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SCALE INSECTS (HEMIPTERA COCCOIDEA) ON MULBERRY TREES IN TURKEY ([1])

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Ülgentürk S., Mohammed E.M.A.M. – Scale insects (Hemiptera Coccoidea) on mulberry trees in Turkey.

In Turkey commonly cultivated mulberry species are *Morus alba* L., *M. nigra* L., and *M. rubra* L (Moraceae). Mulberry fruits are widely consumed freshly or as traditional products such as mulberry molasses and mulberry dried fruit pulp. Mulberry leaves are used for sericulture. In this study, scale pests of mulberry trees were investigated mainly in Ankara and some other regions in Turkey. Eight scale insect species namely *Ceroplastes japonicus* Green*, C. rusci* (L.)*, Neopulvinaria innumerabilis* (Rathvon)*, Parthenolecanium corni* (Bouché) (Coccidae), *Pseudaulacaspis pentagona* Targioni-Tozzetti (Diaspididae), *Phenacoccus aceris* (Signoret)*, Planococcus ficus* (Signoret) and *Pseudococcus comstocki* (Kuwana) (Pseudococcidae) were found on the *Morus* spp. *P. pentagona* was the most common and important pest species of the mulberry trees in research area. Populations of *C.japonicus, N. innumerabilis,* and *P.comstocki* are found at very high levels in some local gardens.

KEY WORDS: *Morus* spp., pest, *Ceroplastes japonicus, Planococcus ficus, Pseudococcus comstocki.*

INTRODUCTION

There are 24 species of mulberry (*Morus* spp., Moraceae) and one subspecies, with at least 100 varieties (QIN *et al.,* 2012). Mulberry is widespread in many regions from the tropics to the sub-arctic and from sea level to altitudes as high as 4000 m (MACHII *et al*., 2000; QIN *et al*., 2012). *Morus alba* L. is distributed all over the world for breeding silkworm (QIN *et al.,* 2012). During the time of the Byzantine Emperor, two Byzantine priests were brought silkworms and seeds of mulberry hiding in bamboo tubes from China to İstanbul in 552 AD. This was the beginning of the cultivation of mulberries and silkworms in the Byzantine territory (HAUSSIG, 2001; TEZCAN, 2014). Silk production and the silk trade had very important roles between the 16th and 19th centuries (TEZCAN, 2014). Silk production lost its importance after the First World War in Turkey (YILDIRIM, 2013) and mulberry orchards were abandoned and destroyed. Since that time mulberries are grown for fruit production rather than silkworm breeding in Turkey like in most European countries (ERCISLI, 2004; GERASOPOULOS & STAVROULAKIS, 1997). Ninety nine percentage of the mulberries grown in Turkey are *M. alba*, 3% are *M. rubra* L. and 2% are *M. nigra* L. (ERCISLI, 2004). Mulberry fruit production in 2014 was 74,600 tons and 3.751 tons were exported (ANONYMOUS, 2015). In Turkey mulberry fruit is consumed fresh or is processed into juice, and made into jam, marmalade, molasses, dried fruit pulp and jelly (ERCISLI, 2004; YOGURTCU & KAMIŞLI, 2006). Recently, production of mulberry fruit and sericulture in Turkey has been encouraged and supported by the Turkish Ministry of Agriculture. Therefore, large mulberry orchards have been planted in recent years.

Mulberry products are also important for timber, medicines, and ornamental plantings and therefore have important ecological values (QIN *et al.,* 2012). Certain diseases and pests, including scale insects, have limited the quality and productivity of mulberries in China, India, Italy, Pakistan and Turkey (PELLIZZARI *et al*., 2012; SAHITO *et al*., 2012; VIJAYA KUMARI 2014; MOHAMMED *et al*., 2016). In India, pink hibiscus mealybug, *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae) is a major pest of mulberry. Feeding damage results in crinkling and distortion of the leaves and stunted growth in the apical shoot resulting in malformation. These symptoms are called Tukra disease and cause losses of 30-50% (VIJAYA KUMARI, 2014). In Turkey *Pseudaulacaspis pentagona* Targioni Tozzetti (Hemiptera: Diaspididae) and other pests of mulberry were recorded by several authors (BODENHEIMER, 1958; KAYDAN *et al*. 2013; UYGUN *et al.* 2013; MOHAMMED *et al*., 2016). The aim of the study is to identify the scale insect pests on mulberry trees in some parts of Turkey.

