Persian J. Acarol., 2019, Vol. 8, No. 3, pp. 211–224.
http://dx.doi.org/10.22073/pja.v8i3.46349
Journal homepage: http://www.biotaxa.org/pja

Article

Phytophagous mite (Acari) species on garlic (*Allium sativum* L.) cultivation areas and storages of Kastamonu, Turkey

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ABSTRACT
Turkey has a certain special garlic variety called "Taşköprü garlic", (*Allium sativum* L.), which is an important agricultural crop, besides being especially tolerant aganist extreme climatic conditions. This study was carried out to determine harmful mite species of garlic fields and storages during 2015–2016. The samples were collected from Kastamonu (Taşköprü, Hanönü and Centrum) with a weekly interval between April to August. Twelve mite species represented two orders (Prostigmata and Oribatida [Astigmatina]); the identified species belong into five families, including Acaridae (seven species), Glycyphagidae (two species), Tetranychidae (one species), Tarsonemidae (one species) and Eriophyidae (one species). These results showed that Kastamonu has rich biodiversity, especially concerning the garlic groving areas and storages. *Rhyoglyphus robini* Clarapède (Acaridae) was found as the most abundant and common species with a frequency of 71.35% in Hanönü, while *Tyrophagus putrescentia* (Schrank) (Acaridae) was identified as the most populated species.

KEY WORDS: Acari; Astigmatina; Kastamonu; Prostigmata; *Rhizoglyphus*; storage; garlic; Turkey.

PAPER INFO.: Received: 19 February 2019, Accepted: 20 May 2019, Published: 15 July 2019

INTRODUCTION

Garlic is one of the most important agriculture crops, because it is especially tolerant aganist extreme climate conditions. "Taşköprü garlic", which is suitable for export because of its high quality, characterizes the area of Kastamonu. This variety includes high quantity of selenium element which is cancer inhibitor and risk dedective. Variety of Taşköprü garlic is the richest cultivar in terms of compound elements, minerals and vitamins. It can be maintained at normal storage condition for 10–11 months (Anonymous 2018).

Approximately 27.6 million metric tons of garlic are produced anuually worldwide. Nearly 80% of this global production belongs to China, which alongside India, South Korea, Egypt, and Russia comprise the top five producing countires. Turkey produces over 87.000 tons of garlic annually, which is considered as 0.36% of the total world production. The greatest production area in Turkey is in Taşköprü Province, especially near the city of Kastamonu (25.2% of total production in Turkey) (Anonymous 2018).

Pests and diseases are playing an important role in the garlic production, depending on their effects on crop losses from 10–50%. This loss sometimes reaches 100% depending on the crop

How to cite: Cilbircioğlu, C. & Çobanoğlu, S. (2019) Determination of the phytophagous mite (Acari) species on garlic (*Allium sativum* L.) cultivation areas and storages of Kastamonu, Turkey. *Persian Journal of Acarology*, 8(3): 201–224.

species and density of the pest. There are very limited number of the studies related to the garlic plants. Most of them are related to the mite species belonging to onion and bulbous ornamental plants (Chen and Lo 1989; Madanlar and Önder 1996; Díaz *et al*. 2000; Straub 2004; Bayram and Çobanoğlu 2006; Kılıç 2010; Denizhan 2012; Kılıç *et al*. 2012).

Two most common mite species, *Rhizoglyphus echinopus* (Fumouze & Robin) (Acaridae) and *Rhizoglyphus robini* Claparède (Acaridae), are cosmopolitan and damage a variety of crops, including onion (*Allium cepa*), garlic (*A. sativum*), other *Allium* species, and ornamentals in storage (Zhang 2003).

Aceria tulipae (Keifer) (Eriophyidae) was determined in the fields of garlic cultivation in Taşköprü town of Kastamonu by Denizhan (2012). Therefore mites associated with garlic fields and storages must be further studied. Surveys of this research provide determination of plant parasitic mite species which may have the economic importance on both garlic fields and storages. Alternative control strategies, including cultural and biological control, have shown limited success, so it needs to be further developed and implemented (Díaz *et al*. 2000; Straub 2004).

The aim of this study was to determine harmful mite species of garlic plants and storages in Kastamonu (Taşköprü, Hanönü and Centrum) during 2015–2016 (Table 1).

Table 1. Localities and coordinates of sampling areas.

