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Major insect pests of tea plant (*Camellia sinensis*) in Iran

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Abstract

An extensive survey was carried out during 2022-2023 for collection and identification of insect pests associated with tea plant in Guilan province, North of Iran. A total of 10 species belonging to nine genera and eight families were identified. Considering the species spectrum, the order Hemiptera has been reported as the most prevalent insect order with seven species followed by Thysanoptera (with two species) and Orthoptera (with one species). Out of 10 species of insects reported *Toxoptera aurantii* (Boyer de Fonscolombe), *Pseudococcus viburni* (Signoret), *Pulvinaria floccifera* (Westwood), *Pulvinaria aurantii* (Cockerell), *Thrips hawaiiensis* (Morgan) and *Heliothrips haemorrhoidalis* (Bouché) have been identified as the predominant species and therefore considered as the pests of major importance. All identified species except *T. aurantii*, *P. floccifera* and *P. viburni* appeared new to tea gardens of the Guilan province. An alphabetic list of the identified insect pest species and collection information has been provided.

Key words: Tea, Guilan, insects, new record, damage

1. Introduction

Tea (*Camellia sinensis* (L.) O. Kuntze) is one of the most popular and lowest cost beverages in the world and is consumed by a wide range of age groups in all levels of society with more than three billion cups daily worldwide (Hick, 2009; Phong *et al.*, 2016). According to FAO, 2005, tea is cultivated on more than 2.7 million hectares in around 34 countries across Africa, Asia, Oceania and Latin America to produce more than 3.2 million metric tons of made tea per annum (Deka *et al.*, 2020). According to the World Food Organization (2018), Iran with an acreage of 23380 hectares of tea plantation (95 per cent are located in Guilan province and the rest in Mazandaran province) and dry tea production of 179287 tons is the ninth largest tea producer in the world (Ghaderi *et al.*, 2019; Ministry of Agricultural Jihad, 2023).

The important pests of tea are insects and mites. Globally, 1031 arthropod species are associated with tea (Hazarika *et al.*, 2009) and are attacked by nearly 250 insect species (Barthakur, 2011). The important insect pests of tea in India (as major tea producers in the

world) belong to the orders of Lepidoptera, Hemiptera and Coleoptera (Muraleedharan & Roy, 2016). During the last few decades, the infestation of thrips has been increasing and *Scirtothrips dorsalis* Hood get recognized as the foremost sucking pest in the tea-cultivated regions in India (Deka *et al.*, 2020). The main insect pests of tea in Iran are the grape mealybug, *Pseudococcus maritimus* (Ehrhorn), obscure mealybug, *Pseudococcus viburni* (Signoret); dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan); cottony camellia scale, *Pulvinaria floccifera* (Westw); and black citrus aphid, *Toxoptera aurantii* (Boyer de Fonscolombe) (Habibian, 1989; Abbasipour & Taghavi, 2007; Ramzi, 2017). Some researchers believe that *Pseudococcus viburni* was incorrectly identified as *P. maritimus* for many years in Iran (Kiriukhin, 1947; Moghaddam, 2013). The privet mite, *Brevipalpus obovatus* (*Donnadieu*) and yellow tea mite, *Polyphagotarsonemus latus* (Banks) are recorded as important injurious mites of tea plants in Iran (Taghavi *et al.*, 1998; Abbasipour *et al.*, 2007; Ramzi *et al.*, 2019; Hajizadeh *et al.*, 2020).

The review of the literatures shows that complete research has not been done to identify injurious and beneficial insects associated with tea plantations in Iran. The main purpose of this article is to review the insect pests of tea plants in Iran. Due to the importance of tea cultivation in Lahijan city, Guilan province, a detailed survey was conducted on pests of tea gardens in this city.

2. Materials and methods

To identify insect pests of tea plants in Lahijan city, Guilan province, sampling was done during the summer and autumn seasons of 2022 and the spring season of 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 thrips, aphids and scale insects. 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 mounted on cardboard points. Large insects such as grasshoppers, were pinned by insect needles. The insects were identified using valid keys available in relevant books and scientific articles. For final confirmation, some samples were sent to relevant specialists. All materials 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 the survey for insect pests in tea gardens in Lahijan city, Guilan province a total of 10 species belonging to nine genera and eight families were collected and identified. An alphabetic list of the identified insect pest species of the tea gardens in Lahijan city and collection information has been provided. All species except *Toxoptera aurantii*, *Pulvinaria floccifera* and *Pseudococcus viburni* were recorded for the first time from the tea gardens of the Guilan province.

