PEST SPECIES OF APHIDOMORPHA AND COCCOMORPHA (HEMIPTERA) ON CONIFERS URBAN AREAS OF ANKARA, TURKEY

Selma Ülgentürk*, Işıl Özdemir, Murat Muştu***, Özlem Dostbil**** and Candan Erbaş*******

* Ankara University Faculty of Agriculture, Department of Plant Protection, Ankara, TURKEY.
** Ministry of Food, Agriculture and Livestock, Directorate of Plant Protection Central Research Institute, Ankara, TURKEY.
*** Erciyes University Seyrani Faculty of Agriculture, Department of Plant Protection, Kayseri TURKEY.
**** Ministry of Forestry and Water Affairs, General Directorate of Forestry, Central Anatolia Forestry Research Institute, Ankara, TURKEY.
***** Ministry of Food, Agriculture and Livestock, Agriculture and Rural Support Institution, Ankara, TURKEY.

[Ülgentürk, S., Özdemir, I., Muştu, M., Dostbil, Ö. & Erbaş, C. 2019. Pest species of Aphidomorpha and Coccomorpha (Hemiptera) on conifers urban areas of Ankara, Turkey. Munis Entomology & Zoology, 14 (1): 51-61**]**

ABSTRACT: Due to the fact that coniferous trees are evergreen, they have a peculiar importance for the urban ecosystem. Apart from air pollution and other negative factors, they are susceptible to infestations caused by insects and other hazardous elements. For the purpose of establishing the species of Aphidomorpha and Coccomorpha (Hemiptera) seen on coniferous trees in Ankara Metropolitan Municipality urban green spaces, samples were collected from major parks, urban forests (Kazan, Beynam, Kızılcahamam, Oran) and also from street trees between the years of 2006-2016. As a result of the study, 13 species of Aphidomorpha –belonging to Lacninae (12), Adelgidae (1), and 13 species of Coccomorpha –belonging to Coccidae (3), Diaspididae (8), Pseudococcidae (1) and Matsucoccidae (1) were determined on coniferous trees. Of these species *Physokermes piceae* Schrank, 1801 on spruce trees, *Torosaspis cedricola* (Balachowsky & Alkan, 1956) and *Cinara cedri* Mimeur, 1936 on cedar trees, *Leucaspis pusilla* Löw, 1883 on pine trees were found to be the most common species. Especially the first two species mentioned above were observed to cause the hosts to dry and die. *Nemolecanim abietis* Borchsenius, 1955 was recorded on *Abies nordmanniana* (Steven) for the first time. Information as to *Matsucoccus pini* (Green, 1925), one of the less-known species was also provided.

KEY WORDS: *Torosaspis cedricola, Physokermes piceae, Nemolecanium abietis, Matsucoccus pini,* pine, fir, cedar

Being one of the evergreen plants, Coniferous trees are among the most common tree species used in urban green spaces because of their beauties, and durability and also of their dust suppression, habitat offering birds and other properties. Among the evergreen plants used in urban forests and city green spaces in Ankara are cedar trees (*Cedrus atlantica* (Endl.), *C. libani* (A. Rich), *C. deodora* (Roxb.) Pinaceae), cypress trees (*Cupressus* sp., Cupressaceae), fir trees (*Abies nordmanniana* (Steven) Spach, *A. bornmüllerina* (Mattf., Pinaceace), juniper trees (*Juniperus* sp. Cupressaceae), pine trees (*Pinus nigra* J.F.Arnold, *P. sylvestris* (L.), *P. brutia* Ten. etc., Pinaceace), spruce trees (*Piceae pungens* Engelm., *P. abies* (L.) (=*P. excelsa*), *P. orientalis* (L.) Pinaceace), (Arslan & Çelem, 2001). Endeavors to increase green spaces in Ankara have gained momentum in recent years, and it was announced that green area volume per

person in Ankara was 19.85 m² in 2016 (https://www.ankara.bel.tr/index.php?cID=4245).

Insects are the major factors that afflict damage to coniferous trees which take long years to grow. Aphids (Aphidomorpha) and scale insects (Coccimorpha) (Hemiptera) feed by sucking the sap of plants, and cause reduced host vigor, reduced productivity, defoliation, premature falling of leaves and dieback of braches. Similarly, the feeding habits of these insects (especially aphids) might pave the way for the disfiguration of the plant and gall formations (Kidd, 1988; Kozstarab & Kozar, 1988; Johnson & Lyon, 1991). Generally, aphids and scale insects (except Diaspididae) secrete honeydew that covers all parts of the plant, and disfigures it, causing fumagine. This impacts the plant photosynthesis negatively and as a result less sugar is produced in the fruits and ornamental plant loses their aesthetic value (Miller & Davidson, 2005). Both Aphids and Coccoids are separated from other insects in terms of their morphological and biological properties. Scale insects have powdery, waxy, hardy covering, and on the whole, inhabit on the plant constantly except for some biological stages. Crawlers and winds play an important role in natural spreading of these species (Kozstarab & Kozar, 1988). Aphids on the other hand, can infest the far-away host plants easily thanks to their wings. Since aphids reproduce in viviparous and parthenogenetic forms during summer seasons, their reproduction capacities are very high. Likewise, especially aphids are also known as the vector of most plant diseases.