TAŞKÖPRÜ			
Alamaşişli Village	41° 28' 41.6748" N 34° 7' 38.4888" E	Kızılcaören Village	41° 25' 6.258" N 34° 7' 34.2408" E
Alisaray Village	41° 26' 32.75" N 34° 16' 04.14" E	Centrum Gizlice Village	41° 30' 25.5996" N 34° 12' 48.87" E
Aşağıçayırcık Village	41° 30' 3.852" N 34° 10' 1.3764" E	Centrum Gökırmak Village	41° 30' 29.49" N 33° 012' 26.46" E
Aşağıçit Village	41° 25' 54.04" N 34° 06' 27.52" E	Centrum Ortaca Village	41° 31' 10.65" N 34° 13' 04.81" E
Alatarla Village	41° 29' 46.7556" N 34° 2' 4.2828" E	Tekev Village	41° 27' 59.8104" N 34° 05' 36.4217" E
Çanşa/Çambaşı Village	41° 29' 25.4424" N 34° 21' 18.2016" E	Tekkeoğlu Village	41° 32' 52.8216" N 34° 6' 37.8612" E
Kışla Village	41° 28' 22.05" N 34° 2' 26.9376" E	Yukarıçayırcık Village	41° 29' 51.756" N 34° 9' 0.4212" E
HANÖNÜ			
Donalar Village	41° 33' 09.50" N 34° 05' 50.70" E	İncesu Village	41° 35' 17.7004" N 34° 14' 23.5245" E
Erik Village	41° 38' 12.19" N 34° 19' 18.20" E	Karapürçek Village	41° 33' 57.618" N 34° 10' 26.9376" E
Eskiatça Village	41° 31' 58.1628" N 34° 13' 23.8008" E	Kornapa Village	41° 35' 23.9892" N 34° 17' 25.008" E
Hamzaoğlu Village	41° 36' 13.17" N 34° 18' 44.76" E		
CENTRUM			
Abay Village	41° 31' 11.21" N 33° 59' 14.07" E	Aşağıayvalı Village	41° 29' 21.8976" N 33° 57' 52.7184" E
Çavundur Village	41° 28' 20.20" N 33° 58' 58.32" E	Çaycevher Village	41° 29' 42.09" N 34° 03' 24.02" E
Uzunkavak Village	41° 27' 50.976" N 34° 5' 27.4848" E		

MATERIALS AND METHODS

The study was carried out on garlic growing areas and storages in different localities of Kastamonu (Taşköprü, Hanönü and Centrum), which is located inland of Black Sea, at weekly intervals during 2015–2016 (Table 1, Fig. 1).

The plant samples were collected from April to July of 2015 and 2016. Thegarlic head (bulb) and garlic leaves were taken from five garlic plants. The storage samples were collected randomly from different levels of bulks during storage periods at weekly intervals from August 2015 to April 2016.

The mites were observed under a stereomicroscope. Eventually all the mite samples were extracted using Berlese funnel. The mites were kept in 70% ethyl alcohol, then were cleared in Lacto-phenol solution and mounted in Hoyer's medium, afterwards dried for 15–20 days in an oven at 50 °C (Henderson 2001). The slides were identified using the Leica DM 2500 microscope, by Jeppson *et al*. (1975), Hughes (1976), Bolland *et al*. (1998), Zhang and Fan (2005), Seeman and Beard (2011) and Denizhan *et al*. (2015). The GPS data of the collection sites are shown in Table (1).

