Original article

Determination of the parasitoids of the European sunflower moth and effectiveness in Ankara province

Ankara ilinde Avrupa ayçiçeği güvesinin parazitoitleri ve etkinliklerinin belirlenmesi

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A B S T R A C T

The European sunflower moth [Homoeosoma nebulellum (Denis&Schiffermüller)] (Lepidoptera: Pyralidae) is one of the most important sunflower pest in Turkey. Concerning the parasitoids of this pest, the only one study was conducted in Turkey. The aim of this study is the identification of the parasitoids of the European sunflower moth. Bracon hebetor (Say.), B. trucidator (Marshall), B. pectoralis (Wesmael) (Hymenoptera: Braconidae) and Exeristes roborator F. (Hymenoptera: Ichneumonidae) were found as natural enemies. Bracon pectoralis was determined for the first time on the European sunflower moth in the world. Moreover, it was found that B. hebetor was more common among the other parasites and the rate of parasitism was high. Parasitism rate was estimated 9-30% and 0-6.6% in 2013 and 2014, respectively.

I N T R O D U C T I O N

Sunflower (Helianthus annuus L.), a member of Asteraceae, is an important crop plant which is prevalent in wide cultivation areas. Due to its high ratio of quality oil content around 40-50%, it is cultivated in mass areas in Turkey oil production is supplied with vegetable oils of which 65% is extracted from sunflowers and the rest is supplied with cottonseed, soybean, and other oil crop plants (Yosmanoglu 2002).

The European sunflower moth [Homoeosoma nebulellum (Denis&Schierrermüller)] (Lepidoptera: Pyralidae) is the most crucial pest that affects the production of sunflower oil qualitatively as well as quantitatively. It is reported that only one larva can give harm five to eight seeds and therefore increasing number of larvae can cause high yield losses (Gamundi et al. 1987, Metayer et al. 1991). Two generations of the European sunflower moth occurred in a year of sunflowers fields of Ankara (Yücel and Çobanoğlu 2017). The only study regarding the parasitoids of the European sunflower moth in Turkey was related Habrobracon hebetor (Say.) and Exeristes roborator F. (Zeki and Öneş 1993). Reymonet et al. (1993), determined that B. trucidator Mars. and H. hebetor (Say.) (Hymenoptera: Braconidae) are parasitoids of H. nebulella in France. Horvath and Vecseri (2005) stated that H. hebetor is a natural enemy of H. nebulellum and could be effective in controlling the pest. Furthermore, Bei-Bienko et al. (1967) determined that Apanteles lacteoides Nixon and Apanteles lacteus Nee (Hymenoptera: Braconidae) are parasitoids of H. nebulellum.
It is important to identify the beneficial fauna in order to pest management strategies and therefore hinder the process of yield losses. The European sunflower moth is one of the most harmful pests in Central Anatolian region that caused many economic losses. For the purpose of employing natural enemies in pest control methods, the present study was conducted to determine the activity of parasitoids of the pest during the time period of intense harm caused by the pest. Parasitoids that have impacts on the European sunflower moth in sunflower fields of Ankara were identified in the study.

MATERIALS AND METHODS

Survey of the parasitoid species

Observation and sampling were carried out in sunflower fields located in villages of Ayaş, Bala, Beypaşarı and Kalecik counties of Ankara province in 2013 and 2014. Sampling was begun in the blooming time of sunflowers and conducted once in every two weeks until harvesting (Table 1).

Table 1. Sampling dates in the study of parasitoid identification

| Date | Survey          | Ayaş - Beypaşarı | Bala | Kalecik |
|------|----------------|------------------|------|--------|
| I    | 26.06.2013     | 27.06.2013       | 25.06.2013 |
| II   | 11.07.2013     | 10.07.2013       | 09.07.2013 |
| III  | 26.07.2013     | 24.07.2013       | 24.07.2013 |
| IV   | 12.08.2013     | 13.08.2013       | 14.08.2013 |
| I    | 02.07.2014     | 03.07.2014       | 28.06.2014 |
| II   | 18.07.2014     | 16.07.2014       | 16.07.2014 |
| III  | 06.08.2014     | 05.08.2014       | 04.08.2014 |
| IV   | 20.08.2014     | 19.08.2014       | 19.08.2014 |

Taking into consideration of the field size, 50 plants were sampled from ten different rows and points based on 10 da calculation. Number of plants sampled was increased in compliance with the field size (Jarvis and Guthrie 1987). Parasitoidal larvae were transferred to plastic Petri dishes of 9 cm diameter that have blotting papers at the bottom and cheesecloth at the top with 3 cm opening. Then, Petri dishes with larvae were cultured in climate cabinet at 24±1 °C temperature, 65±5% average humidity and 16:8 photoperiod. Parasitoidal hatchings were observed during daily controls.