Özkazanç & Yücel (1985) established that four aphid species fed on conifers in semi-arid regional plantations. Ülgentürk et al. (2013), also added that *Cinara palaestinensis* Hille Ris lambers 1948*, C. pilicornis* (Harting, 1895), *Eulachnus rileyi* (Williams, 1911) and *Schizolachnus pineti* (Fabricius 1781) were found in the forests of western coastal regions of Turkey, and that their secretions were used an alternative source to produce honeydew honey by honeybees. Besides aphids, scale insects have harmful effects on coniferous trees (Ülgentürket al., 2004). It has been reported that 11 Coccoidea species on cedar trees (Ülgentürk et al., 2012a) and 13 Coccoidea species on pine trees inflict damage (Ülgentürk et al., 2012b). The fact that a number of forest trees are used as park trees and new plant species are imported as ornamental plants may lead new insect species to enter the country. Species which don't cause a serious damage in their natural habitat may reproduce uncontrollably and inflict damage in a new ecosystem as they may not have natural enemies. While *Torosaspis* (*Acanthomytilus*) *cedricola* (Balachowsky & Alkan, 1956) (Hemiptera: Diaspididae), for example, sustain their existence in low populations in natural cedar forests, it is the major pest of cedar trees in urban greenbelts (Şahin & Ülgentürk, 2012; Dostbil & Ülgentürk 2016).

In parallel with increasing population in big cities, ever-increasing concretion stress makes the conservation of available green areas more important than ever. A successful combat against the pests in a most efficient way requires an insight into the recognition of pests and their biology. The fact that scale insects and some aphids are covered with a peculiar waxy and powdery protective layer makes this fact more important. In this study we have embarked on establishing Aphidomorpha and Coccomorpha (Hemiptera) species found on coniferous trees in the urban forests and parks within the boundaries of Ankara Metropolitan Municipality.

MATERIAL AND METHOD

We took samples from the main parks, gardens, street trees and urban forests to the east, west, north and south of the city in a way to represent Ankara in order to collect Aphidomorpha and Coccomorpha species found on coniferous trees in Ankara Metropolitan Municipality urban greenbelts (parks, greenery on streets, gardens of institutions and houses, urban forests). Samples were collected twice a week from the needle and branches of the plants between the months of May-October and between the years of 2006-2010. In the same way, sampling results of the studies conducted for the same purpose so far have also been included in this study by the lead and coauthors.

Infested plant parts by insects were brought in the laboratory and investigated under the stereomicroscope. They were preserved into 70% ethanol. Hille Ris Lambers (1950) method was used for the preparation of aphids, and Kozstarab & Kozár (1988) method for cocoids. Identification of aphid species were made by utilizing Bodenheimer & Swirski (1957), Çanakçıoğlu (1975), Blackman & Eastop (2000, 2018), Favret (2018); Identification of coccoids, on the other hand, was made using Balachowski & Alkan (1956), Kosztarab & Kozar (1988), Hogson (1994), Foldi (2004) and Williams (2004). Samples are preserved in Ankara University, Agricultural Faculty, The Department of Plant Protection, and Ministry of Food, Agriculture and Livestock, Directorate of Plant Protection Central Research Institute, Ankara.

RESULTS

Insect species found as a result of the study have been evaluated by dealing with coniferous trees separately, and presented in alphabetical order (Tables 1,2,3). *Torosaspis cedricola* (Balachowsky & Alkan, 1956) are the most common and harmful species on cedar trees (Table 1, Fig. 1H). While *T. cedricola* and *Dynaspidiotus britannicus* (Newstead, 1898) (Hemiptera: Diaspididae) feed on the needles, thereby causing them discoloration and premature falling, *Cinara cedri* Mimeur, 1936 (Hemiptera: Aphididae) feed on the woody parts of cedar trees. It has been observed to form colonies on the twigs and branches of mature cedar or on the trunk of young cedar trees. Colonies composed by winged and wingless females (Figs. 1A,B) and nymphs settle on those surfaces of the cedar branch overlooking the ground. That's why; the existence of *C. cedri* mainly shows itself by the secretion of honeydew. Honeydew covers the needles and branches, and drips down the tree with increasing quantity as season's progress. The earth around the trees seems to be wet, and park benches, if any, used for the relaxation by people become unusable. It also drips down on the parked cars and pollutes them. Contaminated cedar trees darken due to fumagine.

We have found only aphids feeding on fir trees, *Cinara confinis* (Koch, 1856) in this study. While *Dynaspidiotus abieticola* (Koreneous, 1934) feed on fir needles (Fig. 1I) and *D. britannicus* (Newstead, 1898) (Hemiptera: Diaspididae) mainly on cedar trees, low populations of them have been found on the needles of fir and spruce trees (Table 1). *Physokermes hellenicus* Kozár & Gounari, 2012 (Hemiptera: Coccidae) females settle under the growth cones of fir trees (Fig. 1E), blending in with the area where they live thanks to their similar color of its host plant, thereby going unnoticed. *Nemolecanium abietis* Borschsenius, 1955 (Hemiptera: Coccidae), other soft scale insect species feeding on fir trees, their females, nymphs and male pupae have been found on needles (Fig. 1D).

Cypress and Juniper which are widely available in Ankara, are harmed by aphids and coccoids infestation too. *Cinara (Cupressobium) fresai* Blanchard, 1939 and *Cinara* (*Cupressobium*) *juniperi* (de Geer, 1773) (Hemiptera: Aphididae) have been recorded to feed on all parts of juniper trees (Table 2). Plants on which *Cinara* species feed seem to be wet due to honeydew, and during hot and humid seasons the tree is covered by fumagine in part or altogether. Yellowing of needles and drying of offshoot tips are observed. *Carulaspis minima* (Signoret, 1869) and *Carulaspis juniperi* (Bouché, 1851) (Hemiptera: Diaspididae) are two common scale insects seen on species of Juniper trees (Table 2).

Cinara pilicornis (Harting, 1841) (Aphididae) *Pineus pini* (Macquart, 1819) (Adelgidae) and *Physokermes picea* Schrank, 1801 (Coccidae) have been found to feed on spruce trees which flourish well in Ankara parks (Table 2). Spruce trees, are harmed most by spruce bud scale *Physokermes picea* in Ankara (Table 2). As a result of this feeding, shortening, drying, yellowing, contraction and immature falling of yearly offshoots and recession in tree growth are observed. Secretion of abundant honeydew during late April- mid May causes the trees to be covered by it completely, and makes trees seem unattractive.