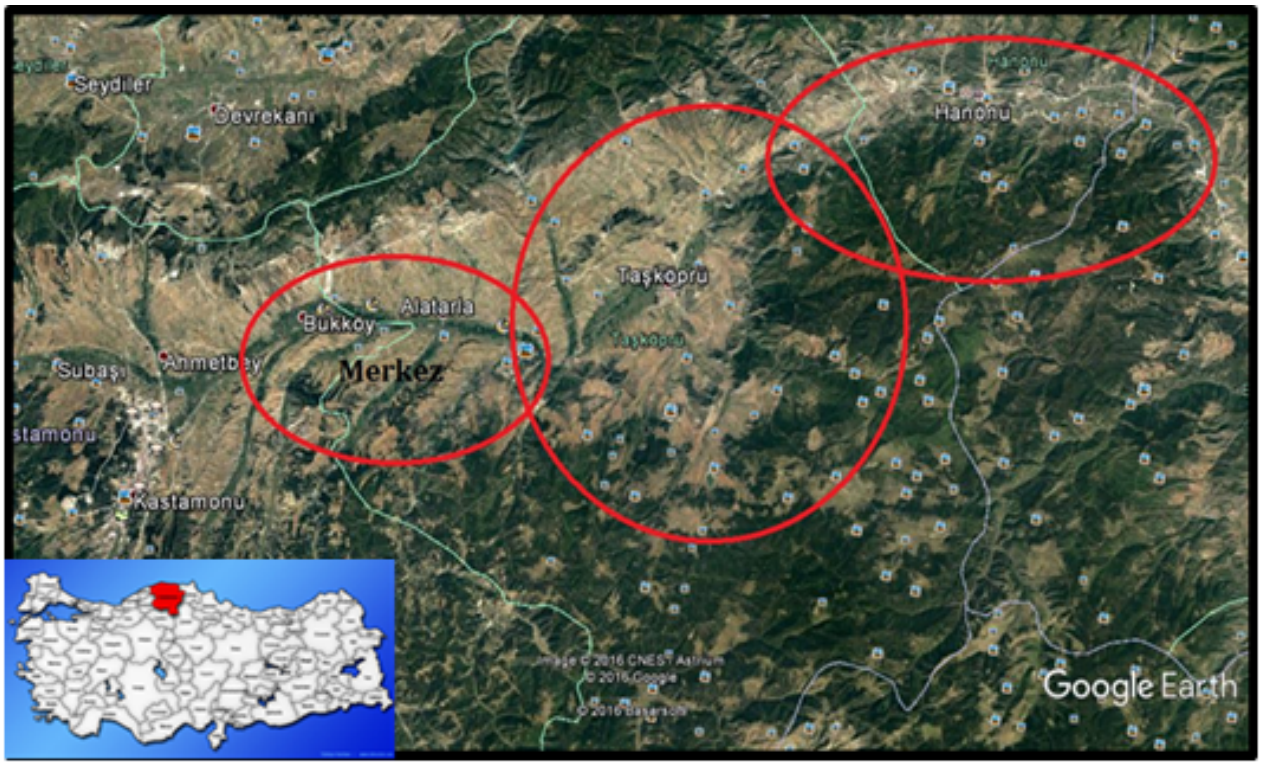

Figure 1. Localities of phytophagous mite species collected in garlic cultivation areas and storages of Kastamonu.

RESULTS

In the study, 931 samples were taken from 57 different localities, including 30 villages from Taşköprü, 14 from Hanönü and 13 from the Centrum. 1798 mites were determined and the rate of mite contamination was reported as 93.13% in plant samples and 96% in storages samples.

In total, 12 harmful mite species belonging to five families and seven genera were identified from head, green parts and storage samples (Table 2). The identified mite families were as: Acaridae, Glycyphagidae, Tetranychidae, Tarsonemidae and Eriophyidae.

Table 2. Plant parasitic mite species collected in garlic cultivation areas and storages of Kastamonu.

Family	Mite Species	Family	Harmfull Mite Species
Acaridae	*Tyrophagus putrescentiae* (Schrank)	**Glycyphagidae**	*Glycyphagus destructor* (Schrank)
	Tyrophagus perniciosus (Zakhvatkin)		*Glycyphagus domesticus* (De Geer)
	Tyrophagus neiswanderi (Johnstone & Bruce)		
	Tyrophagus similis (Volgin)	**Tetranychidae**	*Tetranychus urticae* Koch
	Rhizoglyphus robini (Clarapède)		
	Rhizoglyphus echinopus (Fumouze & Robin, 1868)	**Eriophyidae**	*Aceria tulipae* (Keifer)
	Acarus immobilis (Griffiths)	**Tarsonemidae**	*Tarsonemus waitei* Banks

The highest number of individuals was determined in the head of garlic field samples. This is followed by green parts and storage samples (Fig. 2).

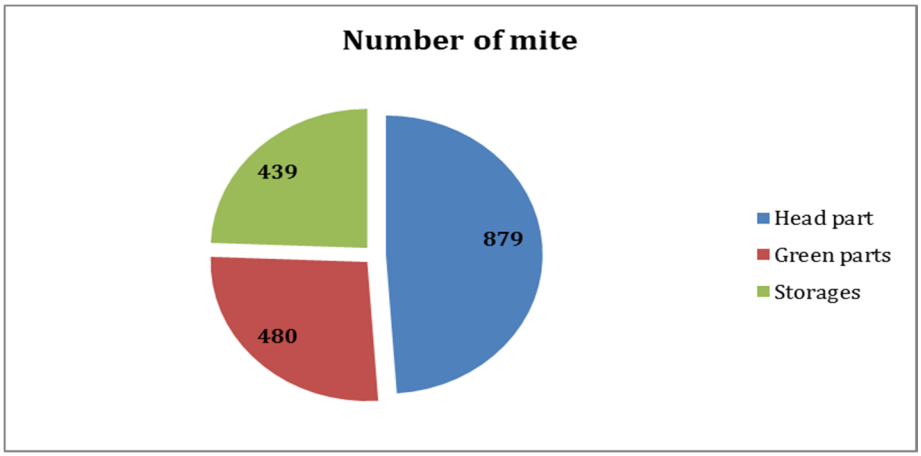

Figure 2. Distribution of mite samples according with the plant parts and storage Acaridae was most abundant (94.00%) determined mite group from garlic head samples (See Fig 3).