Order: Hemiptera

Family: Aphididae

Toxoptera aurantii (Boyer de Fonscolombe) (Figures 1 & 2)

Material examined: A large number of aphids were collected from Lahijan, 37°12'21.1"N 50°00'09.8"E, September 26, 2022; Ezbaram, 37°08′33″N 49°54′08″E, October 1, 2022; Bazkiagorab, 37°21′83.01″N 49°96′78.21"E, October 1, 2022; Goharsara, 37°18′74.16"N 50°03′98.67"E, October 4, 2022; Ahandan, 37°17′51.94"N 49°98′59.87"E, October 17, 2022; collected by direct observation.

Remark: The members of the family Aphididae feed on plant sap of leaves and buds in a colony, and by secreting honeydew, they attract sooty mold (Singh & Singh, 2021). *T. aurantii* is one polyphagous species, having been recorded from plants in at least 190 genera in 80

families. Its hosts include many economically important plants besides citrus, e.g. coffee, tea, cacao, *Camellia,* avocado, mango, Piper and fig. This species is a more efficient vectors of citrus tristeza and Coffee Ring Spot diseases (Carver, 1978; Sevim *et al.*, 2012). In Iran this species is collected on citrus, tea and ornamental plants in Northern provinces (especially Guilan and Mazandaran), its population on tea plants is impressive (Rezwani, 2004).

Family: Coccidae

Pulvinaria aurantii (Cockerell) (Figures 5 & 6)

Material examined: A large number of scale insects were collected from Bazkiagorab, 37°21′83.01″N 49°96′78.21"E, May 15, 2023; collected by direct observation.

Pulvinaria floccifera (Westwood) (Figures 3 & 4)

Material examined: A large number of scale insects were collected from Bazkiagorab, 37°21′83.01″N 49°96′78.21"E, May 15, 2023; collected by direct observation.

Remark: The species of the family Coccidae cause damage in two direct and indirect ways, direct damage is in the form of penetration to plant tissue through insect feeding, and indirect damage is in the form of contamination of the plant surface with sooty mold and transmission of pathogens (Vranjic, 1997). Both species *P. aurantii* and *P. floccifera* are recorded on citrus, tea and ornamental plants in Northern provinces (especially Guilan and Mazandaran) (Esmaili, 1983; Moghaddam, 2010; Naeimamini *et al.*, 2014; Ramzi, 2017; Moghaddam, 2017).

Family: Cydnidae

Cydnus aterrimus (Forster) (Figure 7)

Material examined: Eight specimens, Lahijan, 37°12'21.1"N 50°00'09.8"E, August 21, 2022; collected from the soil.

Remark: Most members of this family are phytophagous and feed on plant roots some species are mycetophagous (Yazici *et al.*, 2015). In Iran *Cydnus aterrimus* previously recorded in Mazandaran and Guilan provinces in rice and peanut fields (Linnavuori, 2007a; Askari, 2023). This is the first record of this pest in the tea gardens of Iran.

Family: Lygaeidae

Nysius cymoides (Spinola, 1837) (Figure 8)

Material examined: 10 specimens, Sarcheshmeh, 37°14'6517"N 50°08'19.47"E, October 16, 2022; collected from insect net.

Remark: The species of family Lygaeidae mainly feed on plants and seeds (Eiben & Rubinoff, 2010). Some species of genus *Nysius* were recorded from different parts of Iran on steppes, meadows and fields (Linnavuori, 2007b). *Nysius cymoides* is recorded from different parts in Guilan province on steppes, meadows and fields (Linnavuori, 2007b). This is the first record of this pest in the tea gardens of Iran.