We have established that 7 Lachninae species on Pine trees and 1 species on Thuja (Table 3). *Cinara palaestinensis* Hille Ris Lambers, 1948, *C. pinea* Mordvilko, 1895, *C. pini* (Linnaeus, 1758), *C. pilicornis* and *Schizolachnus pineti* (Fabricius, 1911) exist on pine branches as colonies, that is, they feed on xylem. *Cinara tujafilina* del Guercio,1909 (Fig. 1C) feeds on the trunk, branches and the needles of Thuja. Individuals of *Cinara* species are bulky and dark. *Eulachnus rileyi* (Williams, 1911) and *E. tuberculostemmatus* (Theobald, 1915) feed in hidden areas where two needles overlap each other. The individuals of these species whose statures are thin and long take flight immediately if disturbed. The populations of Lachninae feeding on cedar, juniper and pine trees increase twice a year, April-May and September-October. During these periods pine trees are covered with honeydew, and ant infestation rises (Fig. 2). Three armored scale insects (*Leucaspis loewi* Colvée,1882*, L. pini* Harting, 1839, *L pusilla* Löw, 1883) are seen on pine trees in city greenbelts in Ankara. *L. pusilla* are the most common and populous scale insects of all. The surfaces of needles where these scale insects feed turn yellowish first, then brownish and finally the needles fall prematurely. While *L. loewi* and *L. pini* are rare, *L. pini* are only found on Calabrian pine (Table 3). Very small amount of *Matsucoccus pini* Green, 1925 (Hemiptera: Matsucoccidae) have been recorded on Scots pine (*P. sylvestris*) in Kızılcahamam (Centrum).

DISCUSSION

Cedar trees are used very commonly as ornamental trees and city forest in Ankara. *T. cedricola* is most harmful species on cedar. Generally, *C. cedri* is seen on cedar in the spring and autumn. Çanakçıoğlu (1975) noted that *C. cedri* fed as colonies on the lower branches of cedar trees, and reached the highest population level in June. Contribution of *C. cedri* to honeydew and ants is known in Turkey (Ülgentürk et al., 2013). Beekeepers state that honeybees produce cedar honey from *C. cedri* secretion in cedar forest (personal communication with local beekeeper in Antalya).

Fir trees (*Abies* sp.) are less available compared to other coniferous trees in Ankara green spaces due to climate conditions. *D. abieticola* and *D. britannicus* are known to be pests on Fir and Spruce trees in natural forests, urban forests and

parks in Turkey (Ülgentürk & Toros, 1996; Ülgentürk et al., 2012a). *D. britannicus* develop two generations per year on cedar trees in Ankara and overwinter in its second stage nymph (Ayhan 2011, unpublished Ms thesis). *P. hellenicus* is occured only fir species. It overwinters as third stage nymph and develop one generation per year. Parasitoid *Aphycoides clavallatus* (Dalman) (Hymenoptera: Encyrtidae) suppress their populations. As a host plant, *A. nordmanniana* and Taurus fir trees (*Abies cilicica* (Antoine & Kotschy)) have been recorded in Turkey (Ülgentürk, 2016). The other soft scale inset, *N. abietis* is a new record for Turkish fauna that mainly seen on *Abies* sp. and *Abies numidica* de Lannoy ex Carriére in Romania, Ukraine and Georgia (Hodgson, 1994). *Nemolecanium aptii* (Bodenheimer, 1941), an endemic species in Turkey, is known to feed on *Abies nordmanniana* needles (Bodenheimer, 1953). Kosztarab & Kozár (1988), however, states that while *P. graniformis* is a species grown in the mountainous regions (500 and 1400 m) of central Europe, *N. abietis* are found only southern coasts of Crimea. These discussions arise the necessity to work on these species.

C. juniperi, is a significant pest on juniper trees. *C. juniperi* develops one generation per year and overwinters as a fertilized female on juniper branches and needles in the Belgrade area (Graora et al., 2010).

It is present in large numbers on plant twigs, needles and cones, and causes a slowdown in growth, needle chlorosis and premature needle fall, the loss of aesthetic value, drying of branches and whole plants. *Planococcus vovae* (Nasonov, 1908) is harmed the growth of Juniper trees from time to time, pave the way for the drying of young branches. This species previously has been found on different locations of various juniper trees in Turkey (Kaydan et al., 2013). Graora et al. (2014) was recorded *P. vovae* was found to develop three generations per year and overwinter on branches at the egg or second instar stages. The first generation adults were observed at the end of May, the second generation at the beginning of August, while the third generation was recorded at the beginning of October.

P. piceae develops one generation per year in Ankara and overwinters in the second-stage nymph (Turguter & Ülgentürk, 2006). It has also been reported that *P. piceae*, a major pest for European spruce trees as well, cause needle weight and offshoot growth to diminish (Gedminas et al. 2015).

Kanturski et al. (2017) reported, aphids from the genus *Eulachnus* are trophically associated with pines (*Pinus* spp.) All *Eulachnus* species are monoecious (having a life cycle without host alternation) and holocyclic (with sexual phase occurring).

However, previously record is not specified exact location in Turkey and the hosts (Kaydan et al., 2013). *M. pini* is parthenogenetic or bisexual, mono or bivoltine species. Occasionally it is a pest on pine trees. It distributed in Austria, Bulgaria, Croatia, Czech Republic, England Hungary, France, Italy, Morocco, Netherland, Poland, Romania, Russia, Spain, Turkey (Foldi, 2004).

