Original article

Distribution, host plants and natural enemies of *Aleyrodes proletella* L. (Hemiptera: Aleyrodidae) on collard (*Brassica oleracea* L. var. *acephala*) in Düzce province of Turkey

Düzce ilinde karayaprak lahanasında (*Brassica oleracea* L. var. *acephala*) zararlı *Aleyrodes proletella* L. (Hemiptera: Aleyrodidae)'nin yayılışı, konukçuları ve doğal düşmanları

Abdurrahman Sami KOCAa*, Halil KÜTÜKb

a Bolu Abant Izzet Baysal University, Faculty of Agriculture and Natural Sciences, Department of Plant Protection, 14030 Gölköy, Bolu, Turkey

**ARTICLE INFO**

**ABSTRACT**

This study was carried out on distribution, density, host plant, and natural enemies affecting its population fluctuation of *Aleyrodes proletella* L. (Hemiptera: Aleyrodidae) on collard during the years of 2016-2017 in Düzce province in Western Black Sea Region. *Aleyrodes proletella* was widespread in all districts of Düzce province and the infestation rate was 84.3%. The highest infestation rates were determined in Akçakoca (97.8%), Yüğülca (93.3%), Gümüşova (88.9%), Kaynaşlı (84.4%), Cumayeri (82.2%), Gölyaka (80%), Çilimli (75.6%) and Central (75%) districts, respectively. Hosts of *A. proletella* except collard were determined that white cabbage (*Brassica oleracea* L. var. capitata) and *Lapsana communis* L. subsp. *intermedia* (Bieb.) Hayek plant which is called as common nippleworth belonging to the Asteraceae (Capparales) family. Parasitoid of *A. proletella* except collard was detected as *Encarsia tricolor* Förster (Hymenoptera: Aphelinidae), and predators of *A. proletella* were found as *Clitostethus arcuatus* Rossi (Coleoptera: Coccinellidae) and *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae).

**INTRODUCTION**

Vegetables in the Brassicaceae (Capparales) family are rich in terms of nutrients and phytochemicals (glucosinolate, isothiocyanate, indole compounds), and provides normal levels of cholesterol and blood sugar levels in the human body. They also have protective effects against bone resorption, heart disease, and cancer. Due to these properties, the importance of healthy nutrition is understood better every day as a result of researches (Vural et al. 2000). Collard (*Brassica oleracea* L. var. *acephala*) is one of the oldest forms of the family Brassicaceae (Nieuwhof 1969) and it's indispensable for healthy nutrition for many years due to its rich nutritional values (Güney 1984).

Western Black Sea Region is one of the important regions...
in Turkey in terms of winter vegetable production. Among the cultivated winter vegetables, collard is one of the most valuable vegetables for the region and approximately 53,000 da areas were cultivated in 2017 and 66,000 tons were harvested (TÜİK 2018). In the region, 8,401 da parts corresponding to roughly 15% of the cultivated areas are located. Collard plant was grown in the 1,389 da area in Düzce province and 2,020 tons of products were obtained (TÜİK 2018).

*Aleyrodes proletella* is among the pests which are very difficult to control for farmers. The pest can give a large number of progenies, have a wide host range and improve resistance to insecticides in a short time (Byrne and Bellows 1991, Springate 2016). Besides, this pest is seen in the temperate regions of the world (De Barro and Carver 1997) and causes damage by sucking phloem sap directly, which affects cabbage growth and yield. Indirect damage caused by honeydew excretion contaminated with wax deposition and remains of dead whitefly bodies. It is very important because this provides the substrate for sooty mod fungi and a sticky layer on the plant surface (Ramsey and Ellis 1996). *Aleyrodes proletella* has not been determined as a virus vector (Springate and Colvin 2012). Recently, *A. proletella* has developed into one of the most important Brassica pests in vegetable production in Europe, especially in Germany (Saucke et al. 2011, Springate and Colvin 2012).

The origin of *A. proletella* called as cabbage whitefly is the European continent. It is one of the main pests damaging members of the Brassicaceae family in Turkey and European countries (De Barro and Carver 1997, Evans 2008, Martin et al. 2000, Mound and Halsey 1978, Springate 2016, Ulusoy and Vatansever 1997).