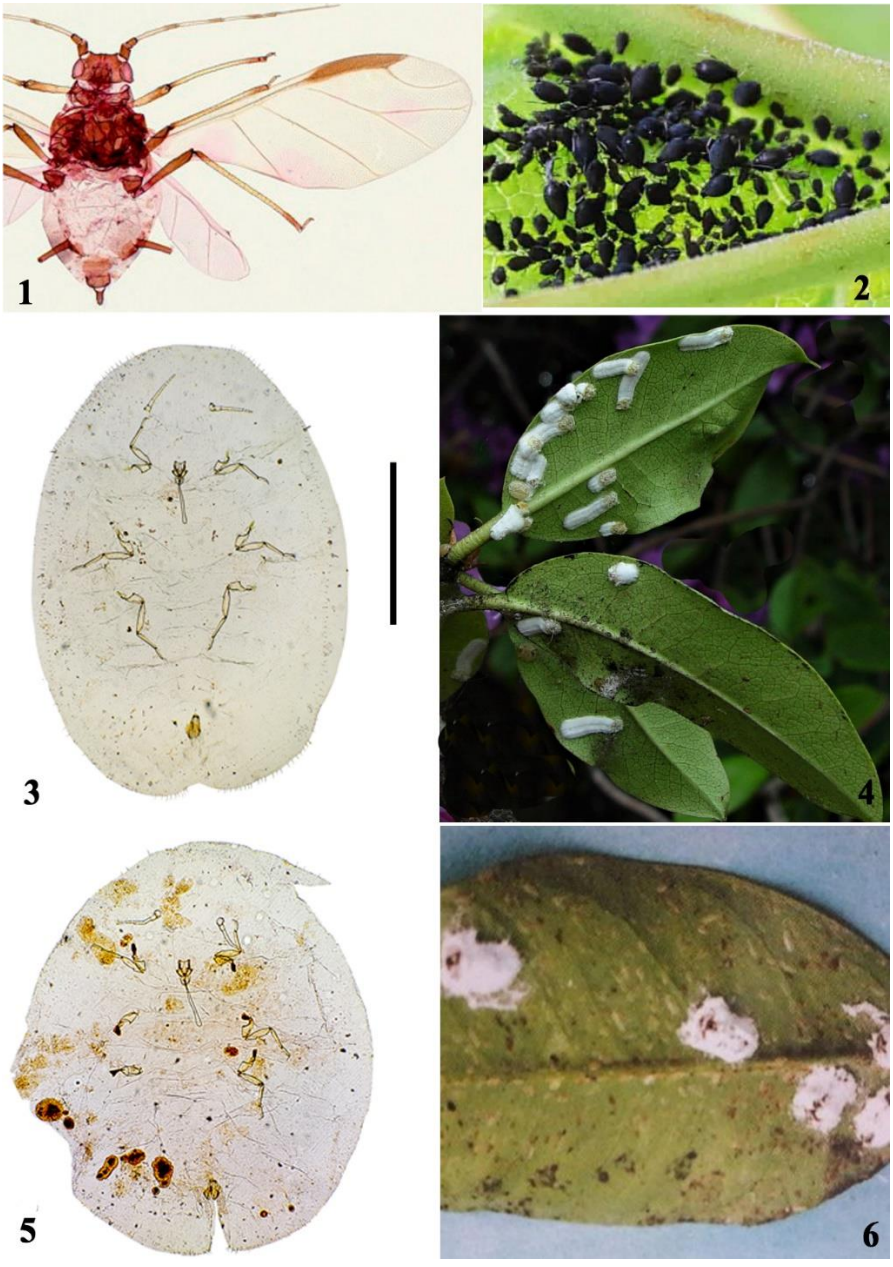
Family: Pseudococcidae

Pseudococcus viburni (Signoret) (Figures 9 & 10)

Material examined: A large number of this species were collected in, Lahijan, 37°12'21.1"N 50°00'09.8"E, September 21, 2022; Bazkiagorab, 37°21′83.01″N 49°96′78.21"E, September 24, 2022; collected by direct observation.

Remark: Mealybugs are important plant pests worldwide, their feeding may cause leaf yellowing, defoliation, reduced plant growth and death of plants. They may also damage plants indirectly, by transmission of plant diseases. In addition, the production of honeydew contributes to the development of sooty mold that decreases photosynthesis and may reduce the marketability of fruits, leaves etc. (Miller *et al.*, 2002, 2005; Hull, 2014). In Iran, *P. viburni* occurs in Esfahan, Guilan, Khorasan, Khouzestan, Mazandaran and Tehran provinces. *Pseudococcus viburni* is a common polyphagous mealybug in many parts of northern Iran.

This mealybug is a dominant species in tea gardens in Mazandaran and Guilan provinces in northern Iran (Abbasipour & Taghavi, 2007; Hosseini & Hajizadeh, 2011; Moghaddam, 2013).