Planting monocultures, or extensive plantings relying on only a very few species can create genetic vulnerability by encouraging the build-up of pests and diseases (Bassuk, 1990). In creating urban green areas ensuring plant diversity will protect the plants from wide scale harms caused by various pests and disease factors. In this study we have seen that coniferous trees, which have been organized as groups belonging to the same species or genus are more contaminated through pests. Zahradnik (1990) states that cocoids feeding on coniferous trees are oligophages. The results of this study support this view. For instance, Spruce Bud Scale has contaminated all spruce trees grown in Ankara *P.*

abides, P. orientalis, P. pungens, P. pungens vr. galauca). Similarly, cedar scale insects (*T. cedricola*) inflict damage to all cedar species (*C. libani, C. atlantica, C. deodara*). While Small Pine Scale insects (*L. pusilla*) feed on *P. nigra* and *P. sylvestris*, only *L. pini* have been seen on *P. brutia*. We have observed that pine trees act as a host for a number of aphid species. While *C. cedri* feed mostly on cedar species, *C. fresai* and *C. juniper* only on juniper trees, and *C. thujaflina* only on Thuja trees. Not only do pests wreak havoc on the health of the plant, but also they decrease the aesthetic value of the plant. In creating green spaces, planting of the same species or genus so close as to touch each other makes it possible for pests - even those which have a sedentary life style such as coccoids to spread and wreak havoc on plants. That's why, besides visual considerations, pest factors should be taken into account in landscape designing.

Note: Original scientific contribution presented and discussed at Proceeding of the fouth Plant Protection Congress of Turkey, 28-30 June 2011, Kahramanmaraş, Turkey.

ACKNOWLEDGEMENTS

The authors are grateful to Ankara University, Foundation of Scientific Research for supporting (BAP 20060711096).

LITERATURE CITED

Arslan, M. & Çelem, H. 2001. Exotic Trees and Plants of Ankara. Scientific and Technical Research Council of Turkey, TARP Publications, Ankara, 87 pp.

Ayhan, B. 2011. Phenology of *Dynaspidiotus britannicus* (Newstead) (Hemiptera: Diaspididae) on Cedar. MSc Ankara University, Ankara, Turkey.

Balachowsky, A. S. & Alkan, B. 1956. Sur un *Acanthomytilus* Borkh. (Coccoidea-Diaspidini) nouveau vivant sur cedre dans les montagnes de Turquie. Bulletinet Annales de la Société Royale d'Entomologie de Belgique, 92: 319-323.

Bassuk, N. L. 1990. Street Tree diversity making beter choices for the urban landscapes. Trees for the Nineties: Landscape Tree Selection, Testing, Evaluation, and Introduction. In: Proceedings of the seventh conference of the Metropolitan Tree Improvement Alliance. The Morton Arboretum, Lisle, Illinois, June 11-12, 1990, p. 71-78.

Blackman, R. L. & Eastop, V. F. 2000. Aphids on The World's Crops: An Identification quide. 2 nd ed. A Wiley. Newyork, USA.

Blackman, R. L. & Eastop, V. F. 2018. Aphids of the World's Plants: An Online Identification and Information Guide. Retrieved from http://www.aphidsonworldsplants.info (accessed 10 March 2018).

Bodenheimer, F. S. 1953. The Coccoidea of Turkey III. Revue de la Faculté des Sciences de l'Université d'Istanbul, Ser. B, 18: 91-167.

Bodenheimer, F. S. & Swirski, E. 1957. The Aphidodea of the Middle East. The Weizmann Science Press of Israel, Jerusalem.

Çanakçıoğlu, H. 1975. The Aphidoidea of Turkey. Publications of İstanbul University Faculty of Forestry. İstanbul, Turkey.

Dostbil, Ö. & Ülgentürk, S. 2016. Bio-ecology of cedar scale insect *Torosaspis cedricola* (Balachowsky & Alkan) (Hemiptera: Diaspididae) in Ankara, Turkey. Redia, xcix: 163-170.

Favret, C. 2018. Aphid Species File. <http://Aphid.SpeciesFile.org> [06.03.2018].

Gaora, D., Spasić, R. & Ilić, S. 2014. Biology and harmfulness of *Planococcus vovae* (Nassonov) (Hemiptera: Pseudococcidae) in Belgrade area. Journa of Pesticide and Phytomedicine (Belgrade), 29: 67-74.

Gedminas, A., Lynikienė, J., Marciulynas, A. & Povilaitienė, A. 2015. Effect of *Physokermes piceae* Schrank on shoot and needle growth in Norway spruce stands in Lithuania. Baltic Forestry, 21: 162-169.

Foldi, I. 2004. The Matsucoccidae in the Mediterranean basin with a World list of species (Hemiptera: Sternorrhyncha: Coccoidea), Annales de la Société Entomologique de France, 40 (2): 145-168.

Hille Ris Lambers, D. 1950. On Mounting Aphids and Other Softskinned Insects. Entomol Berich, 13: 55-58.

Hodgson, C. J. 1994. The Scale Insect Family Coccidae: An Indetification Manual to Genera., CAB International, Wallingford, Oxon, UK, 639 pp.

Johnson, W. T. & Lyon, H. H. 1991. Insects That Feed on Trees and Shrubs. 2nd ed. Comstock Publishing/Cornell University Press, Ithaca, 556 pp.

Kanturski, M., Kajtoch, L. & Wieczorek, K. 2017. European species of the aphid genus *Eulachnus* Del Guercio, 1909 (Hemiptera: Aphididae: Lachninae): revision and molecular phylogeny. Zootaxa, 4356: 88 pp.

Kaydan, M. B., Ülgentürk, S. & Erkılıç, L. 2013. Checklist of Turkish Coccoidea (Hemiptera: Sternorryncha) species. Turk. Bull. Entomol., 3: 157-182.

Kidd, N. A. C. 1988. The large pine aphid on Scots pine in Britain. In: Berryman A. A. (Ed), Dynamics of Forest Insect Populations: Patterns, Causes and Implications. Plenum Press, New York: pp. 111-128.

Kosztarab, M. & Kozár, F. 1988. Scale Insects of Central Europe. Akademiai Kiado, Budapest, 456 pp.

Miller, D. R. & Davidson, J. A. 2005. Armored Scale Insect Pests of Trees and Shrubs. Cornell University Press, Ithaca and London, 442.