Effectiveness of Bracon species

Parasitoid effectiveness was determined based on the evaluation of larvae collected in 2013 and 2014 from 4 and 3 sunflower fields located in Kalecik district of Ankara province, respectively. Taking into consideration of the field size, 100 plants were sampled from ten different rows and points based on 10 da calculation (Jarvis and Guthrie 1987). For each separate field, infection of the European sunflower moth, larvae number per field, and number of parasitoids collected were determined. Identification of the parasitoid samples was done by Prof. Dr. Ahmet BEYARSLAN (Bitlis Eren University, Faculty of Arts and Sciences, Department of Biology) and Dr. Yasemin ÖZDEMİR [Plant Protection Central Research Institute (retired)].

Evaluation of the results

Parasitism ratio was calculated by modifying Briggs formula as (P/L) x 100 (P: number of larvae parasitized, L: number of larvae) (Briggs 2007).

RESULTS AND DISCUSSION

Determination of parasitoid species was begun from blooming time of sunflowers in June to until harvesting time in 2013 and 2014. Survey of the parasitoid species

No parasitic activity was observed in the first sampling of sunflower fields in 2013. While also no parasitoid was observed in the third sampling during the second sampling of sunflowers, parasitoids were identified on pests in the fourth sampling of sunflower fields, which was conducted between 12-14 of August in 2013. B. hebetor (Say, 1836) was identified from Ayaş, Bala, Beypaşarı, and Kalecik whereas B. (Bracon) trucidator (Marshall, 1888) was identified from Ayaş and Kalecik. B. (Bracon) pectoralis (Wesmael, 1838) (Hymenoptera: Braconidae) was also identified from Bala and Kalecik. Parasitoid E. roborator (Fabricius, 1793) (Hymenoptera: Ichneumonidae) was found in Bala and Kalecik. A parasitoid specimen belonged Diptera order from Kalecik could not be identified due to deformation.

There had been no observance of parasitic activity in firstly sampling of the sunflowers fields in 2014. Parasitoids were identified on pests in the third sampling of the second production between August 4-6 and in the fourth sampling of the second production between 19-20 of August in 2014. The parasitoids collected from Bala and Kalecik were identified as Bracon hebetor (Say, 1836) (Hymenoptera: Braconidae).

Bracon (Habrobracon) hebetor (Say 1836)

Material examined: Ankara-Ayaş-Gençali, (39°53’56 N 31°59’47 E, 927 m), 12.08.2013, 2♂; Bala-Akkoşan, (39°30’35 N 33°23’24 E, 935 m) 13.08.2013, 2♂; Erdemli, (39°28’26 N 33°20’18 E, 783 m) 05.08.2014, 2♂; Kesikköprü, (39°53’56 N 33°20’18 E, 873 m) 05.08.2014, 2♂; Kesikköprü, (39°53’56 N 33°20’18 E, 873 m) 05.08.2014, 2♂.
B. hebetor
Mars. from Ayaş and
L. (Tortricidae); L., ♂ is a natural
B. trucidator
Heliothis peltigera
Hb., (Pyralidae);
Hyperparasite of
Polycyrtidea pusilla
sp. (Ichneumonidae). Aragon (2011) also reported that
and Vecseri (2005) pointed out that
present study identified
H. electellum (Cress.) (Ichneumonidae) is a pupate
gets parasitic by
H. nebulellum
Bkh., (Pyralidae);
Hyperparasite of
Gregopimpla malacosomae
Say. (Ichneumonidae). Concerning Braconidae family, the
species. [E. roborator F. was identified from Kalecik and
Bala. Zeki and Öneş (1993) reported that they identified
nine specimens of the parasitoid
Hubrobracon hebetor from
H. nebulula moth collected in Yenicimenli, Aksaray and
defined 1 specimen of the parasitoid
E. roborator Diadegma
G. (Ichneumonidae). Aragon (2011) also reported that
Polycyrtidea pusilla (Cress.) (Ichneumonidae) is a pucose parasite of
H. electellum in Cuba.