Figures 1-6: 1-2. *Toxoptera aurantii*: 1. Body, 2. Aphid on leaf; 3-4. *Pulvinaria floccifera*: 3. Body, 4. Scale on leaf; 5-6. *Pulvinaria aurantii*: 5. Body, 6. Scale on leaf. Scale bar 1 mm for 1, 3 mm for 3 and 1.5 mm for 5.

Family: Ricaniidae

Orosanga japonica (Melichar) (Figures 11 & 12)

Material examined: A large number of this species were collected in Bazkiagorab, 37°21′83.01″N 49°96′78.21"E, September 9, 2022; Lahijan, 37°12'21.1"N 50°00'09.8"E, September 17, 2022; collected by insect net.

Remark: The members of the family Ricaniidae are important due to their large population, spawning, honeydew secretion, polyphagous feeding habits and disease vectors (Park & Jung, 2021). *Orosanga japonica* is an invasive and polyphagous pest in the Palearctic region, this pest was reported from the northern part of Iran on citrus orchards in 2010. During 2013-2016 many specimens were collected among large populations of Kiwi fruit and fig in other localities in the northern provinces of Iran (Mozaffarian, 2018). Nymphs and adults of the pest cause economic and critical damage to different plants by direct feeding and heavy deposits of honeydew on leaves. This is the first record of this pest in the tea gardens of Iran.

Order: Orthoptera

Family: Tettigoniidae

Leptophyes punctatissima (Bosc) (Figures 13 & 14)

Material examined: Ten specimens were collected from Lahijan, 37°12'21.1"N 50°00'09.8"E, April 18, 2023; collected by insect net.

Remark: The members of the family Tettigoniidae are herbivorous to omnivorous (Naskrecki, 2013). *Leptophyes punctatissima* is a flightless species of bush-cricket belonging to family Tettigoniidae. The speckled bush-cricket is common across much of Europe. This species mainly occurs in dry shrubby environments, in open woodland, in scrub, hedgerows and gardens, with birch, bramble and gorse (Davies, 1987). This is the first record of this pest in the tea gardens of Iran.

Order: Thysanoptera

Family: Thripidae

Heliothrips haemorrhoidalis (Bouché) (Figures 15 & 16)

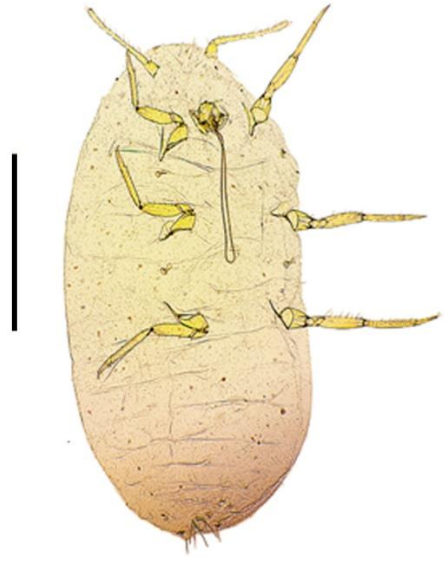
Material examined: A large number of specimens were collected on flowers, buds and leaves of tea plants from Khortay, 37°12′61.43″N, 50°00′01.16″E, May 21, 2023; collected by direct observation and Berlese funnel.

Thrips hawaiiensis (Morgan) (Figures 17 & 18)