In previous studies in Turkey, it was determined that *A. proletella* was distributed in Central and North Anatolian Regions (Alkan 1961). Ulusoy and Vatansever (1997) reported that *A. proletella* was detected on cabbage, cauliflower, and red cabbage for the first time in the Eastern Mediterranean Region and their populations were not at a significant level and suppressed by natural enemies which exist in nature. Also, it has been noted that cabbage whitely is found in Eastern Mediterranean (İçel, Hatay, Adana) and Western Mediterranean (Antalya, Burdur, Isparta), Aegean (Muğla, Aydın), Marmara (Balkesir, Bursa), Central (Konya, Karaman, Akşaray, Niğde, Kayseri, Sivas) and Eastern Anatolian Regions (Malatya) (Ulusoğlu 2001). Finally, *A. proletella* was determined in Uşak, Manisa, İzmir (Ulusoy et al. 2012a), Bartın and Kastamonu provinces (Ulusoy et al. 2012b). Only detection studies have been done related to *A. proletella* until now, but there is not any study about damage levels, prevalence, and parasitism rate in Turkey.

The study aimed to reveal distribution, hosts and natural enemies affecting population fluctuation of *A. proletella*. Also, this study will contribute to creating a management program against *A. proletella* causing economic losses in Düzce province in the Western Black Sea Region.

### MATERIALS AND METHODS

This study was conducted in the 2016 and 2017 agricultural growing season in Düzce province of Turkey. The samples were periodically collected every 15 days in the collard areas and its around other plants for the determined hosts and natural enemies of the *A. proletella*. The geographical information about sample sites was given in Table 1.

The survey was conducted in July-August determining for distribution areas of *A. proletella* that density of *A. proletella* populations was highly seen (Koca et al. 2017). Sample areas where the distribution studies of *A. proletella* were given Table 2. Eggs, larvae, pupae and pupae molts of the pest were searched for all the leaves of 15 plants in each field. When a biological period of the pest is found on one leaf of a plant, the field is considered as infecting with whitefly. According to the infestation in the surveyed fields, the infestation rates (%) of each district were determined.

Besides, heavily infected leaves with the whiteflies were collected from collard fields and they were brought to the laboratory in the icebox. Since the whiteflies were diagnosed from the pupae, the individuals of the pest in the pupae period were removed from the leaves with a fine tip brush and taken into the 70% alcohol. Preparations of samples

### Table 1. The geographical information of the sample areas where the studies of *Aleyrodes proletella* L. are periodically conducted

| District | Location  | Altitude | Coordinates                 |
|----------|-----------|----------|-----------------------------|
| Merkez   | Aziziyè   | 145 m    | 40° 50’ 39.767174” N / 31° 7’ 44.929873” E |
| Merkez   | Ağa       | 143 m    | 40° 50’ 41.398276” N / 31° 7’ 41.400622” E |
| Çilimli  | Mahiraga  | 160 m    | 40° 52’ 47.002000” N / 31° 3’ 1.136904” E |
| Çilimli  | Topçular  | 148 m    | 40° 52’ 26.779871” N / 31° 3’ 4.386132” E |
stored in alcohol were carried out according to Bink (1979), Düzgüneş (1980) and Martin (1987). The larvae and pupae of the whiteflies on the leaf samples were counted with a stereoscopic microscope as parasitized or non-parasitized. The leaves were taken into the parasitoid boxes after the counts of the leaf samples were completed.

To determine the predators fed on the whiteflies, the plants infected with whiteflies were firstly examined by the visual inspection method after waiting for a few minutes around the plants. The adults of the predators which observed to be fed on whiteflies were collected. After that, the leaves were removed from the other pests and the immature periods of the predators were taken into the culture boxes with their prey in the laboratory.

**RESULTS AND DISCUSSION**

The host diversity of *A. proletella* comprised three species in Düzce province. These species were determined as *Brassica oleracea* var. capitata, *Brassica oleracea* var. acephala (Brassicaceae) and *Lapsana communis* subsp. *intermedia* (Asteraceae).