Murphy, S. T., Abraham, Y. J. & Cross, A. E. 1991. Ecology and economic importance of the aphid pests, Pineus sp. and *Eulachnus rileyi* on exotic pine plantations in southern and eastern Africa. In: Ciesla, W.M., Odera, J., & Cock, M.J.W. (Eds), Workshop Proceedings: Exotic Aphid Pests of Conifers. A Crisis in African Forestry, 3-6 June 1991, Muguga, Kenya.

Özkazanç, O. & Yücel, M. 1985. Investigations on insects damaging in the semiarid zone plantations, Journal of Forestry Research Institute, Technical Bulletin Series No: 153, TU, Ankara, Çağ Press, 45 pp.

Schmutterer, H. 1972. Unterordnung Coccoidea, Schildläuse, cochenilles. In: Schwenke, W. (Ed), Die Forstschädlinge Europas, Vol. I, Hamburg & Berlin, Paul Parey Publication, (in German). 405-418.

Şahin, Ö. &, Ülgentürk, S. 2011 Distribution of *Torasaspis (Acanthomytilus) cedricola* Balachowsky& Alkan (Hemiptera: Diaspididae) in the Turkey. In: Turkey I. Forest Entomology and pathology Symposium, 2011, Antalya, Turkey, pp. 261-265.

Turguter, S. &, Ülgentürk, S. 2006. *Physokermes piceae* (Schrank) (Yumrulu Ladin Koşnili) (Hemiptera; Coccidae)'nin biyolojik özellikleri. Tarım Bilim Dergisi, 12: 44-50.

Ülgentürk, S. 2016. Biology, natural enemies and the distribution of *Physokermes hellenicus* Kozàr and Gounari (Hemiptera: Coccidae) in Turkey; Entomologica, Bari, 47: 71-75.

Ülgentürk, S., Çanakçıoğlu, H. & Toper, A. 2004. Scale insects of the conifer trees in Turkey and their zoogeographical distribution. Journal of Pest Sciences, 77: 99-104.

Ülgentürk, S., Şahin, Ö., Ayhan, B., Sarıbaşak, H. & Kaydan, M. B. 2012a. Scale insects species of Taurus cedar in Turkey. Turkish Journal of Entomology, 36: 113-121.

Ülgentürk, S., Evren, N., Ayhan, B., Dostbil, Ö., Dursun, O. & Civelek, H. S. 2012b. Scale insect (Hemiptera: Coccoidea) species on pine trees of Turkey. Turkish Journal of Zoology, 36, 623-636.

Ülgentürk, S., Özdemir, I., Kozar, F., Kaydan, M. B., Dostbil, Ö., Sarıbaşak, H. & Civelek, H. S. 2013. Honeydew producing insect species in forest areas in Western Turkey. Bulletin of Turkish Entomology, 3: 125-133.

Ülgentürk, S. & Toros, S. 1996. Diaspididae species (Homoptera: Coccoidea) on park plants in Ankara. In: 3rd. Congress of Entomology. Ankara University Faculty of Agriculture, Plant Protection Department, Ankara, Turkey, pp. 541-548.

Williams, D. J. 2004. Mealybugs of Southern Asia. The Natural History Museum, Southdene SDN. BHD., Kuala Lumpur, Malasia, 896 pp.

Zahradnik, J. 1990. Forest: conifers. In: Rosen, D. (Ed.) Armored scale insects: their biology, natural enemies and control, vol 4B. Elsevier, Amsterdam, pp. 633-644.

Figure 1. Colony of *Cinara cedri* (A) and hibernated eggs (B), *Cinara tujafilina* (C), female of *Nemolecanium abietis* (D), *Physokermes hellenicus* (E) *P. piceae* (F, G), *Torosaspis cedricola* (H), *Dynaspidiotus abieticola* (I) *Leucaspis pusilla* (K).

Table 1. Species of Aphidoidea and Coccoidea on Cedar, fir and spruce in Ankara.