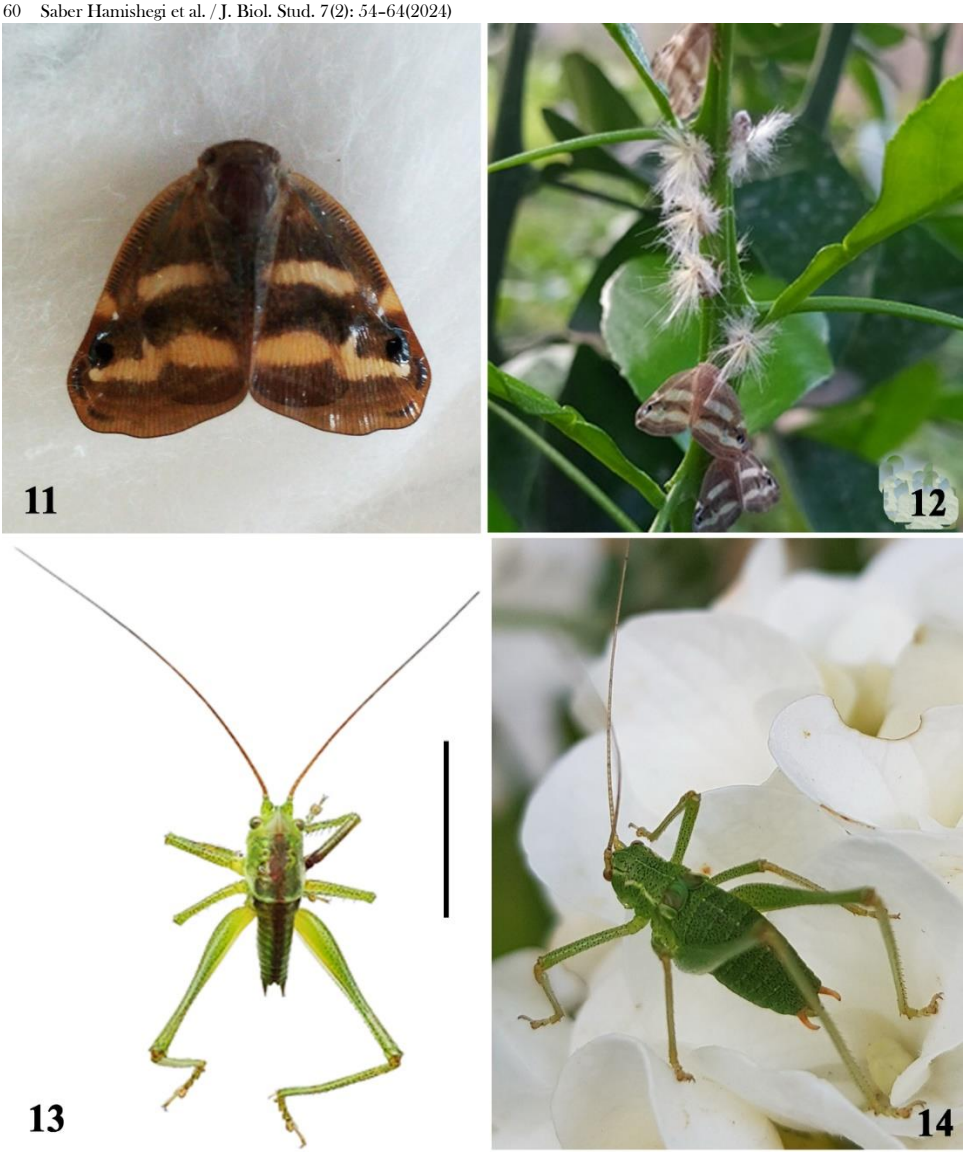
Material examined: A large number of specimens were collected on flowers, buds and leaves of tea plants from Ahandan, 37°17′51.94"N 49°98′59.87"E, October 1, 2022; Lahijan, 37°12'21.1"N 50°00'09.8"E, October 1, 2022; Ezbaram, 37°08′33″N 49°54′08″E, October 1, 2022; collected by direct observation and Berlese funnel.

Remark: Some species of the family Thripidae are pests of crops and flowers, either by direct damage caused to plant tissue during feeding or by transmission of pathogenic agents, especially viruses (Mirab-balou, 2013). Feeding of the thrips causes shortness of the bushes and deformation of leaves, few species carry viruses (Sarwar, 2020). *Heliothrips haemorrhoidalis* is a minor pest of tea in Hawaii. Greenhouse thrips feed on plant sap, and the damage causes a silvering of the leaf. These thrips appear to prefer living and feeding on the undersides of the older leaves of a tea plant. They cause a characteristic fecal spotting, which appears as dark specks on the leaf. These insects prefer to live in the shady areas of the tea tree canopy and do not appear to damage the tea shoot (Hamasaki *et al.*, 2008). In South India, this species attacks tea leaves (Muraleedharan & Kandaswamy, 1980). *H. haemorrhoidalis* recorded from Mazandaran, Guilan and Kordestan provinces in Iran (Mirab-balou, 2013). *Thrips hawaiiensis* is one of the most common flowers inhabiting thrips distributed in the different parts of the world. *T. hawaiiensis* considered to be a minor pest of tea plants in Japan, even though very large numbers of *T. hawaiiensis* were occasionally

