute the main objective of conservation biological control in tea plantations (Jonsson *et al.*, 2008; Hazarika *et al.*, 2009). During 2022-2023, a faunal study was conducted for the identification of predator and parasitoid insects associated with tea plantations in Guilan province, northern Iran. Totally 17 species were collected and identified. *Lysiphlebus fabarum* (Marshall) is parasitoid and other species are predators. All the species of natural enemies reported here except *Cryptolaemus montrouzieri* appeared to be new to the tea gardens of Iran. Among the identified natural enemies, it seems that ladybugs of the family Coccinellidae, ground beetles of the family Carabidae and the parasitoid wasp *Lysiphlebus fabarum* of the family Braconidae are more common and have been identified as the predominant species. In the future, it is necessary to study the biology and mass rearing methods of these beneficial species and use them for control of harmful mites and insects in the tea gardens of Iran.

Acknowledgements

We would like to thank the reviewers for their valuable comments and suggestions to improve the paper's quality.

Conflict of interests

The authors declare that they have no competing interests.

References

Abbasipour, H. & Taghavi, A. (2007). Description & seasonal abundance of the tea mealybug, *Pseudococcus viburni* (Affinis) (Signoret) (Homoptera: Pseudococcidae) Found on Tea in Iran. Journal of Entomology, 4(6), 474-478.

Abbasipour, H., Taghavi, A., Kamali, K. & Sahragard, A. (2007). Biology of tea scarlet mite, *Brevipalpus obovatus* Donnadieu (Acari: Tenuipalpidae) under different temperatures in laboratory conditions. Iranian Journal of Agricultural Sciences, 38 (2), 313-319.

Allegro, G., Magrini, P. & Pavesi, M. (2022). An illustrated key to the species of the genus *Harpalus* recorded from Italy (Coleoptera, Carabidae, Harpalinae) [English version].

Azadbakhsh, S. & Nozari, J. (2015). Checklist of the Iranian ground beetles (Coleoptera; Carabidae). Zootaxa, 4024 (1), 1-108.

Brooks, S. J. (1994). A taxonomic review of the common green lacewing genus *Chrysoperla* (Neuroptera: Chrysopidae). Bulletin of the British Museum of Natural History (Entomology), 63(2), 137-210.

Dousti, A. F. & Hayat, R. (2006). A catalogue of the Syrphidae (Insecta: Diptera) of Iran. Journal of the Entomological Research Society, 8(3), 5-38.

Farahani, S., Talebi, A. A. & Rakhshani, E. (2016). Iranian Braconidae (Insecta: Hymenoptera: Ichneumonoidea): diversity, distribution and host association. Journal of Insect Biodiversity and Systematics, 2(1), 1-92.

Farahi, S., Sadeghi, H. & Whittington, A. E. (2009). Lacewings (Neuroptera: Chrysopidae & Hemerobiidae) from north eastern and east provinces of Iran. Munis Entomology & Zoology, 4(2), 501-509.

Ghahari, H., Avgin, S. S. & Ostovan, H. (2010). Carabid beetles (Coleoptera: Carabidae)