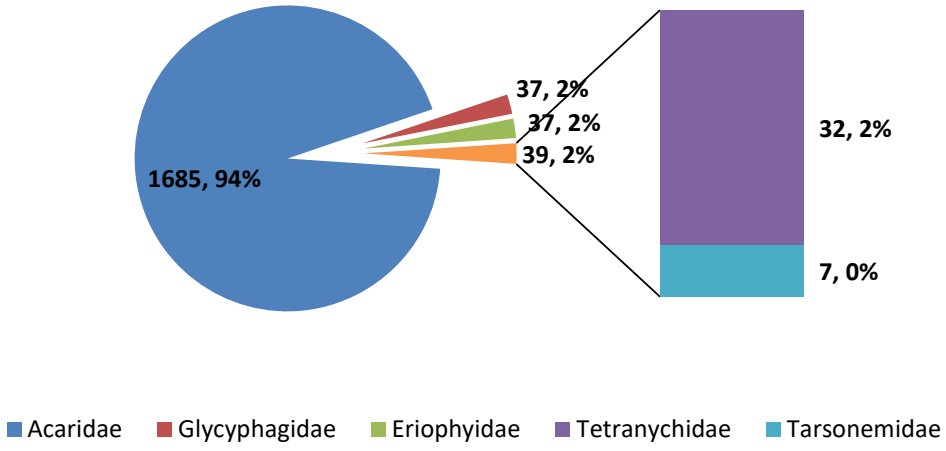

Figure 3. Distribution of mites according to the mite families.

Astigmatine species were considered as the most abundant with 90.00% in storage and 77.06% in garlic head specimens and totally 94% were determined intensively of field (Fig. 4).

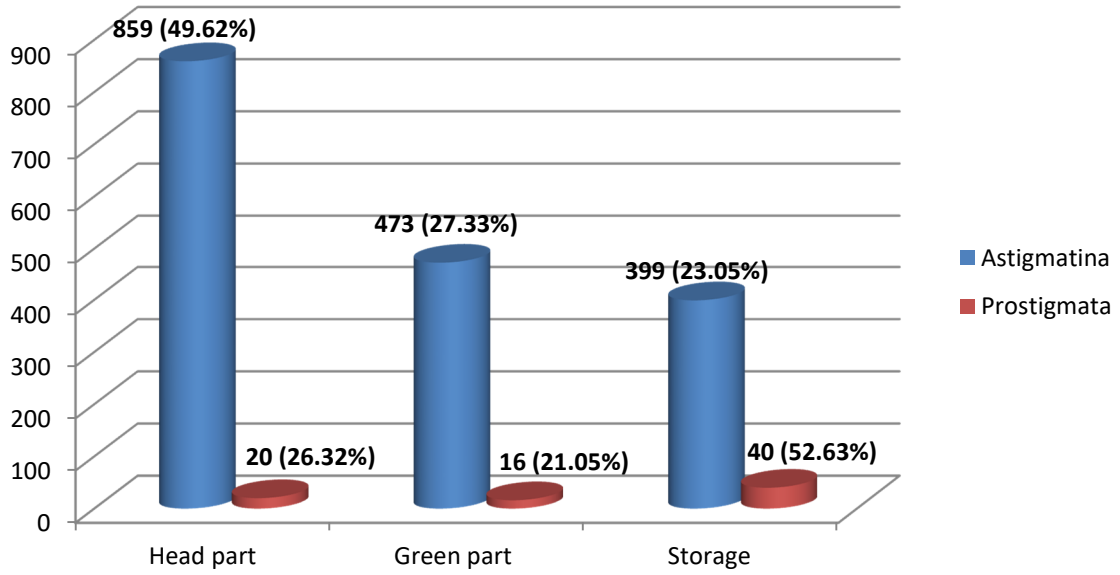

Figure 4. Number of mites collected in garlic cultivation areas (garlic head, garlic leaves) and storage surveys.

The highest percentage of mite specimens were found in Taşköprü (77.90%) and and Centrum (4.15%), respectively (Fig. 5).