Activity of Bracon species
The highest parasitism ratio was obtained for the sunflower
field located in the riverside of Kızılırmak in the village of
Alibeyli (Table 2). This location displayed the highest
parasitism ratio because the location is known for intense
production of vegetables, which brings about the prevalence of
Bracon species.
### Table 2. Related to parasitoid activity works conducted in 2013

| Location | Counting | Infection of larvae (%) | Number of larvae | Number of larvae parasitized | Parasitism rate (%) | Number of parasitoid |
|----------|----------|--------------------------|-----------------|------------------------------|---------------------|---------------------|
|          |          |                          |                 |                              |                      |                     |
| Hacıköy I | I        | 2                        | 2               | 0                            | ~                   | 0                   |
|          | II       | 3                        | 5               | 0                            | ~                   | 0                   |
|          | III      | 7                        | 16              | 0                            | ~                   | 0                   |
|          | IV       | 11                       | 78              | 7                            | 9                   | 17                  |
| Hacıköy II | I       | 0                        | 0               | 0                            | ~                   | 0                   |
|          | II       | 4                        | 9               | 0                            | ~                   | 0                   |
|          | III      | 6                        | 21              | 0                            | ~                   | 0                   |
|          | IV       | 8                        | 136             | 15                           | 11                  | 28                  |
| Alibeyli I | I       | 0                        | 0               | 0                            | ~                   | 0                   |
|          | II       | 7                        | 29              | 0                            | ~                   | 0                   |
|          | III      | 9                        | 72              | 0                            | ~                   | 0                   |
|          | IV       | 12                       | 209             | 46                           | 22                  | 73                  |
| Alibeyli II | I      | 3                        | 14              | 0                            | ~                   | 0                   |
|          | II       | 5                        | 33              | 0                            | ~                   | 0                   |
|          | III      | 8                        | 96              | 0                            | ~                   | 0                   |
|          | IV       | 10                       | 273             | 82                           | 30                  | 102                 |

### Table 3. Related to parasitoid activity works conducted in 2014

| Location | Counting | Infection of larvae (%) | Number of larvae | Number of larvae parasitized | Parasitism rate (%) | Number of parasitoid |
|----------|----------|--------------------------|-----------------|------------------------------|---------------------|---------------------|
|          |          |                          |                 |                              |                      |                     |
| Hacıköy  | I        | 0                        | 0               | 0                            | ~                   | 0                   |
|          | II       | 1                        | 1               | 0                            | ~                   | 0                   |
|          | III      | 2                        | 4               | 0                            | ~                   | 0                   |
|          | IV       | 7                        | 121             | 8                            | 6.6                 | 14                  |
| Alibeyli | I        | 1                        | 1               | 0                            | ~                   | 0                   |
|          | II       | 5                        | 14              | 0                            | ~                   | 0                   |
|          | III      | 6                        | 74              | 3                            | 4.1                 | 8                   |
|          | IV       | 9                        | 211             | 7                            | 3.3                 | 9                   |
| Aktepe   | I        | 0                        | 0               | 0                            | ~                   | 0                   |
|          | II       | 1                        | 1               | 0                            | ~                   | 0                   |
|          | III      | 3                        | 18              | 0                            | ~                   | 0                   |
|          | IV       | 4                        | 38              | 1                            | 2.6                 | 1                   |
In 2014, the highest parasitism ratio of parasitoids was captured in the village of Hackköy (Table 3). Although Alibeyli village also showed parasitism in 2014, parasitic activity was less than in 2013. It is thought that parasitoid prevalence and mature larvae of the pest probably did not coincide in time due to late start and early end of the blooming time experienced in 2014.

Almost all of the Bracon species were identified as *Bracon hebetor* during the studies. It was detected that the pest larvae were parasitized by *Bracon* species by 9-30% in 2013 and 0-6.6% in 2014. Chen and Welter (2002) reported that the parasitoid *Dolichogenidea homeosomae* (Muesebeck) (Hymenoptera: Braconidae) parasitized Sunflower moth by 11-18%. *B. hebetor* is a gregarine, idiobiont larva ectoparasitoid that employs different species of Lepidoptera as its host. The female parasitoid prefers mature larvae of its host to lay eggs (Gündüz et al. 2008). Horvath and Vecseri (2005) reports that *B. hebetor* is a natural enemy of *H. nebulellum* and can be employed to control the pest.

In the present study, parasitoids of the European sunflower moth were identified. These species were identified as; *Bracon hebetor, Bracon trucidator, Bracon pectoralis* (Braconidae), and *Exeristes roborator* (Ichneumonidae) (Hymenoptera). *Bracon pectoralis* was determined for the first time on the European sunflower moth in the world. This moth is the new host for *B. pectoralis*. Parasitoid increased its activity around the end of June and suppresses the population of the pest through August both of the growing seasons of 2013 and 2014. Thus, a natural support of parasitoids for the first offspring of the European sunflower moth on sunflower fields.