MATERIAL AND METHODS

Scale insects on mulberry were collected at irregular intervals mainly in Ankara and other cities in Turkey. Specimens were slide mounted for light microscopy using the method of KOSZTARAB & KOZÁR (1988). Identification was made according to KOSZTARAB & KOZÁR (1988), HODGSON (1994), WILLIAMS (2004), MILLER & DAVIDSON (2005), FEYKO & KOZÁR (2012). Slides and dry material are stored at the Ankara University, Faculty of Agriculture, Department of Plant Protection, Turkey.

RESULT AND DISCUSSION

In this study, eight scale insects were detected as pests in mulberry trees, mainly in Ankara and other provinces in

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Turkey (Table 1). *P. pentagona* is the main pest (Fig. I 2, 5). Although it has been called the "white peach scale" in many parts of the World (Kosztarab & Kozár, 1988), because of its importance on mulberry, it is called the "mulberry scale" in Turkey (Keyder, 1956; Uygun *et al*., 2013). Bodenheimer (1958) reported that after the Independent War of Turkey, infestations of *P. pentagona* were so heavy that many mulberry and peach trees died, especially in the Bursa provinces, which was the main production area of fruit and silkworms. The species continues to be an important pest on peach, mulberry and ornamental plants in Turkey (Kiroğlu 1981; Erkiliç & Uygun, 1995; Kaydan *et a*l., 2013; Mohammed *et al*., 2016). Brown soft scale (*Parthenolecanium corni* Bouché) (Fig. I, 3) is a common species but *Neopulvinaria innumerabilis* (Rathvon) (Fig. I, 1) has large populations on mulberry in some localities. *N. innumerabilis* could become a serious pest for mulberries in Ankara. The wax scales (*Ceroplastes rusci* (L.) and *C. japonicus* (Green) have high infestations on mulberry in Antalya, Bolu and İstanbul respectively. They were recorded on mulberry in previous studies in Turkey (Ülgentürk *et al*., 2008; Ülgentürk *et al*., 2013). Three mealybugs *Phenacoccus aceris* (Signoret) (Fig. I, 4), *Planococcus ficus* (Signoret) and *Pseudococcus comstocki* (Kuwana) (Fig. I, 6) are also found on mulberry. The first two mealybugs are widely distributed species but they rarely cause harmful effects on mulberry. *P.comstocki* on the other hand was observed to produce heavy infestations on ornamental mulberries in Kızılcahamam (Ankara). It causes unsightly appearance, gall formation on young twigs, and drying of some branches in district Kızılcahamam (Ankara) (Fig. I, 4). Pellizzari *et al*. (2012), reported *P. comstocki* as a notorious pest of fruit trees and ornamentals particularly on *Morus* spp., *Catalpa* spp. (Binoniaceae), in the countries where it was accidentally introduced. This mealybug was first reported on *M. alba* and *Vitis vinifera* L. (Vitaceae) in East Anatolia, Turkey by Kaydan & Kozár (2010). Ataş & Kaydan (2015) demonstrated that *P. comstocki* populations were affected differently depending on the mulberry host species and by different temperature regimes. They showed that *M.nigra* is more susceptible to the mealybug than *M. alba* regardless of the temperature.