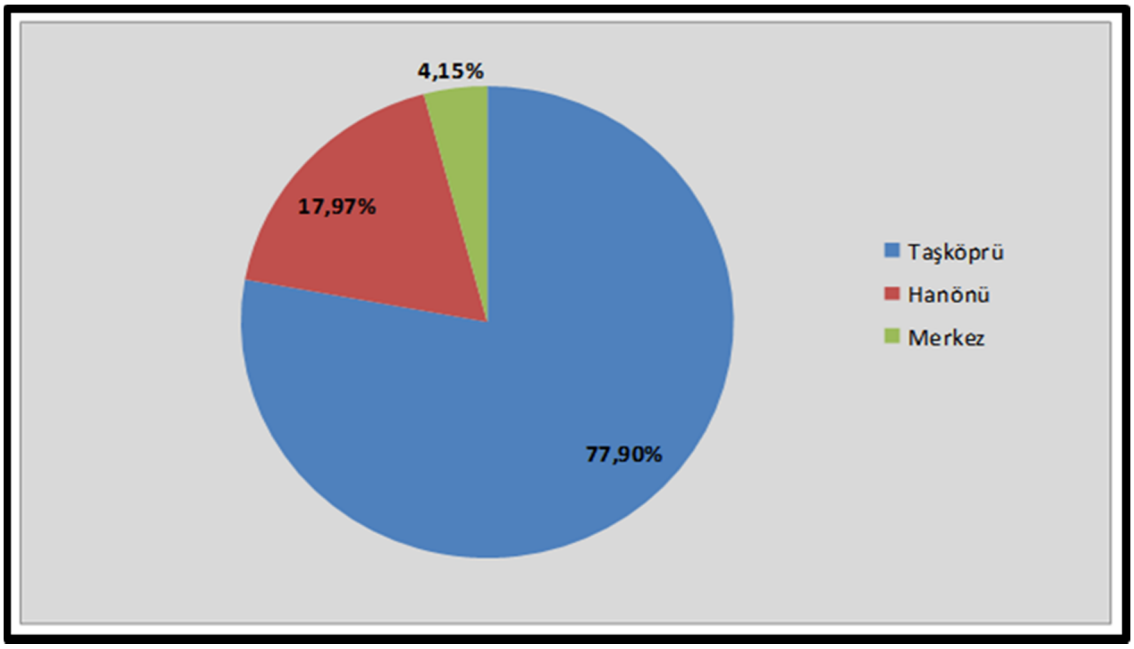

Figure 5. Percentage distribution of mites collected in garlic cultivation areas according to the localities (Merkez = Centrum).

Totally, Acaridae (with seven species), Glycyphagidae (with two species), Tarsonemidae, Tetranychidae and Eriophyidae (each with one species) were found. The most frequent genera was *Tyrophagus* with four species, following by *Rhizoglyphus* (2), *Glycyphagus* (2), *Acarus* (1), *Aceria* (1), *Tetranychus* (1), *Tarsonemus* (1).

Rhysoglyphus robini was the most abundant harmfull species in Taşköprü, Hanönü and Centrum (67.91, 71.35 and 61.54%), respectively. In the garlic storages, *Tyrophagus putrescentiae* was the most common species (49.56%) (Table 3).

Table 3. Density of mite species that were determined in Kastamonu Garlic areas according to the localities.

Group	Family	Mite Species	Distribution of mite samples to the localities (%)			
			Taşköprü	Hanönü	Centrum	Storage
Astigmatina	Acaridae	*Rhizoglyphus robini*	**67.91**	**71.35**	**61.54**	24.89
		R. echinopus	-	-	-	1.09
		Tyrophagus putrescentiae	17.65	5.26	10.26	**49.56**
		T. similis	3.83	5.85	25.64	3.49
		T. perniciosus	0.62	7.01	-	1.09
		T. neiswanderi	0.36	-	-	-
		Acarus immobilis	7.66	-	-	6.11
	Glycyphagidae	*Glycyphagus destructor*	1.07	-	-	1.09
		Glycyphagus domesticus	-	0.59	-	0.44
Prostigmata	Tetranychidae	*Tetranychus urticae*	0.53	9.94	-	3.06
	Eriophyidae	*Aceria tulipae*	-	-	-	9.17
	Tarsonemidae	*Tarsonemus waitei*	0.36	-	2.56	-
Total			100	100	100	100

Oribatida
Astigmatina
Acaridae

Rhizoglyphus robini (Claparède), 1869

Width of dorsal idiosom: 427.50 ± 0.98 (292.46–564.86), length of dorsal idiosoma: 652.35 ± 1.18 (470.83–798.84) (n = 10).

Specimens examined

Taşköprü/ Alamaşişli Village, 1.IV.2014 (4♀♀,3♂♂); Taşköprü/ Donalar Village, 05.IV.2014 (3 ♀♀); Taşköprü/ Aşağıçayırcık Village, 24.V.2014 (7 ♀♀, 5 ♂♂); Hanönü/ Eskiatça Village, 7.VI.2014 (2 ♂♂), Taşköprü/ Donalar Village garlic storage (1♀); Taşköprü/ Centrum Ağcıkişi Village, 10.IV.2015 (20 ♀♀, 28 ♂♂); Taşköprü/ Akdoğan Tekke Village garlic storage, 24.IV.2015 (3 ♂♂); Hanönü/ Karapürçek Village garlic storage (2 ♀♀); Centrum/ Yavuç Village, 8.VIII.2018 (9 ♀♀, 5 ♂♂); Centrum/ Uzunkavak Village garlic storage, 10.IX.2015 (15 ♀♀, 25 ♂♂); Centrum/ Çaycevher Village, 24.V.2016 (3 ♀♀, 3 ♂♂); Taşköprü/ Çanşa Village, 3.VI.2016 (2 ♀♀); Hanönü/ Kornapa Village, 10.VI.2016 (1 ♀♀, 2 ♂♂).

Comments

This species has been identified as the most common and harmful species that determine the mite fauna of bulbous flowers in Turkey during 2000 and 2002 (Bayram and Çobanoğlu 2006).

Medeni and Yılmaz (2010) identified it in house dust in Muş-Hasköy. Kılıç *et al*. (2012) reported damage of the species on onion in İzmir-Bayındır, Menemen and Tire. Kumral and Cobanoglu (2015b) found it on dog grape (Solanaceae) plant in Bursa.