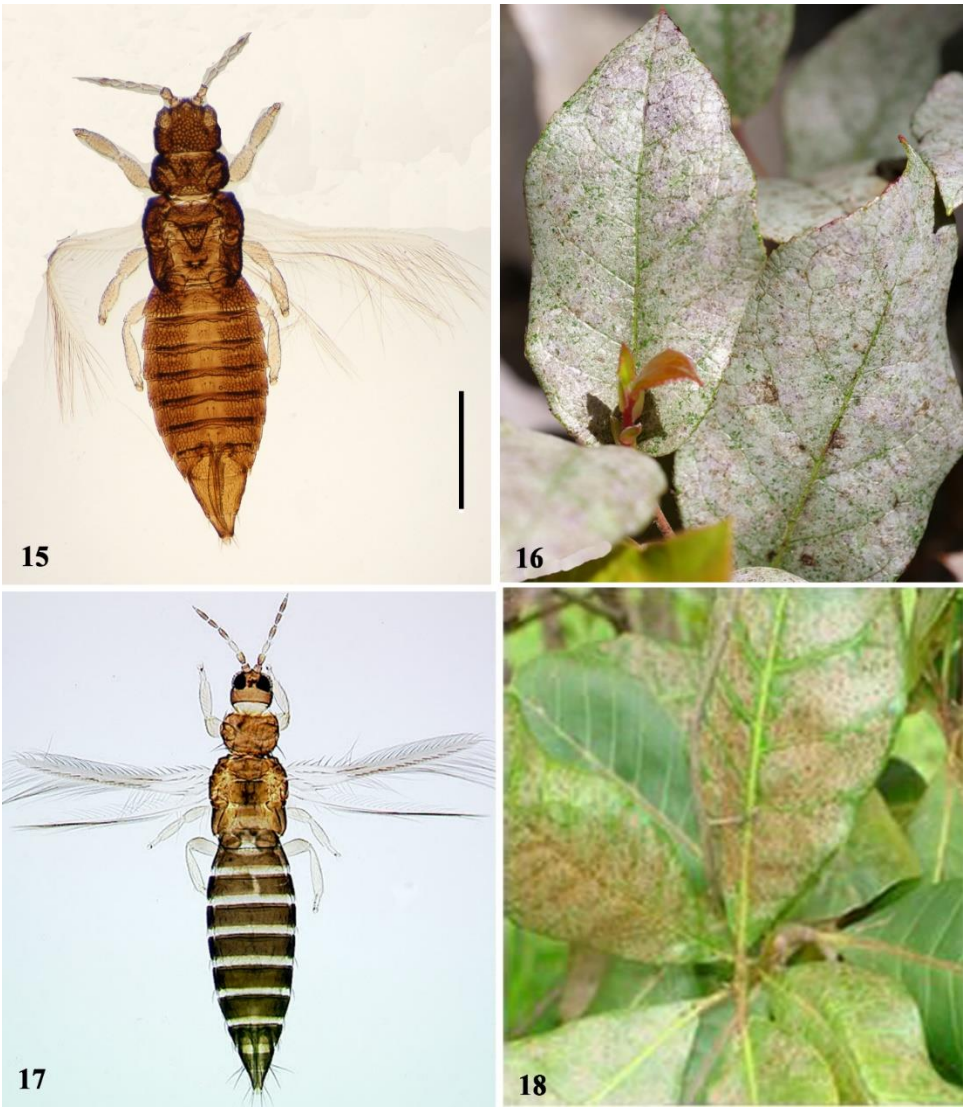
observed in flowers of tea plants (Okada & Kudo, 1982; Murai, 2001). This species was recorded as one tea leaf feeder pest in China (Mirab-balou *et al.*, 2012). *T. hawaiiensis was* recorded from Isfahan and Hamedan provinces in Iran (Mirab-balou, 2013). This is the first record of *H. haemorrhoidalis* and *T. hawaiiensis* in the tea gardens of Iran.



Figures 7-10: 7. *Cydnus aterrimus*, 8. *Nysius cymoides*, 9-10. *Pseudococcus viburni*: 9. Body, 10. Mealybug on leaf. Scale bar 6 mm for 7, 1.6 mm for 8 and 1 mm for 9.



Figures 11-14: 11-12. *Orosanga japonica*, 13-14. *Leptophyes punctatissima*. Scale bar 4.5 mm for 11, 12 mm for 13.