Qin *et al.* (2012) pointed out that with increased interest in preventing deterioration of the environment there should be renewed interest in the use of mulberries in China to counteract such important environmental issues as desertification, salinization and soil erosion. Because the mulberry is important in so many ways in Turkey, we also suggest that it should continue to be encouraged in this country as well. Unfortunately, control strategies for managing scale insect pests on mulberry are inadequate and cause undo harm to the environment. Integrated pest management (IPM) strategies using a suite of control systems comprising integration of physical, chemical, and biological control will allow healthy growth of mulberries without serious degradation of the environment. However, implementation of IPM requires detailed knowledge of the life history, host preferences, natural enemies, and physical requirements of each pest species. This research provides some of this information, but much more is needed.

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Table 1 – Scale insects and localities on mulberries in Turkey.

Families	Species	Localities
Coccidae	*Ceroplastes japonicus* Green	Akçakoca/Düzce, *M. alba*, 28.viii.2014; Emirgan/ İstanbul, *M. alba*, 5.vi.2014
	Ceroplastes rusci (L.)	Kumluca/Antalya, *M. alba*, 19.xi.2012
	Neopulvinaria innumerabilis (Rathvon)	Ayaş/Ankara, *Morus alba*, 26.vi.2014; Keçiören/Ankara, *M. alba*, 13.vi.2015; Çankaya/Ankara, *M. alba, M. pendula*, 23.v.2015; Altındağ/Ankara, *Morus nigra pendula*, 12.iii. 2014; Yenimahalle/Ankara, *M. alba*, 21.x.2015;Hacettepe campus / Ankara, *M. alba*, 8.iv.2016;
	Parthenolecanium corni (Bouché)	*M.nigra,*Nallıhan/Ankara, 21.ıx.2015; Beypazarı/Ankara *M.alba* 22.ix.2015; *M. alba,* Ayaş/Ankara, 5.vi.2014; Keçiören/Ankara, *M. alba*, 13.vi.2015; Aydınlıkevler/ Ankara, *M. alba*, 21.3.2016; Polatlı/Ankara, *M. alba*, 15.vii. 2015; Gölbaşı/Ankara, *M. alba*, 5.iii.2013; Yenimahalle/Ankara, *M. alba*, 21.x.2015;
Diaspididae	*Pseudaulacaspis pentagona* Targioni-Tozzetti	Eskişehir (Centrum), *M. alba*, 30.xi.2013; Nallıhan/Ankara, 21.ıx.2015; Beypazarı/ Ankara *M.alba* 22.ix.2015; *M. alba* pendula, Beypazarı/Ankara; 13.iii. 2013, *M. alba*, Zonguldak; Akçakoca/Düzce, *M. alba*, 28.viii.2014;Denizli (Merkez), *M. alba*, 20.viii.2015;Burdur (centrum), *M. alba*, 16.viii.2015; Yenimahalle/Ankara, *M. alba*, 21.x.2015; Akçakoca/Düzce, *M. alba*, 13.viii.2016
Pseudococcidae	*Phenacoccus aceris* (Signoret)	Beypazarı/Ankara *M.alba* 22.ix.2015; Aydınlıkevler/Ankara, *M. alba*, 21.3.2016
	Planococcus ficus (Signoret)	Beypazarı/Ankara *M.alba* 22.ix.2015; Nallıhan/Ankara, 21.ıx.2015; Aydınlıkevler/ Ankara, *M. alba*, 21.3.2016,
	Pseudococcus comstocki (Kuwana)	Kızılcahamam/Ankara, *M. alba, M. pendula,* 12.x.2015; Kızılcahamam /Ankara *M. alba*, *M. pendula*, 10.iv. 2016