In this study, *R. robini* was found in 33 villages of Taşköprü, Hanönü and Centrum in Kastamonu province.

***Rhizoglyphus echinopus* (Fumouze & Robin, 1868)**

Width: 944.84 ± 0.33, length: 755.63 ± 0.21 (n = 10).

Specimens examined

Centrum/Uzunkavak Village garlic storage, 10.IX.2015, (1 ♀); Taşköprü/ Akdoğan Village garlic storage, 16.IX.2015 (1 ♀); Centrum/ Uzunkavak Village garlic storage, 10.IX.2015 (1 ♂); Taşköprü/ Alatarla Village garlic storage, 20.X.2015 (1 ♂).

Comments

Rhyzoglyphus echinopus was reported for the first time by Çobanoğlu (1996) on wheat and stored sunflower in Edirne. Çobanoğlu and Bayram (1998) found the species in tuberous ornamental plants. In this study, *R. echinopus* has been collected just in the stored garlic heads.

***Tyrophagus putrescentiae* Schrank, 1781**

Width: 239.12 ± 0.62 (163.01–362.38), length: 392.54 ± 0.86 (248.16–550.89) (n = 10).

Specimens examined

Taşköprü/ Centrum garlic storage, 7.V.2014 (5 ♀♀); Taşköprü/ Tekev Village garlic storage, 14.XII.2014 (6 ♀♀, 3 ♂♂); Taşköprü/ Centrum garlic storage, 26.I.2015 (53 ♀♀, 42 ♂♂); Taşköprü/ Ağcıkişi Village (65 ♀♀, 113 ♂♂); Centrum/ Uzunkavak Village garlic storage, 10.IX.2015 (13 ♀♀, 10 ♂♂); Hanönü/ Erik Village, 20.V.2016 (2 ♀♀, 1 ♂); Centrum/ Abay Village, 24.V.2016 (1 ♂).

Comments

This species, which is called the mildew mite, can be found to a wide range of food, plant and animal materials suitable for environmental conditions and is considered as a cosmopolitan storage pest with economic and health importance. It is a potential vector of parasitic fungi, such as *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Mucor racemosus* (Fresen) and *Nectria haematococca* (Wollenweber) (Zhang and Fan 2005). It was identified on head and green parts of garlic and storage samples andfound intensively in storages.

***Tyrophagus perniciosus* Zakhvatkin, 1941**

Width: 308.83 ± 7.13 (225.91–387.34), length: 505.07 ± 8.84 (388.14–616.39) (n = 10).

Specimens examined

Hanönü/ Donalar Village, 16.IV.2015 (3 ♀♀, 2 ♂♂); Taşköprü/ Aşağıçayırcık Village, 20.IV.2015 (5 ♀♀, 9 ♂♂); Taşköprü/ Yukarıçayırcık Village, 20.IV.2015 (5 ♀♀, 6 ♂♂); Taşköprü/ Kızılcaören Village, 25.IV.2015 (11 ♀♀, 14 ♂♂); Centrum/ Çavundur Village, 01.V.2016 (3 ♀♀, 8 ♂♂).

Comments

This mite is in the mold mites group (Zhang and Fan 2005). They are mostly found in stored bodies, organic fertilizers, greenhouses, plant residues and dead arthropods living in soil. This species is an economically important mite for the stored agricultural products (Zhang and Fan 2005). It was found in the head, green parts and storage surveys and determined intensely in land surveys.

Tyrophagus similis (Volgin, 1949)

Width: 213.59 ± 15.15 (170.73–256.44), length: 403.53 ± 22.22 (340.66–466.39) (n = 3).

Specimens examined

Taşköprü/ Aşağıçayırcık Village, 20.IV.2015 (11 ♀♀, 3 ♂♂); Hanönü/ Eskiatça Village, 20.IV.2015 (7 ♀♀, 2 ♂♂); Taşköprü/ Kızılcaören Village, 25.IV.2015 (14 ♀♀, 11 ♂♂); Hanönü/ İncesu Village, 26.IV.2015 (4 ♀♀, 5 ♂♂); Centrum/ Çavundur Village, 01.V.2015 (2 ♀♀, 5 ♂♂); Centrum/ Ayvalı Village, 01.V.2015 (2 ♀♀, 5 ♂♂).

Comments

It can damage plants, such as melon, cucumber, pumpkin. This species population decrease in summer bacause it prefers relatively low temperatures (Kılıç *et al*. 2012). In this study, it was found in the head, green parts and storage surveys and recorded in field surveys frequently (Madanlar and Önder 1996).

Tyrophagus neiswanderi Johnston & Bruce, 1965

Width: 222.47 ± 5.26 (190.60–240.86), length: 419.01 ± 10.88 (289.63–522.20) (n = 3).

Specimens examined

Taşköprü/ Centrum Ağcıkişi Village, 03.IV.2015 (1 ♀,1 ♂); Taşköprü/ Ağcıkişi Village, 9.VII.2015 (1 ♂).