Mound and Halsey (1978) reported that hosts of *A. proletella* were found as *Impatiens parviflora*, *Bongardia chrysogonum*, *Codonopsis clematidae*, *Ostrowskia magnifica*,

| District          | Location   | Altitude (m) | Coordinates                  |
|-------------------|------------|--------------|------------------------------|
| Merkez            | Aziziye    | 145          | 40° 50’ 39.767174” N / 31° 7’ 44.929873” E |
| Merkez            | Ağa        | 143          | 40° 50’ 41.398276” N / 31° 7’ 41.400622” E |
| Merkez            | Mergiç     | 139          | 40° 50’ 41.368704” N / 31° 7’ 7.309679” E |
| Merkez            | Gökçe      | 178          | 40° 49’ 12.900415” N / 31° 12’ 16.092856” E |
| Gölyaka           | Kültür     | 145          | 40° 46’ 57.048859” N / 30° 59’ 44.612925” E |
| Gölyaka           | Yeşil      | 129          | 40° 46’ 32.335354” N / 30° 59’ 26.950981” E |
| Gölyaka           | Yeşilova   | 144          | 40° 46’ 25.084941” N / 30° 58’ 9.176810” E |
| Gümüşova          | Çaybükü    | 126          | 40° 51’ 28.993069” N / 30° 58’ 28.855943” E |
| Gümüşova          | Selamlar   | 120          | 40° 51’ 31.870845” N / 30° 57’ 42.512501” E |
| Gümüşova          | Kültür     | 157          | 40° 51’ 55.575326” N / 30° 56’ 34.972433” E |
| Cumayeri          | Orta       | 117          | 40° 52’ 24.280337” N / 30° 56’ 43.740339” E |
| Cumayeri          | Yeniyaka   | 114          | 40° 52’ 57.400254” N / 30° 57’ 27.104618” E |
| Cumayeri          | Aşağı Avlayan | 159        | 40° 53’ 13.504572” N / 30° 58’ 30.058712” E |
| Çilimli           | Mahirağa    | 160          | 40° 52’ 47.002000” N / 31° 3’ 1.136904” E |
| Çilimli           | Topçular   | 148          | 40° 52’ 26.779871” N / 31° 3’ 4.386132” E |
| Çilimli           | Yukarı Karaköy | 138       | 40° 52’ 50.046643” N / 31° 0’ 20.910253” E |
| Kaynaşlı          | Şimşir      | 242          | 40° 46’ 41.137056” N / 31° 16’ 30.478622” E |
| Kaynaşlı          | Merkez      | 298          | 40° 46’ 14.91188” N / 31° 19’ 9.995560” E |
| Kaynaşlı          | Sarıçökek   | 289          | 40° 46’ 35.086546” N / 31° 19’ 3.543271” E |
| Yığılca           | Dutlar      | 291          | 40° 56’ 41.737601” N / 31° 20’ 36.343914” E |
| Yığılca           | Hoşafoglu   | 312          | 40° 56’ 26.343448” N / 31° 22’ 46.815747” E |
| Yığılca           | Orhangazi   | 312          | 40° 57’ 43.832919” N / 31° 26’ 31.271681” E |
| Akçakoca          | Ayaz        | 26           | 41° 5’ 22.661951” N / 31° 8’ 21.650823” E |
| Akçakoca          | Yeni        | 34           | 41° 4’ 59.933752” N / 31° 7’ 27.119167” E |
| Akçakoca          | Dadali      | 124          | 41° 3’ 42.474908” N / 31° 11’ 2.874786” E |

Table 2. The geographical information of the sample areas where the distribution studies of *Aleyrodes proletella* L.
Acanthocephalus benthamianus, Cephalorrhynchus sp., Irula sp., Steptorhamphus crambifolium, Cichorium sp., Lactuca muralis, L. triangulata, Lapsana communis, Mutisia acutifolium, Prenanthes purpurea, Sonchus arvensis, S. oleraceus, Sonchus sp., Taraxacum officinale, Brassica balearica, B. cretica, B. incana, B. macrocarpa, B. robertiana, B. tinei, B. oleracea, Cheiranthus sp., Lepidium latiolum, Euphorbia peplus, Quercus robur, Vicia faba, Chelidonium majus, Aquilegia montana, A. lactiflora, Thalictrum minus, Linaria sp., Petroselinum sp. and Laser trilobus.