Figures 15-18: 15-16. *Heliothrips haemorrhoidalis*: 15. Adult thrips, 16. Damaged leaf; 17-18. *Thrips hawaiiensis*: 17. Adult thrips, 18. Damaged leaf. Scale bar 0.4 mm for 15, 0.4 mm for 17.

4. Conclusion

During 2022-2023, a faunal study was conducted for the identification of insect pests associated with tea plantations in Lahijan city, Guilan province, Northern Iran. Totally ten insect pest species were identified. Among identified species *Toxoptera aurantii* (Boyer.), *Pseudococcus viburni* (Signoret), *Pulvinaria floccifera* (Westwood), *Pulvinaria aurantii* (Cockerell), *Thrips hawaiiensis* (Morgan) and *Heliothrips haemorrhoidalis* (Bouché) have been identified as the predominant species and therefore considered as the pests of major

importance. In the future, it is necessary to study the biology of these pest species and their natural enemies in the tea gardens of Iran.

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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.

Askari, M. (2023). Identification of insects & mites associated with peanut fileds in Astaneh-ye-Ashrafieh. MSc. Thesis, University of Guilan, 139 pp.

Barthakur, BK. (2011). Recent approach of Tocklai to plant protection in tea in North East India. *Science* and Culture 77(9-10), 381-384.

Carver, M. (1978). The Black Citrus Aphids, *Toxoptera citricidus* (Kirkaldy) & *T. aurantii* (Boyer de Fonscolombe) (Homoptera: Aphididae). Journal Austrian Entomological Society, 17, 263 – 270.

Davies, M. (1987). Grasshoppers, crickets & bush-crickets in Devon. Nature in Devon, 8, 45-64.

Deka, B., Babu, A. & Sarkar, S. (2020). *Scirtothrips dorsalis*, Hood (Thysanoptera: Thripidae): A major pest of tea plantations in North East India. Journal of Entomology & Zoology Studies, 8, 1222-1228.

Eiben, J. A., & Rubinoff, D. (2010). Life history & captive rearing of the Wekiu bug (*Nysius wekiuicola*, Lygaeidae), an alpine carnivore endemic to the Mauna Kea volcano of Hawaii. Journal of Insect Conservation, 14 (6), 701-709.

Esmaili, M. (1983). The important pests of fruit trees. Sepehr Publication, Tehran, Iran, 578 pp.

Ghaderi, Z., Menhaj, M.H., Kavoosi-Kalashami, M. & Sanjari, S.M. (2019). Efficiency analysis of traditional tea farms in Iran. Economics of Agriculture, 66(2), 423–436.

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.

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.

Hamasaki, R.T., Shimabuku, R. & Nakamoto, S.T. (2008). Guide to insect and mite pests of tea (*Camellia sinensis*) in Hawaii. Cooperative Extension Service, University of Hawaii, IP 28, 15 pp.

Hazarika, L. K., Bhuyan, M. & Hazarika, B. N. (2009). Insect pests of tea & their management. Annual Review of Entomology, 54, 267-284.

Hick A. (2009). Current status & future development of global tea production & tea product. Assumption University, Journal of Technology, 12(4), 251–264.

Hosseini, R. & Hajizadeh, J. (2011) Molecular identification of three of the most important mealybug species (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) on ornamental plants in Guilan, Iran. Zootaxa, 3009, 46–54.

Hull, R. (2014). Plant to plant movement. In Hull, R. (Ed.). Plant virology, Academic Press, London, pp. 669-751.

Kiriukhin, G. (1947). Les cochenilles farineuses et leurs parasites en Iran (Sous-famille: Pseudococcinae). Entomologie et Phythopathologie Appliquees, 4, 1-17.

Linnavuori, R.E. (2007a). Studies on the Piesmatidae, Berytidae, Pyrrhocoridae, Stenocephalidae, Coreidae, Rhopalidae, Alydidae, Cydnidae, & Plataspidae (Heteroptera) of Gilan & the adjacent provinces in northern Iran. Acta Entomologica Musei Nationalis Pragae, 47, pp.77-91.

Linnavuori, R.E. (2007b). Studies on the Lygaeidae s. lat. (Heteroptera) of Gilan & the adjacent provinces in northern Iran. Acta Entomologica Musei Nationalis Pragae, 47, 57-75.

Miller, D.R., Miller, G.L. & Watson, G.W. (2002). Invasive species of mealybugs (Hemiptera: Pseudococcidae) & their threat to US. Agriculture. Proceedings of the Entomological *Society* of *Washington*, 104, 825-836.