Species	**Localities**
Cinara cedri Mimeur, 1936 Lachninae	Botanik Park, 27.ix.2007, *Cedrus libani*; Botanik park, 10.ix.2013, *C. libani*; İncek Park, 12.v.2008,*C. libani*; Campus of Agriculture Yenimahalle, 30.iv.2012, *C. libani*; Campus of Agriculture Faculty, 27.IX.2009, *C. libani*; Kurtuluş Park, 20.x.2010, *C. libani*; Campus of Hacettepe, 15.v.2015, *C. libani*; Atatürk Park Keçiören, 12.iv.2016, *C.atlantica*; Şehitler Park, Mamak, 21.ix.2017, *C. cedri.*
Cinara confinis (Koch, 1856) Lachninae	Altınpark 18.VIII.2010, *Abies* sp.; Kurtulus Park,20.x.2010, *Abies* sp.
Nemolecanium abietis Borchsenius 1955 Coccidae	Kızılcahamam (Centrum), 15.x.2015 *Abies* sp.; Kızılcahamam (Centrum), 14.iv.2016, *Abies* sp.
Physokermes hellenicus Kozár & Gounari, 2012 Coccidae	Tandoğan Campus of Ankara University 12.iv.2013, *Abies nordmülleriana*, 20.vii.2013, 11.iii.2014, Kızılcahamam (Centrum),15.iv.2015, *Abies* sp.; Çubuk Barrage II, 21.v.2015, *Abies* sp.
Dynaspidiotus abieticola (Koroneos 1934) Diaspididae	Tandoğan campus of Ankara University, 9.xii.2008, *Abies bornmülleriana*; Çubuk Barrage I, 30.v.2007, *Abies* sp.; Çubuk Barrage II, 21.v.2008, *Abies* sp; *Abies pinsapo*, 19.ii.2014, *Abies* sp. 13. ix. 2010, Campus of Agriculture Faculty.
Dynaspidiotus britannicus (Newstead, 1898) Diaspididae	Tandoğan Campus of Ankara University, 9.xii.2008, *Abies bornmülleriana*; Çubuk Barrage I, 30.v.2007, *Abies* sp.; Çubuk Barajı, II, 21.5.2008, *Abies* sp.; Campus of Agriculture Faculty, 19.12.2008, *Abies pinsapo*; Tandoğan Campus of Ankara University 16.vı.2013, *Piceae pungens*; Campus of Agriculture Faculty, 19.iv.2007, *Cedrus libani*; Keçiören Atatürk Park, 30.v.2007, *C.atlanticus, C. libani*; Campus of Agriculture Yenimahalle, 18.iv.2011; *C. libani*; Küçükesat, 19.vii.2008, *C.libani*; Campus University of Middle East (METU), 18.vi.2009, *C. libani*; Campus of Gazi University, 23.v.2009, *C. libani*; Aşağı Ayrancı, 15.vii.2010, *C. libani*; Farm and Forestry of Atatürk, 22.ii.2010, *C.libani*; Campus of Ankara University, 16.vı.2013, *Piceae pungens*.
Torosaspis cedricola (Balachowski et Alkan, 1956) Diaspididae	Campus of Agriculture Faculty, 23.iv.2007, *Cedrus libani*; Atatürk Park, Keçiören, 12.v.2007, *C. libani, C. atlantica*; Subayevleri,12.ii.2013, *C. libani*; Kalaba, 23.v.2008, *C. libani*; Gençlik Park, 10.v.2008, *C. libani*; Castle of Ankara, 17.v.2008, *C. libani*; Abdi İpekçi Park, 10.v.2008, *C. libani*; Güven Park, 10.v.2008, ,*C.libani*; Kurtuluş Parkı, 2008, C. atlatica, *C.libani*; Küçükesat 21.iv. 2009, *C. libani*; Portakal Çiçeği Valley, 21.v.2009, *C. libani*; Yukarı Ayrancı, 21.v.2009, *C. libani*; Anıtkabir, 9.vi.2009, *C. libani*; Keçiören, 4.iv.2010, *C.libani*; Mamak, 9.vi.2009, *C.libani*; Zafer Aslan Park Etlik, *C. libani*; Yenimahalle Campus of Agriculture, 9.ix. 2011, *C. libani*; Dikimevi Campus of Ankara University, 18.i.2008, *C. libani*; Cebeci Campus of Ankara University, 18.iv.2008, *C. libani*; Ostim, 21.vi.2010, *C. libani*; Seymenler Park, 18.iv.20008, *C. libani;* METU Campus, 9.vii.2010, *C. libani*; Beytepe Campus of Hacettepe University 9.vii.2010, *C. libani*; Bilkent, 9.vii. 2010, *C. libani*; Masallar Diyarı Park, 18.iv.2010, *C. libani*; Göksu Park, 18.iv.2010, *C. libani*; Bağlum Sanatoryum, 10.ix.2010, *C.libani*; Campus of Gazi University, 5.vii.2012, *C. libani*;

	Etlik Garden of Gülhane Hospital, 9.ii.2010, *C. libani*; Eymir, 12.iv.2009, *C. libani*; Çubuk Barrrage II, 1.vii.2008, *C. libani*; Çubuk Barrage II, 14.ıx.2013, *C. libani*; Kazan Urban Forest, 23.v.2008, *C. libani*; Gölbaşı Mogan Park, 21.iv.2011, *C. libani*; Ümitköy Gazililer Sitesi, 20.vi.2007, *C. libani*; Altınpark, 30x.2006, *C. libani*; Çankaya Belediyesi Tesisi, Ahlatlıbel, 20.vi.2012, *C. libani*; Oran, 20.vi.2007, *C. libani*; Çukurambar, 18.iv.2008, *C. libani*; AOÇ, 18.iv.2008, *C. libani*; Karşıyaka Cementary, 18.vi.2008, *C. libani*; Atatürk Park Keçiören, 12.iv.2016, *C. atlantica.*

Table 2. Species pest of Aphidoidea and Coccoidea on Juniper and spruce in Ankara.