Comments

It is a polyphage species. Agricultural lands, barn powders, bean plumules, cucumbers, garlic, kiwi, lilies cabbage, corn, melon, melon seed beds, algae, mushrooms, narcissus bulbs, orchids, pastures, pumpkin are the important hosts of *T. neiswanderi* (Johnston and Bruce 1965). It was determined in Turkey by Kılıç and Toros (2000), Çobanoğlu (2008), Kılıç *et al*. (2012), on spinach (*Spinacia oleracea* L.) by Kırışık *et al*. (2018). This species was found on head and green parts samples in Taşköprü.

Acarus immobilis Griffiths, 1964

Width: 266.25 ± 0.30 (221.91–317.42), length: 460.85 ± 0.38 (393.87–520.35) (n = 10).

Specimens examined

Taşköprü/ Centrum garlic storage, 7.VI.2014 (4 ♀♀, 4 ♂♂); Taşköprü/ Ağcıkişi Village. 10.IV.2015 (42 ♀♀, 23 ♂♂); Taşköprü Donalar Village garlic storage. 11.VII.2015 (4 ♀♀, 5 ♂♂).

Comments

Acarus immobilis was reported by Çobanoğlu (1996) on wheat in Edirne. The damage of this mite was also identified on kashar cheese by Çobanoğlu and Toros (1988). This mite is a

polyphagous species, which is known as flour-cereal mite. Its hosts are flour, seed, onion, garlic, pet food, oilseed, harvested grain, hay, grass, soils, medicinal plants, cheese, abandoned beehives, deep poultry (Solomon 1962; Solarz *et al*. 1997; Mason 2004; Webster *et al*. 2004). In this study, it was found on head, green parts and storage of garlic cultivation areas in six villages of Taşköprü.

Glycyphagidae

Glycyphagus domesticus (De Geer, 1778)

Width: 260.82 ± 0.45 (202.20–350.10), length: 395.44 ± 0.45 (321.48–456.32) (n = 10).

Specimens examined

Taşköprü/ Ağcıkişi Village garlic storage. 26.I.2015 (2 ♀♀, 2 ♂♂); Hanönü/İncesu Village. 26.IV.2015 (1 ♂).

Comments

This mite is called furniture mite, cereal mite or household mite (Goracci *et al*. 1985). This species was reported in Bursa (Gülegen *et al*. 2005), on storage products in Edirne (Çobanoğlu 1996), as house dust mite in Bitlis and Muş (Medeni *et al*. 2013) and Kutahya (Akdemir and Gürdal 2005).

Glycyphagus destructor (Schrank, 1781)

Width: 260.82 ± 0.45 (202.20–350.10), length: 395.44 ± 0.45 (456.32–321.48) (n = 10).

Specimens examined

Taşköprü/ Ağcıkişi Village. 10.IV.2015 (6 ♀♀, 6 ♂♂); Taşköprü/ Yeniköy Village garlic storage. 20.VII.2015 (1 ♀); Taşköprü/ Yazıhamit Village garlic storage, 07.XII.2015 (9 ♀♀, 5 ♂♂).

Comments

This species was determined on stored flour and wheat in Izmir by Çobanoğlu (1996); in wheat silos in Erzurum by Gültekin and Özkan (1999); in the flour factories in Bursa by Çoşkuncu *et al*. (2005); on stored wheat in Kahramanmaraş and Adıyaman by Işıkber *et al*. (2005).

Prostigmata
Tetranychidae

Tetranychus urticae Koch, 1836

Species examined

Hanönü/ Eskiatça Village. 28.VI.2015 (8 ♀♀, 8 ♂♂); Taşköprü/ Centrum garlic storage. 21.VII.2015 (1 ♀, 3 ♂♂); Taşköprü/ Çit Village. 25.VII.2015 (4 ♀♀, 1♂♂).

Comments

It was recorded previously in Turkey by Yoldaş *et al*. (1990), Öncüer *et al*. (1992), Erdoğan (2006), Yanar & Üstünol (2009); Can & Çobanoğlu (2010). In this study, it was determined on head, green parts and garlic storage samples.

Eriophyidae

Aceria tulipae (Keifer, 1938)

Specimens examined

Taşköprü/ Tekev-Karşı Village garlic storage. 8.VII.2015 (2 ♀♀, 2 ♂♂); Taşköprü/ Akdoğan Tekke Village garlic storage. 30.VIII.2015 (5 ♀♀, 1 ♂); Hanönü/ Kornapa Village. 28.IV.2016 (1 ♀, 1 ♂); Taşköprü/Alisaray Village. 28.IV.2016 (1 ♀).