collected from different ecosystems in Iran with new records. Türkiye Entomoloji Dergisi, 34(2), 179-195.
Ghaderi, Z., Menhaj, M. H., Kavoosi-Kalashami, M. & Sanjari, S. M. (2019). Efficiency analysis of traditional tea farms in Iran. Economics of Agriculture, 66, 423-436.
Gilasian, E. & Sorokina, V. S. (2011). The genus *Paragus* Latreille (Diptera: Syrphidae) in Iran, with the description of a new species. Zootaxa, 2764 (1), 49-60.
Giorgi, J. A., Vandenberg, N. J., McHugh, J. V., Forrester, J. A., Ślipiński, A., Miller, K. B., Shapiro, L. R. & Whiting, M. F. (2009). The evolution of food preferences in Coccinellidae. Biological Control, 51, 215–231.
Gordon, R. D. (1985). The Coccinellidae (Coleoptera) of America north of Mexico. Journal of the New York Entomological Society, 93 (1), 1- 912.
Habibian, A. (1989). An overview of the most important tea pests in northern Iran. Proceeding of the 9th Iranian Plant Protection Congress. Ferdowsi University, Mashhad, Iran, p. 5.
Hackston, M. (2019). Keys to the British species of tribe Harpalini (Coleoptera, family Carabidae). 85 pp. Available: https://quelestcetanimal-lagalerie.com/wp-content/uploads/2022/01/Tribe-Harpalini-key-to-British-species.pdf
Hajizadeh, J., Jalali, S. J. & Peyrovi, C. S. H. E. (2003). Introduction a part of the Coccinellids (Col.: Coccinellidae) fauna of Guilan province. Journal of Agricultural Sciences and Natural Resources, 9 (4), 99-111.
Hajizadeh, J., Ramzi, S. & Daghighi, E. (2020). Prostigmatid mites (Acari: Prostigmata) associated with tea orchards in Iran. Journal of Biological Studies, 3(3), 96-110.
Hangay, G. & Zborowski, P. (2010). A guide to the beetle of Australia. CSIRO publishing. Melbourne, 249 pp.
Hazarika, L K, Puzari, K. C. & Wahab, S. (2001). Biological control of tea pests. In: Upadhyay, R. K., Mukerji, K. G. & Chamola B. P. (Ed.) Biocontrol Potential and Its Exploitation in Sustainable Agriculture. Vol. 2: Insect Pests, New York: Kluwer Academic, pp. 159–80.
Hazarika, L. K., Bhuyan, M. & Hazarika, B. N. (2009). Insect pests of tea and their management. Annual review of entomology, 54(1), 267-284.
Helmkampf, M. E., Schwarz, C. J., & Beck, J. (2007). A first look at the biodiversity of praying mantids (Insecta: Mantodea) in Sabah, Borneo. Sepilok Bulletin, 7, 1-13.
Hodek, I., van Emden, H. F. & Honěk, A. (2012). Ecology and behavior of the ladybird beetles (Coccinellidae). Wiley- Blackwell, Chichester, 604 pp.
Horton, D. R. (2008). Minute pirate bugs (Hemiptera: Anthocoridae). Encyclopedia of Entomology, 3, 2402-2412.
Jonsson, M., Wratten, S. D., Landis, D. A. & Gurr, G. M. (2008). Recent advances in conservation biological control of arthropods by arthropods. Biological Control, 45:172–75.
Kavallieratos, N. G., Tomanović, Ž., Petrović, A., Janković, M., Starý, P., Yovkova, M. & Athanassiou, C. G. (2013). Review and key for the identification of parasitoids (Hymenoptera: Braconidae: Aphidiinae) of aphids infesting herbaceous and shrubby ornamental plants in southeastern Europe. Annals of the Entomological Society of America, 106(3), 294-309.
Kolnegari, M. (2023). Mantodea of Iran: A review-based study. Journal of Orthoptera Research, 32(2), 177-188.
Kromp, B. (1999). Carabid beetles in sustainable agriculture: a review on pest control efficacy, cultivation impacts and enhancement. Agriculture, Ecosystem and Environment, 74(1-3), 187- 228.
Lattin, J. D. (1999). Bionomics of the Anthocoridae. Annual Review of Entomology, 44(1), 207-231.
Lindroth, C. H. (1985). The Carabidae (Coleoptera) of Fennoscandia and Denmark. Fauna Entomologica Scandinavica, Scandinavian Science, Vinderup, Denmark, 15(1), 1-225.

Lindroth, C. H. (1986). The Carabidae (Coleoptera) of Fennoscandia and Denmark. Fauna Entomologica, Scandinavian Science, Vinderup, Denmark, 15(2), 225- 497.

Linnavuori, R. E. & Hosseini, R. (2000). Heteroptera of Guilan with remarks on species of the adjacent areas. Part 1. Guilan University Press, Rasht, Iran, 90 pp.

Moghaddam, M. (2017). The scale insects of citrus in Iran (Hemiptera, Coccomorpha) (identification, biology, natural Enemies & distribution). Ministry of Jihad-e Agriculture Agricultural Research, Education & Extension Organization Iranian Research Institute of Plant Protection. 177 pp.

Panhwar, W. A., Tasleem, S., Asif, M., Alam, M., Anwar, F., Nisa, Z. U., Jatoi, N.A. & Bhatti, W. A. (2020). Praying mantis (Mantodea: Dictyoptera) of Pakistan: a review-based study. Bulletin of Environment, Pharmacology and Life Sciences, 9, 180-183.