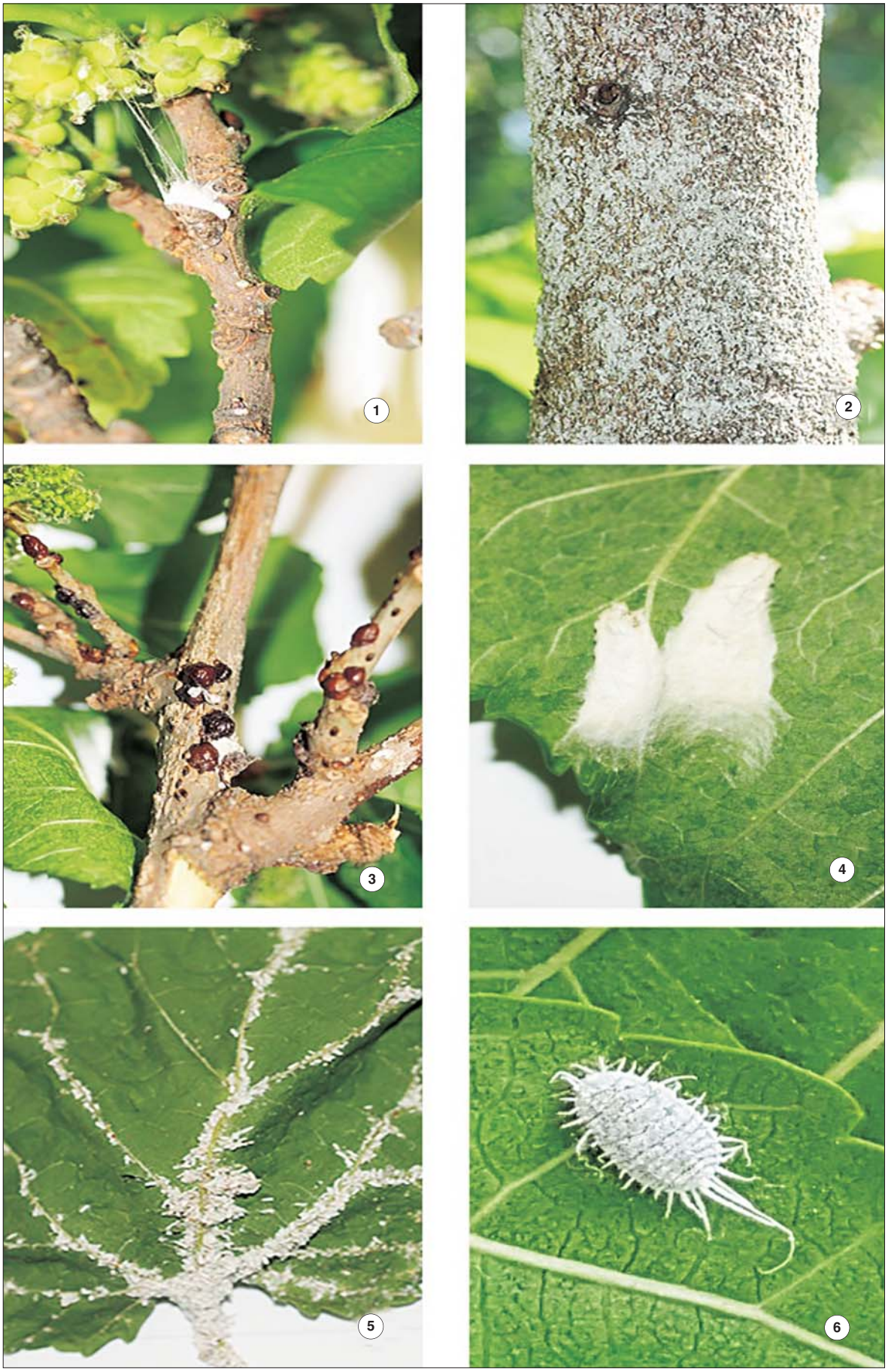

Fig I – *Neopulvinaria innumerabilis* (1), *Pseudaulacaspis pentagona* (2, 5), *Parthenolecanium corni* (3), *Phenacoccus aceris* (4) and *Pseudococcus comstocki* (6) on mulberry in Turkey.

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