Brassica oleracea, Sonchus sp., Lactuca serriola, Euphorbia sp., E. peplus, and Cichorium intby were identified as hosts of A. proletella in Turkey (Alkan 1961, Ulusoy 2001, Ulusoy and Vatansever 1997).

In Düzce province, the farmers start to plant the collard seedlings at the beginning of May and begin to harvest the leaves from June. The harvest finishes with the cooling of the weather in October. However, many farmers continue to collect leaves of collard in winter because of withstanding to winter conditions of these plants. In such cases, the cabbage whitefly can hibernate on collard. These plants are removed at the beginning of the spring season, especially at the end of March-beginning of April, and new collard seedlings were planted at the beginning of May depending on the climatic conditions. In this period of soil preparation in the fields, it was found that the adults of A. proletella migrated to Lapsana communis plants around the collard fields and created a population on these weeds.

Related to A. proletella in the past years in Turkey had only detection studies, which it is reported in many provinces in the Middle, North, and Eastern Anatolia, Mediterranean, Aegean, Marmara and Black Sea Regions (Alkan 1961, Ulusoy 2001, Ulusoy and Vatansever 1997, Ulusoy et al. 2012a, Ulusoy et al. 2012b, Ülgentürk and Ulusoy 1999). However, studies were not conducted to determine the distribution and density of the pests in these provinces. In this study, A. proletella was detected in Düzce province in the Western Black Sea Region and determined the infestation rates of whiteflies in all districts.

Table 3 showed that A. proletella was spread throughout in whole of Düzce province and the infestation rate of whitely was 84.3%. Aleyrodes proletella has the highest infestation rate in Akça köca with 97.8% followed by Yiğdelca with 93.3%. On the contrary, the least infestation rates were determined in Central with 75% and Çilimli with 75.6%.

The natural enemies of cabbage whitefly were found in this study. Encarsia tricolor Forster (Hymenoptera: Aphelinidae) known as a larval parasitoid of whiteflies was identified as the natural enemies of A. proletella in the collard areas. The morphological identification of E. tricolor was performed by Dr. Andrew POLASZEK (International Institute of Entomology, The Natural History Museum, London, UK). The distribution areas of this parasitoid have been reported as Belgium, Canary Islands, Czech Republic, France, Germany, Greece, Hungary, Italy, the Netherlands, Portugal, Russia, Serbia, Spain, Sweden, Ukraine, United States of America and the United Kingdom in the world (Anonymous 2017). In our country, this parasitoid was firstly identified by Ulusoy (1999) on the Aleyrodes lonicerae (Walker) fed on Sonchus spp. in the Mediterranean Region. In this study, the parasitoid E. tricolor was detected on A. proletella fed on Brassica oleracea var. acephala. When the previous studies were examined on the activities of Encarsia species, it was seen that 70-80% of A. proletella was parasitized by E. inaron, 45-60% of Trialeurodes vaporariorum Westwood (Hemiptera: Aleyrodidae) was parasitized by Encarsia spp. (Ulusoy and Vatansever 1997). Further, in a conducted study in California by Dreistadt and Flint (1995), it was reported that the amount of Siphoninus phillyrae Haliday (Hemiptera: Aleyroidae) on the leaves was 98% before E. inaron was placed in the area. After that, when the parasitoids placement in the area, the density of whiteflies decreased to less than 1%. Koca et al. (2018) found that the natural parasitism rate of E. tricolor on A. proletella reached up to 80%. Lodos (1986) reported that there was no need to use chemicals in control of A. proletella and these parasitoids kept to the pests under the control. Similarly, Manzari et al. (2002) referred that Encarsia genus has been very effective in biological control, especially on whiteflies.