Miller, G.L., D.R. Miller, G.S. Hodges & Davidson, A. (2005). Introduced scale insects (Hemiptera: Coccidea) of the United States & their impact on U.S. Agriculture. Proceedings of the Entomological *Society* of *Washington*, 107: 123-158.

Ministry of Agricultural Jihad of Iran, Statistics Center. (2023). Statistics of Agriculture, garden and greenhouse products in 2022. 401 pp.

Mirab-balou, M. (2013). A checklist of Iranian thrips (Insecta: Thysanoptera). Far Eastern Entomologist, 267: 1-27.

Mirab-balou, M., Tong XiaoLi, T.X. & Chen XueXin, C.X., (2012). Thrips species associated with tea (*Camellia sinensis*) in Hangzhou, China. Persian Gulf Crop Protection 1(1), 29-35.

Moghaddam, M. (2010). Scale insect (Hemiptera: Coccoidea) fauna of the southern coast of Caspian Sea (Golestan, Mazandaran & Gilan Provinces, Iran). Journal of Entomological Society of Iran, 29(2), 65–98.

Moghaddam, M. (2013). A review of the mealybugs (Hemiptera: Coccoidea: Pseudococcidae, Putoidae and Rhizoecidae) of Iran, with descriptions of four new species and three new records for the Iranian fauna. Zootaxa, 3632 (1), 1–107. doi: 10.11646/Zootaxa.3632.1.1.

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.

Mozaffarian, F. (2018). An Identification key to the species of Auchenorrhyncha of Iranian fauna recorded as pests in orchards & a review on the pest status of the species. Zootaxa, 4420(4), 475-501.

Murai, T. (2001). Development & reproductive capacity of *Thrips hawaiiensis* (Thysanoptera: Thripidae) & its potential as a major pest. Bulletin of Entomological Research, 91(3), 193-198.

Muraleedharan, N. & Kandaswamy, C. (1980). Tea thrips & their control. Planters' Chronicle (India), 75: 447-448.

Muraleedharan, N. & Roy, S. (2016). Arthropod pests & natural enemy communities in tea ecosystems of India. Economic & Ecological Significance of Arthropods in Diversified Ecosystems: Sustaining Regulatory Mechanisms, 361-392.

Naskrecki, P. (2013). Grasshoppers & their Relatives. Encyclopedia of Biodiversity, 3, 722–736.

Naeimamini, S., Abbasipour H. & Aghajanzadeh, S. (2014). Spatial distribution of the cottony camellia scale, *Pulvinaria floccifera* (Westwood) (Hemiptera: Coccidae) in the tea orchards. Journal of Plant Protection Research, 54 (1), 44−52.

Okada, T. & Kudo, I. (1982). Relative abundance & phenology of Thysanoptera in a tea field. Japanese Journal of Applied Entomology & Zoology 26, 96–102. (in Japanese with English summary).

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.

Park, J., & Jung, S. (2021). Taxonomic review of the family Ricaniidae (Hemiptera: Auchenorrhyncha: Fulgoroidea) from Korea. Journal of Asia-Pacific Entomology, 24(4), 1286-1300.

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.

Rezwani, A. (2004). Aphids on Trees & Shrubs in Iran. Agricultural Research, Education Organization, Tehran, 270 pp.

Sarwar, M. (2020). Insects as transport devices of plant viruses. In Awasthi L.P. (Ed.). Applied Plant Virology, Academic Press, pp. 381-402.

Sevim, E., Celebi, O. & Sevim, A. (2012). Determination of the Bacterial Flora as a Microbial Control Agent of *Toxoptera aurantii* (Homoptera: Aphididae). Biologica, 67, 397 -404.

Singh, R. & Singh, G. (2021). Aphids, In Omkar (Ed.). Polyphagous Pests of Crops, springer press, Singapore. pp. 105-182.

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.

Vranjic, J. A. (1997). Effects on host plant. In Ben-Dov, V. & Hodgson. C. J. (Eds.). World Crop Pests, Volume 7, Part A, *Elsevier,* pp. 323-336.

Yazici, G., Avar, Y., & Yildirim, E. (2015). Contribution to the knowledge of the Cydnidae (Hemiptera, Heteroptera, Pentatomoidea) fauna of Turkey. Turkish Journal of Zoology, 39(4), 604-609.