Pashaie Rad, S. & Mirzaee, Z. (2017). Seven new records of Mantids (Insecta: Mantodea) for Alborz Mountain (Tehran Province) Iran. Iranian Journal of Animal Biosystematics, 13(2), 221-228.

Phong, N. H., Pongnak, W., Soytong, K., Poeaim, S. & Poeaim, A. (2016). Diversity of tea (*Camellia sinensis*) grown in Vietnam based on morphological characteristics & inter-primer binding sites (iPBS) marker. International Journal of Agriculture & Biology, 18, 385-392.

Price, S. & Patterson, R. (2019). Beneficial Predators: Syrphid flies. 3 pp. Available: https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2969&context=extension_curall.

Rahimi Kaldeh, S., Hosseini, R., Hajizadeh, J. & Sohani, M. M. (2012). Molecular identification and detection of *Lysiphlebus fabarum* (Hym.: Braconidae): A key parasitoid of aphids, by using polymerase chain reaction. Journal of Agricultural Science and Technology, 14, 1453-1463.

Ramzi, S. (2017). Tea red mite. Technical publication of Ministry of Jihad–e-Agriculture, Agricultural Research, Education & Extension Organization of Iran. 19 pp.

Ramzi, S., Hajizadeh, J. & Daghighi, E. (2019). First report of damage caused by yellow broad mite *Polyphagotarsonemus latus* (Acari: Tarsonemidae) from tea gardens in Guilan province, Iran. Plant Pest Research 9 (2), 75-79.

Saber Hamishegi, M., Hajizadeh, J. & Ramzi, S. (2024). Major insect pests of tea plant (Camellia sinensis) in Iran. Journal of Biological Studies, 7(2), 54–64.

Salari, M. (2012). Phonestic study of the ground beetles (Coleoptera: Carabidae) in Guilan Province. MSc. Thesis, University of Guilan, 115 pp.

Shojai, M. (1989). Entomology, otology, social life and natural enemies. Tehran University Press, p. 381.

Sommaggio, D. (1999). Syrphidae: can they be used as environmental bioindicators?. Agriculture, Ecosystems & Environment, 74(1-3), 343-356.

Sorokina, V. S. (2009). Hover flies of the genus Paragus Latr. (Diptera, Syrphidae) of Russia and adjacent countries. Entomological Review. 89, 351-366.

Taghavi, A., Kamali, K. & Sahragard, A. (1998). A faunal study of mites associated with tea plant in western region of Mazandaran province. Proceeding of the 13th Iranian Plant Protection Congress. Karaj, Iran, p.100.

Tauber, C. A., Tauber, M. J. & Albuquerque, G. S. (2009). Neuroptera: (lacewings, antlions). In: Resh, Vincent H. & Ring T. Cardé (Eds.). Encyclopedia of insects, Academic Press. pp. 695-707.

Vockeroth, J. R. & Thompson, F. C. (1987). Syrphidae. In: McAlpine, J. F. (Ed.), Manual of Nearctic Diptera Vol. 2., Monograph No. 28. Research Branch, Agriculture Canada, Ottawa. pp. 713–743.

Yaghobi, P. (1997). Investigation of the fauna of Aphididae bees (parasitoids of aphids) in Guilan Province. MSc. Thesis, University of Tehran, 126 pp.

Yamada, K. & Hirowatari, T. (2003). Japanese species of the genus *Amphiareus* Distant

(Heteroptera: Anthocoridae), with descriptions of two new species. Entomological Science, 6(4), 289-300.

Ye, G. Y., Xiao, Q., Chen, M., Chen, X. X., Yuan, Z. J., Stanley, D. W. & Hu, C. (2014). Tea: biological control of insect and mite pests in China, Biological Control, 68, 73-91.

Yu, D. S., Van Achterberg, K. & Horstmann, K. (2005). Biological and taxonomical information: Ichneumonoidea 2004. Taxapad Interactive Catalogue, Vancouver. Available: https://www.catalogueoflife.org/data/dataset/1068

Wolski, G. J., Piwowarczyk, R., Plášek, V., Kukwa, M. & Ruraż, K. (2021). Tea plantations and their importance as host plants and hot spots for epiphytic cryptogams. Scientific Reports, 11(1), 1-14.

Zargari, A. (1990). Medicinal plants (in Persian). Tehran University Press, Iran, Tehran. 942 pp.