Clitostethus arcuatus Rossi (Coleoptera: Coccinellidae) and Chrysoperla carnea Stephens (Neuroptera: Chrysopidae) were identified as the predators of A. proletella on collard in this study. The distribution areas of C. arcuratus have been reported as Albania, Austria, Belgium, Bosnia and Herzegovina, England, Bulgaria, Canary Islands, Croatia, Czech Republic, France, Germany, Greece, Hungary, Italy, Luxembourg, Malta, Poland, Portugal, Romania, San Marino, Sicily, Slovakia, Russia, Spain, Switzerland, the Netherlands, Ukraine and Yugoslavia in the world (Fauna Europaea 2017). It was reported that this predator species is located in the Eastern Mediterranean Region, Mediterranean Region and Eastern Anatolia Region in our country (Gözüaçı et al. 2012, Soylu 1980, Soylu and Ürel 1977). Both larvae and adults of C. arcuratus are fed on larvae and pupae of whiteflies. Paratetranychus citri, Brevipalpus levis, Dialeurodes citri, A. proletella, Aleurothrixus floccosus, A. racgiphora, A. floccosus, A. lonicera, Bemisia tabaci, B. hancocki, Parabemisia myricae, Paraleurodes minei, Siphoninus phillyrae, and Trialeurodes
vaporariorum have been reported as hosts of this predator (Soylu and Ürel 1977, Ulusoy and Ülgentürk 2003, Ulusoy and Vatansever 1997). Regarding the efficacy of predator, Bathon and Pietrzik (1986) reported that C. arcuatus was able to consume roughly 550 A. proletella eggs during larval development and it was an effective predator of A. proletella. Chrysoperla carnea has been reported to be a polyphagous predator fed with aphids, whiteflies, armored scale insects, some lepidopterous eggs and larvae, thrips, psyllids, chrysomelid larvae and some mite species (Kaya and Öncüer 1988). Chrysoperla Steinman species are widely seen in different agro-ecosystems in many parts of the world (Ridgway and Jones 1968, Stark and Whitford 1987). It was reported that this predator insect is fed on Acaudaleyrodes citri, A. rachiophora, Aleuroboles olivinus, Aleurothrixus floccosus, A. lonicerae, A. proletella, B. tabaci, Diauleuroboles pulcher, Diauleurodes citri, S. phillyrae, T. vaporariorum, Parabemisia myricae, and Paraleyrodes minei (Tell and Yiğit 2012, Ulusoy and Ülgentürk 2003, Ulusoy et al. 1996, Zia et al. 2008).

Table 3. Infestation rates of Aleyrodes proletella L. on collard in Düzce province, Turkey in 2017