Comments

Members of *A. tulipae* feed on young leaves and are found in layers of tulips, onions and garlic bulbs. As a result of their feeding on knitting, twisting, curling green parts and leaves of the plants, they damage and dry the leaf texture (Debnath and Karmakar 2013). This species carries the wheat streak mosaic virus (WSMV) and garlic mosaic virus especially in garlic and onions which cause significant yield losses in the economic sense (Denizhan 2012). Denizhan (2012) reported this mite feeding on the leaves of garlic. This species was found in nine garlic storages of Taşköprü and Hanönü in this study.

Tarsonemidae

Tarsonemus waitei Banks, 1912

Width: 140.82 ± 5.06 (126.50–155.13), length: 262.84 ± 2.06 (257.00–268.67) (n = 10).

Specimens examined

Taşköprü/Akdoğan Village garlic storage. 23.VIII.2015 (1♀1♂).

Comments

This mite was determined first on the leaf spills of *Pyracantha coccinea* (Roem.) in Edirne by Çobanoğlu (1995). This species was reported in Ankara, Bursa and Yalova on dog grape plant (Kumral and Çobanoğlu 2015b), on eggplant in Ankara, Bursa and Yalova (Kumral and Çobanoğlu 2015a). In this study, *T. waitei* was found in the samples that were taken from a garlic storage in Taşköprü of Kastamonu.

DISCUSSION AND CONCLUSION

Within the scope of the study, the harmful mite fauna was determined for the first time in garlic in Turkey with their abundances and distributions. The densities of harmful mite populations in garlic have been determined for the first time.

Rhizoglyphus robini was considered as the most abundant and predominant species in the garlic cultivation areas.

In accordance with the scientific studies carried out in bulbous plants in the world, the most important harmful species in the land and srotages of garlic plant are determined as *Rhizoglyphus* and *Tyrophagus* (Ho and Chen 1987; Díaz *et al*. 2000; Straub 2004).

Some mite species that are harmful on garlic are vectors, especially carrying some virus diseases. The basic data on fighting against virus diseases have been obtained with the identification of mite species that are likely the vectors in our study. In this study, *Aceria tulipae* was determined as the important harmful species on the garlic parts, especially head and leaf. Since *A. tulipae* is the vector of viruses that cause important plant diseases, this issue is of particular importance and further studies are needed on this subject (Pokharel and Larsen 2007; Lommen *et al*. 2012).

In our study, *Tyrophagus* spp., especially *T. neiswanderi*, were determined frequently on green parts of garlic.

It is very important to study garlic mite problems, especially considering the importance of garlic for health and exporting values. For protecting natural enemies and sustainable growth, it is important to train farmers to use less chemicals in fields.

The richness of biodiversity of garlic growing areas depends on the natural enemies or beneficial mite fauna, then the phtophagous mite species.

ACKNOWLEDGEMENTS

The authors wish to thank Funding for this study through grants by the Turkish Council of Research (TUBITAK TOVAG grant no: 114O416).

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گونه‌های کنه‌های گیاهخوار مناطق کشت و انبارهای سیر (*Allium sativum* L.) کاستامونو، ترکیه

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چکیده

ترکیه رقم مشخصی از سیر (*Allium sativum* L.) به نام «تاشکوپرو» دارد که افزون بر اینکه از گیاهان مهم کشاورزی است به ویژه به شرایط اقلیمی بسیار سخت مقاوم است. این بررسی برای تعیین کنه‌های زیان‌آور مزارع و انبارهای سیر در طی سال‌های ۲۰۱۵-۲۰۱۶ انجام شد. نمونه‌ها از کاستامونو (تاشکوپرو، هانونو و سنتروم) با فاصله یک هفته بین ماه‌های آوریل تا آگوست جمع‌آوری شدند. دوازده گونه کنه متعلق به دو راسته (پیش‌استیگمایان و اریاتیدها [Astigmatina]) شناسایی شدند؛ گونه‌های شناسایی شده به پنج خانواده شامل Acaridae (هفت گونه)، Glycyphagidae (دو گونه)، Tetranychidae (یک گونه)، Tarsonemidae (یک گونه) و Eriophyidae (یک گونه) تعلق داشتند. نتایج نشان داد که کاستامونو تنوع زیستی زیاد به ویژه در مناطق رویش و انبارهای سیر دارد. گونهٔ *Rhyoglyphus robini* Clarapède (Acaridae) فروان‌ترین و معمول‌ترین گونه با فراوانی ۷۱/۳۵ درصد در هانونو تشخیص داده شد در حالی‌که گونهٔ *Tyrophagus putrescentia* (Schrank) (Acaridae) پر جمعیت‌ترین گونه بود.

واژگان کلیدی: زیرردهٔ کنه‌ها؛ بی‌استیگمایان؛ کاستامونو؛ پیش‌استیگمایان؛ *Rhizoglyphus*؛ انباری؛ سیر؛ ترکیه.

اطلاعات مقاله: تاریخ دریافت: ۱۳۹۷/۱۱/۳۰، تاریخ پذیرش: ۱۳۹۸/۲/۳۰، تاریخ چاپ: ۱۳۹۸/۴/۲۴