Species	**Localities**
Pineus pini (Macquart 1819) Adelgidae	Kurtulus Parkı, 25.x.2009, *Picea orientalis*; Esat Park, 24.vii.2010, *Picea* sp.; Yenimahalle Campus of Agriculture, 21.vii.2010, *Picea* sp.; Kurtulus Park, 26.vii.2010, *Picea* sp.
Cinara pilicornis (Hartig, 1841) Lachninae	Campus of Agriculture Yenimahalle, 21.vii.2010, *Picea* sp.; Kurtulus Park, 29.viii.2010, *Picea* sp.
Cinara fresai Blanchard, 1939 Lachninae	Yenimahalle, 12.viii.2007, *Juniperus* sp.; 14.vi.2008, *Juniperus* sp., Botanik Park, 24.v.2008; Altınpark, 29.ix.2009, *Juniperus* sp.; Kurtulus Park, 25.x.2009, *Cupressus* sp.; Esat Park, 20.iv.2010, *Juniperus* sp.; Gençlik Park, 21.v.2010, *Juniperus* sp.; Yenimahalle Campus of Agriculture 29.iv.2010, *Juniperus* sp.; Kurtulus Park, 28.v.2009, *Juniperus* sp.; Yenimahalle Park, 19.ix.2009, *Juniperus* sp.; Kurtulus Park, 29.x.2010, *Juniperus horizontalis*.
Cinara (Cupressobium) juniperi (de Geer, 1773) Lacninae	Yenimahalle Campus of Agriculture, 18.v.2007, *Juniperus* sp.; Botanik Park, 22.vi.2007, *Juniperus* sp.; Segmenler Park, 24.ix.2007, *Juniperus* sp.; Kurtulus Park, 15.vi.2008, *Juniperus* sp.; AOÇ, 13.v.2008, *Juniperus* sp.
Carulaspis juniperi (Bouché, 1851) Diaspididae	Campus of Agriculture Faculty, 3.iv.2008, *Juniperus sabina*; Gençlik Park, 16.iv.2008, *Juniperus* sp.; METU 15.v.2008, *Juniperus* sp.; Dikimevi Campus of Ankara University, 28.v.2007, *Juniperus sabina;* Botanik Park, 12.vi.2010, *Juniperus sabina*; Barış Manço Park, 28.vii.2009, *Juniperus* sp.
Carulaspis minima (Signoret, 1869) Diaspididae	Tandoğan Campus of Ankara University, 29.xii.2008, *Cryptomeria japonica*; Garden of Sugar Factory, 29.xii.2008, *Juniperus horizontalis*; Botanik Park, 19.xii.2008, *Juniperus sabina*; Abdi İpekçi Parkı, 21.vi.2010, *Juniperus horizontalis.*
Lepidosaphes juniperi Lindinger, 1912 Diaspididae	Campus of Agriculture Faculty, 19.iv.2007, *Juniperus sabina, J. horizontalis* Harmanlı Park, 30.v.2007; Yenimahalle campus of Agriculture 21.v.2008, *J. sabina*; METU 19.xii.2008, *Juniperus spp.*; Campus of Gazi University, 23.v.2009, *Cupressus* sp.
Physokermes piceae (Schrank, 1801) Coccidae	Dışkapı Campus of Agriculture Faculty, 23.iv.2006, *Picea abies, P. pungens var. Galuca*; Dışkapı Campus of Agriculture Faculty 12.v.2007, *P. orientalis*; Campus of Agriculture Faculty, 8.v.2008, *P. pungens var. Maxima*; Barış Manço Park, 6.v.2010, *P. pungens*; Gençlik Park, 10.v.2008 *P. pungens var. Glauca, P. abies*; Abdi İpekçi Park, 10.v.2008, *P. abies, P. pungens*; Kurtuluş Park, 10.v.2008, *P. abies, P. pungens;* Güven Park, 10.v.2008, *P. abies*; Portakal Çiçeği Park, 21.v.2008, *P. pungens, P. abies*; Anıtkabir, 9.vi.2009, *P. pungens*; Gazino, Keçiören, 4.iv.2009, *P. pungens*; Etlik, 27.v.2009, *P.pungens*; Dikimevi Campus of Ankara,

	18.iv.2009, *P. abies P. pungens*; Seymenler Park, 18.iv.2009, *P. abies, P. pungens*; Botanik Park, 18.iv.2009, *P.abies, P. pungens*; Ümitköy, 2.v.2009, *P. pungens*; Bilkent, 2.v.2009, *P. pungens*; Masallar Diyarı, 18.iv.2009, *P. pungens*; Göksu Park, 18.iv.2009, *P. pungens*; Mamak, 16.iv.2009, *P. abies, P. pungens*; Sincan, 3.iii.2010, *P. pungens.*
Planococcus vovae (Nasonov, 1908) Pseudococcidae	Gazi Osmanpaşa, 23.v.2008, *Juniperus sp.*; Botanik Park, 19.x.2006, *Cupressus sempervirens*; Garden of Sugar Fabric, 29.v.2007, *Juniperus sabina*; Altınpark, 30.iv.2007, *Cupressus* sp.; Campus of Agriculture Faculty, 19.iv.2007, *Juniperus horizontalis*

Table 3. Species pest of Aphidoidea and Coccoidea on pine trees and *Thuja* in Ankara.

Species	**Localities**
Cinara palaestinensis Hille Ris Lambers, 1948 Lachninae	Farm and Forest of Atatürk (AOÇ), 15.vii.2007, *Pinus nigra*; Kurtulus Park, 22.ix.2009, *P. nigra*; Botanik Park, 10.vi,.2009, *Pinus* sp.; 50. yıl Park, *Pinus* sp.; Botanik Park, 12.v.20010, *Pinus* sp.; İncek Park, 10.ix.2009, *Pinus* sp.; Incek Park, 18.v.2010, *Pinus* sp.; Segmenler Park, 22.iv.2010, *P. nigra;* Yenimahalle Campus of Agriculture , 28.ix.2010, *Pinus* sp.; Kurtulus Park, 28.xi.2010, *Pinus* sp.
Cinara pinea (Mordvilko, 1895) Lachninae	Segmenler Park, 20.iv.2007, *P. nigra*; Botanik Park, 27.ix.2007, *P. nigra*; Kurtulus Park, 27.x.2008, *P. nigra*; Esat Park, 25.viii.2009, *P. nigra*; Yenimahalle Campus of Agriculture, 28.ix.2010, *Pinus* sp.; Kurtulus Park, 24.v.2010, *Pinus* sp.
Cinara pini (Linnaeus, 1758) Lachninae	Segmenler Park, 29.vi..2007, *P nigra*; Altınpark, 30.iv.2007, *P. nigra*; Incirli Park, 22.v.2008, *P. nigra*; AOÇ, 31.v.2008, *P. nigra*; Kuğulu Park, 20.ix.2009, *P. nigra*; Botanik Park, 11.v.2010, *P. nigra*; Altınpark, 21.vi.2010, *P. nigra*; Kurtulus Park, 30.iv.2010, *P. nigra*; 50. yıl Park,13.ix.2010, *P. nigra*.
Cinara pilicornis (Hartig, 1841) Lachninae	Kurtulus Park, 25.ix.2009, *Pinus* sp.
Cinara (Cupressobium) tujafilina (del Guercio, 1909) Lacninae	Kurtuluş Park, 14.v.2008, *Thuja orientalis*; Botanik Park, 18.vi.2008, *Thuja orientalis*; Segmenler Park, 22.ix.2009, *Thuja orientalis;* Altınpark, 28.x.2009, *Thuja* sp.; Yenimahalle Campus of Agriculture 28.v.2010, *Thuja* sp.; Kurtulus Park, 28.ix.2010, *Thuja* sp.
Eulachnus rileyi (Williams, 1911) Lachninae	Segmenler Park, 29.vi.2007, *Pinus nigra*; Altınpark, 22.vii.2008, *Pinus sylvestris*; Kuğulu Park, 30.ix.2009, *Pinus nigra*; Esat Park, 25.ix.2010, *Pinus* sp.; Yenimahalle Campus of Tarım, 28.ix.2010, *Pinus* sp.; Kuğulu Park, 28.ix.2010, *Pinus* sp.
Eulachnus tuberculostemmatus (Theobald, 1915) Lachninae	Altınpark, 15.vi.2007, *P. halepensis*; Kurtulus Park, 18.iv.2008, *P. syvestris;* Yenimahalle Park, 19.vi.2008, *Pinus* sp.; Botanik Park, 22.vi.2009, *P. nigra;* Segmenler Park, 20.vi.2009, *Pinus* sp.; Botanik Park, 27.ix.2009, *Pinus* sp.; Kurtulus Park, 27.ix.2010, *Pinus* sp.; Esat Park, 25.vi.2010, Pinus sp.; Yenimahalle Campus of Agriculture, 28.vi.2010, *Pinus* sp.; Kuğulu Park, 28.vi.2010, *Pinus* sp.
Schizolachnus pineti (Fabricius, 1781) Lachninae	Botanik Park, 11.vi. 2007, *Pinus* sp.; Segmenler Park, 14.vi.2007, *Pinus* sp.; Altınpark, 15.vii.2008, *Pinus* sp.; Yenimahalle Park, 18.ix.2009, *Pinus* sp.; Kurtulus Park, 30.vi.2009, *Pinus* sp.; 50. yıl Park, 03.ix.2009, *Pinus* sp.; 50. Yıl Park, 09.x.2009, *Pinus* sp.; Altınpark,18.v.2010, *Pinus* sp.