| District  | Location    | Number of Plant Checked | Infected Plant | Infestation Rate (%) | Average Infestation Rate (%) |
|-----------|-------------|-------------------------|----------------|----------------------|-----------------------------|
| Merkez    | Aziziye     | 15                      | 6              | 40%                  | 75%                         |
| Merkez    | Ağası       | 15                      | 15             | 100%                 |                             |
| Merkez    | Mergiç      | 15                      | 12             | 80%                  | 80%                         |
| Merkez    | Gökçe       | 15                      | 12             | 80%                  | 75%                         |
| Gölüka    | Kültür      | 15                      | 11             | 73.3%                |                             |
| Gölüka    | Yeşil       | 15                      | 14             | 93.3%                | 80%                         |
| Gölüka    | Yeşilova    | 15                      | 11             | 73.3%                |                             |
| Gümüşova  | Çaybükü     | 15                      | 13             | 86.7%                |                             |
| Gümüşova  | Selamlar    | 15                      | 12             | 80%                  | 88.9%                       |
| Gümüşova  | Kültür      | 15                      | 15             | 100%                 |                             |
| Cumayeri  | Orta        | 15                      | 12             | 80%                  |                             |
| Cumayeri  | Yeniya      | 15                      | 11             | 73.3%                | 82.2%                       |
| Cumayeri  | Aşağı Avlayan | 15                  | 14             | 93.3%                |                             |
| Çilimi    | Mahirağa     | 15                      | 12             | 80%                  |                             |
| Çilimi    | Topcular    | 15                      | 10             | 66.7%                | 75.6%                       |
| Çilimi    | Yukarı Karaköy | 15                  | 12             | 80%                  |                             |
| Kaynaşlı  | Şimşir       | 15                      | 12             | 80%                  |                             |
| Kaynaşlı  | Merkez      | 15                      | 12             | 80%                  | 84.4%                       |
| Kaynaşlı  | Sarıçöke    | 15                      | 14             | 93.3%                |                             |
| Yüksekça  | Dutlar      | 15                      | 14             | 93.3%                |                             |
| Yüksekça  | Hoşafoglulu | 15                      | 13             | 86.7%                | 93.3%                       |
| Yüksekça  | Orhangazi   | 15                      | 15             | 100%                 |                             |
| Akçakoca  | Ayaz        | 15                      | 15             | 100%                 | 97.8%                       |
| Akçakoca  | Yeni        | 15                      | 15             | 100%                 |                             |
| Akçakoca  | Dadalı      | 15                      | 14             | 93.3%                |                             |
| TOTAL     |             | 375                     | 316            | 84.3%                |                             |
As a result of the study; considering today’s agricultural conditions, organic agriculture is becoming increasingly important and preferred. So, it should be avoided as much as possible from chemical treatments in terms of damages to humans and the environment in which vegetables consumed directly in leaves such as collards. For this reason, native natural enemies must be supported to achieve the natural balance already existing in nature. Although A. proletella may be a potential pest for the collards, the plants should be inspected at certain intervals from the beginning of the cultivation period. To reduce the populations of this potential pest, it is thought that the support of natural enemies will suppress the pest, as well as preserving the natural balance. If chemical control is needed, it must be considered that an appropriate decision should be made for the application of the pesticides according to the situation of natural enemies and the harvest period of the plants. Also, it is predicted that the pest population will have a significant decrease in the next growing season with the control against A. proletella’s doiğal düşmanları olarak parazitoit Encarsia tricolor Förster (Hymenoptera: Aphelinidae), predatörler ise Clistostethus arcuatus Rossi (Coleoptera: Coccinellidae) ve Chrysoperla carnea Stephens (Neuroptera: Chrysopidae) olarak tespit edilmiştir.

Anahtar kelimeler: Aleyrodes proletella, doiğal düşman, Düzce, konukçu, lahana beyazsineği, yayılış

REFERENCES

Alkan B., 1961. Murgul Bölgesi ziraat nebatlarında zarar yapan hayvan ve böcek nevleri üzerinde incelemler. Ankara Üniversitesi Ziraat Fakültesi Yıllığı, 3, 271-285.

Anonymous 2017. Natural History Museum, http://www.nhm.ac.uk (Accessed date: 11.11.2017).

Bathon H., Pietrzik J., 1986. Zur Nahrungsauflnahme des Bogen-Marienkäfers, Clistostethus arcuatus (Rossi) (Col., Coccinellidae), einem Vertiger der Kohlmottenlaus, Aleyrodes proletella Linné (Hom., Aleyrodidae). Journal of Applied Entomology, 102 (1-5), 312-326.

Bink F.A., 1979. Methods for mounting Aleyrodidae specimens. Entomologische Berichten, 39, 158-160.

Byrne D.N., Bellows T.S., 1991. Whitefly biology. Annual Review of Entomology, 34, 431-457.

De Barro P.J., Carver M., 1997. Cabbage whitefly, Aleyrodes proletella (L.) (Hemiptera: Aleyrodidae), newly discovered in Australia. Australian Journal of Entomology, 36, 255-256.

Dreistadt S.H., Flint M.L., 1995. Ash whitefly, Aleyrodes proletella (L.) (Homoptera: Aleyrodidae) overwintering and biological control by Encarsia inaron (Hymenoptera: Aphelinidae) in Northern California. Environmental Entomology, 24 (2), 459-464.

Düzgüneş Z., 1980. Küçük arthropodların toplanması, saklanması ve mikroskobik preparatların hazırlanması. T.C. Gıda Tarım ve Hayvancılık Bakanlığı, Zirai Mücadele ve Zirai Karantina Genel Müdürlüğü, Ankara, 77 s.

Evans G.A., 2008. The whiteflies (Hemiptera: Aleyrodidae) of the world and their host plants and natural enemies. http://keys.lucidcentral.org/keys/v3/whitefly/PDF_PwP%20ETC/world-whitefly-catalog-Evans.pdf (Accessed date: 05.11.2019).