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ÖZET

Avtropa açıcığı güvesi [*Homoeosoma nebulellum* (Denis&Schierrmüller)] (Lepidoptera: Pyralidae) ülkmizde önemli bir açıcığı zaraarlıdır. Ulkmizde zararının parazitoidleri ile ilgili az sayıda çalışma bulunmaktadır. Çalışmamız ile zararının Ankara ilindeki açıcığı alanlarındaki parazitoidleri belirlenmiştir. *Bracon hebetor* (Say.), *B. trucidator*, (Marshall), *B. pectoralis* (Wesmael) (Hymenoptera: Braconidae) ve *Exeristes roborator* F. (Hymenoptera: Ichneumonidae)’un zararının doğal düşmanı olduğu belirlenmiştir. *Bracon pectoralis*’in zararlı parazitüldüğü dünyada ilk kez tespit edilmişdir. Parazitöllerin zararı larvalarını 2013 yılında %9–30 ve 2014 yılında %0–6.6 oranında parazitüldiği belirlenmiştir.

Anahtar kelimeler: *Homoeosoma nebulellum*, parazitoit, parazitöleme oranı, Braconidae, Ichneumonidae

REFERENCES

Aragon C.A.R., 2011. Propuesta para la lucha biológica contra *Homoeosoma electellum* (Hulst) (Lepidoptera; Pyralidae) sobre girasol. Doctoral thesis, Universidad Central Marta Abreu De Las Villas Facultad De Ciencias Agropecuarias Departamento De Agronomía, 126 p.

Beia-Bienko G.Ya., Bykhovskii B.E., Medvedev G.S., 1967. Keys to the insects of the European USSR. 3 (4), 538- 797.

Briggs D., 2007. Analysis of *Macrocentrus acyclivorae* as a natural enemy of the Sunflower moth, *Homoeosoma electellum*. http://nature.berkeley.edu/classes/es196/projects/2007final/ Briggs.pdf (Erişim tarihi: 01.03.2016).

Chen Y.H., Welter S.C., 2002. Abundance of a native moth *Homoeosoma electellum* (Lepidoptera: Pyralidae) and activity of indigenous parasitoids in native and agricultural sunflower habitats. Environmental Entomology, 31 (4), 626-636.

Gamundi J.C., Molinari N.A., Alvarez J.A., Lietti M., 1987. Bioecology of the sunflower moth *Homoeosoma heinrichi* Pastr. (Lepidoptera, Pyralidae). Informativo de Investigaciones Agrícolas, 23, 441-444.

Gündüz E.A., Gülel A., Işıtan V.Ö., 2008. The effect of two host species on protein, lipid and glycogen levels of the larval ectoparasitoid *Bracon hebetor* (Say, 1836) (Hymenoptera: Braconidae). Turkish Journal of Entomology, 32 (1), 33-42.

Horvath Z., Vecseri C., 2005. A napraforgómoly (*Homoeosoma nebulellum* Hb.) elleni biológiai és genetikai védekezési módszerek. 10. Tiszántúli Növényvédelmi Fórum. Debrecen 417-424.

Jarvis J.L., Guthrie W.D., 1987. Ecological studies of the European corn borer (Lepidoptera: Pyralidae) in Boone County, Iowa. Environmental Entomology, 16, 50-58.

Metayer-le M., Thiery D., Pham-Delegue M.H., Masson
C., 1991. Oviposition behavior and locomotor activity of *Homoeosoma nebulellum* (Lepidoptera: Pyralidae) under laboratory conditions. Environmental Entomology, 20 (2), 615-619.

Reymonet C., Falco G.J.V., Moreno M.J., 1993. Survey of the parasitoids of the European sunflower moth, *Homoeosoma nebulella* (Lep.: Pyralidae) in Palearctic region. Entomophaga, 38 (3), 355-358.

Yosmanoğlu M., 2002. Ayçiçeği raporu. Tarım ve Köy işleri Bakanlığı, Araştırma Planlama Koordinasyon Kurulu Başkanlığı, Aralık, 2002, Ankara.

Yücel C., Çobanoğlu S., 2017. Investigations on the biology and determination of natural enemies and the control possibilities of the European sunflower moth (*Homoeosoma nebulellum* (Den.&Schiff.) (Lepidoptera: Pyralidae) harmful on sunflowers in Ankara province. Doctoral Thesis, Ankara University (unpublished), Ankara.

Zeki H., Öneş Y., 1993. Faunistic studies on harmful and beneficial insects on sunflower (*Helianthus annuus* L.) in Central Anatolia. Plant Protection Bulletin, 33 (3-4), 119–145.

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