Leucaspis loewi Colvée, 1882 Diaspididae	Kazan Kent Forest, 29.v.2007, *P. nigra*; Çamkoru, 21.v.2007, *P. nigra*; Beynam Kent Forest, 18.vi.2009, *P. nigra*.
Leucaspis pini (Hartig, 1839) Diaspididae	Meteoroloji Park, 3.iii. 2007, *Pinus brutia*; Kalaba, 23.v.2008, *P. brutia*; Keçiören, 13.iv. 2009, *P. brutia*.
Leucaspis pusilla Löw, 1883 Diaspididae	Campus of Agriculture Faculty, 23.iv.2007, *Pinus nigra*; Atatürk Park Keçiören, 12.v.2007, *P. nigra*; Kalaba, 12.v.2007, *P. brutia*; Subayevleri, 8.v.2008, *P. nigra*; Barış Manço Park, 6.v.2010, *P. nigra*; Gençlik Park, *P. nigra,* 10.v.2008; Kızılay, 10.v.2008, *P. nigra*; Abdi İpekçi Park, 10.v.2008, *P. nigra*; Kurtuluş Park, 10.v. 2008, *P. nigra*; Botanik Park, 10.v. 2008, *P. nigra, P. sylvestri*; Yukarı Ayrancı, 21.v.2009 *P. nigra*; *P. nigra;* Anıtkabir, 9.vi. 2009; Kızlar Pınarı Keçiören, 4.iv.2010, *P. nigra*; Mamak, 9.v.. 2009, *P.nigra*; Zafer Aslan Park Etlik, *P. nigra,*; Sanatoryum, 9.viii.2009, 20.vi.2013 *P. nigra,*; Dikimevi Campus of Ankara University, 18.iv.2008, *P. nigra, P. sylvestri,*; 21.vi.2010, 18.iv.2008, *P. nigra*, *P. silvestri*,; Beytepe Campus of Hacettepe, 25.iv.2008, *P. nigra*; Ümitköy, 2.v. 2008, *P. nigra*; Bilkent, 2.v.2008, *P. nigra,*; Masallar Diyarı Park, 18.iv.2009, *P. nigra*; Göksu Park, 18.iv. 2009 *P. nigra*; Meteoroloji Genel Müdürlüğü Bahçesi, 9.viii.2009, *P. nigra*; Kuşcağız, 9.viii.2009, *P. nigra*; Kuyuyazı Park, Etlik, 9.viii.2009, *P. nigra*; Garden of Gülhane Hospital, Etlik, 13.ii.2010, *P. nigra*; Çubuk Barrage I., 1.vii.2008, *P. nigra*; Eymir, 12.4.2009, *P. nigra, P. silvestri*; Gölbaşı, 12.4.2009, *P. nigra*; Esenboğa, 23.vii.2010, *P. nigra*; Çubuk, 23.vii.2010, *P. nigra*; Gazililer / Ümitköy, 20.vi.2007, *P. nigra*; Kurtboğazı Barrage, 28.v.2007, *P. nigra*; Çamkoru, 28.v.2008, *P. nigra*; Oran Kent Forest, 16.v.2011, *P. nigra*; Altın Park, 29.xii.2008, *P. nigra*; City Forest of Kazan, 29.v.2007; City Forest of Beynam 18.vi.2007, *P. nigra*; *P. silvestri,* Campus of Gazi Universty, 28.vii.2007, *P. nigra*; Ahlatlıbel, 20.vi.2007, *P. nigra, P. sylvestri*; Çukurambar, 18.vi.2008, *P. nigra*; Söğütözü, 18.vi.2008, *P. nigra*; Atatürk Orman Çiftliği (AOÇ), 23.iv.2010, *P. nigra, P. sylvestri;* State cementary, Gazi, 23.iii.2009, *P. nigra;* Harikalar Diyarı Park, 17.ix.2013, *P. nigra;* METU, 12.iii.2006, *P. nigra*; Lozan Park, 21.v.2006, *P. nigra*; Kırkkonak, 12.iii.2014, *P. nigra*.
Matsucoccus pini Green, 1925 Matsucoccidae	Kızılcahamam, 16.v.2015, *Pinus sylvestris*.