Fauna Europaea, 2017. http://www.fauna-eu.org (Accessed date: 05.11.2019).

ÖZET

Batı Karadeniz Bölgesi’nde yer alan Düzce ilinde karayapraz halaşanın 2016-2017 yıllarında yürütülen bu çalışmada Aleyrodes proletella (L.) (Hemiptera: Aleyrodidae)’nin yayılış alanları, yoğunlukları, konukçuları ve popülasyonlarına etki eden doiğal düşmanları ortaya konulmuştur. Bu amaçla Düzce ilinin tüm ilçelerinde belirlenen karayapraz halaşanlarında belirli tarihlerde örneklemeler yapılmıştır. Çalışma sonucunda A. proletella’nın Düzce ilinin tüm ilçelerinde yaygın gösterdiği belirlenmiş olup, Düzce ilinin bulaşıklık oranları %84.3’tür. İçler bazında ise en yüksek bulaşıklık oranına göre Akçakoca (%97.8), Yiğilca (%93.3), Gümüşova (%88.9), Kaynaşlı (%84.4), Cumayeri (%82.2), Gölyaka (%80), Çalışmam (%75.6) ve Merkez (%75) şeklinde sıralandığı tespit edilmiştir. Aleyrodes proletella’nın karayapraz halaşanın dışındaki konukçuları olarak ise beyaz halaşan (Brassica oleracea L. var. capitata) ve Asteraceae (Capparales) ailesine bağlı Lapsana communis L. subsp. intermedia (Bieb.) Hayek bitkisi olduğu belirlenmiştir. Aleyrodes proletella’nın doiğal düşmanları olarak parazitoit Encarsia tricolor Förster (Hymenoptera: Aphelinidae), predatörler ise Clistostethus arcuatus Rossi (Coleoptera: Coccinellidae) ve Chrysoperla carnea Stephens (Neuroptera: Chrysopidae) olarak tespit edilmiştir.

Acknowledgements

The authors wish to thank Prof. Dr. Nedim UYGUN (retired academician, Adana, Turkey) for the identification of Coccinellidae species, Dr. Maurice JANSEN (Ministry of Agriculture, Nature and Food Quality, The Hague, The Netherlands) for identification of whiteflies and Dr. Andrew POLASZEK (International Institute of Entomology, The Natural History Museum, London, UK) for the identification of whitefly parasitoids. This work was undertaken as part of the author Abdurrahman Sami KOCA’s MSc research, funded by The Scientific and Technological Research Council of Turkey (TUBITAK) under Project Number 116O921 and is adapted from the resulting thesis.
Bitki Koruma Bülteni / Plant Protection Bulletin, 2020, 60 (1) : 17-24

Gözüaçık C., Yiğit A., Uygun N., 2012. Güneydoğu Anadolu Bölgesi’nde farklı habitatlarda bulunan Coccinellidae (Coleoptera) türleri. Türkiye Biyolojik Mücadele Dergisi, 3 (1), 69-88.

Günay A., 1984. Özel sebze yetiştiriciliği. Cilt 3, Çağ Matbaası, Ankara, 312 s.

Koca A.S., Kütük H., İmren M., 2017. Population dynamics of cabbage whitefly in Düzce province of Turkey. International Conference on Agriculture, Forest, Food Science and Technologies, 15-17 May 2017, Cappadocia, Turkey, 257 p.

Koca A.S., İmren M., Kütük H., 2018. Parasitism of cabbage whitefly, *Aleyrodes proletella* L. in Düzce province, Turkey. International Agriculture Congress, 3-6 May 2018, Komrat-Gagauzia, Moldova, 99 p.

Lodos N., 1986. Türkiye Entomolojisi (Genel, Uygulamalı ve Faunistik). Ege Üniversitesi Ziraat Fakültesi, Yayı nº: 429, 569 s.

Martin J.H., 1987. An identification guide to common whitefly pest species of the world (Homoptera: Aleyrodidae). Tropical Pest Management, 23 (4), 298-322.

Mound L.A., Halsey S.H., 1978. Whitefly of the world. A systematic catalogue of the *Encarsia inaron* species-group (Hymenoptera: Aphelinidae), parasitoids of whiteflies (Hemiptera: Aleyrodidae). Bulletin of Entomological Research, 92, 165-175.

Springate S., Colvin J., 2012. Pyrethroid insecticide resistance in British populations of the cabbage whitefly, *Aleyrodes proletella*. Pest Management Science, 68, 260-267.

Stark S.B., Whitford F., 1987. Functional response of *Chrysopa carnea* (Neuroptera: Chrysopidae) larvae feeding on *Heliothis virescens* (Lep.: Noctuidae) eggs on cotton in field cages. Entomophaga, 12 (5), 521-527.

Telli Ö., Yiğit A., 2012. Hatay ili turunçgillerinde zararlı turunçgil pamuklu beyazsineği, *Aleurothrixus floccosus* (Maskell) ve turunçgil ipek beyazsineği, *Paraleyrodes minei* Laccarino (Hemiptera: Aleyrodidae)'nin doğal düşmanları. Türkiye Entomoloji Dergisi, 36 (1), 147-154.

TUIK 2018. Türkiye istatistik kurumu, http://www.tuik.gov.tr (Accessed date: 15.06.2018).

Ulusoy M.R., Kersting U., Karaca İ., Satar S., 1996. Present status of citrus whiteflies (Homoptera: Aleyrodidae) in Turkey and their control. Journal of Plant Diseases and Protection, 103 (4), 397-402.

Ulusoy M.R., Vatansever G., 1997. Doğu Akdeniz Bölgesi sebze alanlarında iki yeni beyazsinek türü: *Aleyrodes proletella* L. ve *Trialeurodes vaporariorum* Westwood (Homoptera: Aleyrodidae). Çukurova Üniversitesi Ziraat Fakültesi Dergisi, 12 (3), 59-68.

Ulusoy M.R., 2001. Türkiye beyazsinek faunası, Baki Kitabevi, ISBN: 975-7024-14-7, Yayın No: 022, Adana, 99 s.
Ulusoy M.R., Ülgentürk S., 2003. The natural enemies of whiteflies (Hemiptera: Aleyrodidae) in Southern Anatolia. Zoology in the Middle East, 28 (1), 119-124, DOI: 10.1080/09397140.2003.10637961.

Ulusoy M.R., Karut K., Çalışkan A.F., 2012a. Ege Bölgesi Aleyrodidae türleri üzerine faunistik çalışmaları. Türkiye Entomoloji Bülteni, 2 (4), 251-262.

Ulusoy M.R., Karut K., Özdemir I., Ülgentürk S., Kaydan M.B., 2012b. Bartın ve Kastamonu illeri Aleyrodidae türleri üzerinde faunistik çalışmalar. Türkiye Entomoloji Dergisi, 36 (3), 363-376.

Ülgentürk S., Ulusoy M.R., 1999. Ankara ilinde bulunan beyazsinek türleri. Türkiye Entomoloji Dergisi, 23 (4), 259-268.

Vural H., Eşiyok D., Duman İ., 2000. Kültür sebzeleri (Sebze yetiştirme). Ege Üniversitesi Basımevi, Bornova, İzmir, 440 p.

Zia K., Hafeez F., Khan R.R., Arshad M., Ullah U.N., 2008. Effectiveness of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) on the population of *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) in different cotton genotypes. Journal of Agriculture and Social Sciences, 4, 112–116.

**Cite this article:** Koca, A, Kütük, H. (2020). Distribution, host plants and natural enemies of *Aleyrodes proletella* L. (Hemiptera: Aleyrodidae) on collard (*Brassica oleracea* L. var. acephala) in Düzce province of Turkey. Plant Protection Bulletin, 60-1. DOI: 10.16955/bitkorb.597889

**Atfıçin:** Koca, A, Kütük, H. (2020). Düzce ilinde karayaprak lahanasında (*Brassica oleracea* L. var. acephala) zararı *Aleyrodes proletella* L. (Hemiptera: Aleyrodidae)’nin yayılışı, konuşturuları ve doğal düşmanları. Bitki Koruma Bülteni, 60-1. DOI: 10.16955/bitkorb.597889