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Original article (Özgün makale)

Morphological characteristics and density of *Bracon (Habrobracon) concolorans* Marshall,1900 (Hymenoptera: Braconidae), a native Turkish parasitoid of *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae), on greenhouse-grown tomatoes in Antalya, Türkiye

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Antalya/Türkiye'de Serada Yetiştirilen Domateslerde Bulunan *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae)'nın Yerli Parazitoidi *Bracon (Habrobracon) concolorans* Marshall, 1900 (Hymenoptera:Braconidae)'ın Morfolojik Özellikleri ve Yoğunluğu

Öz: *Tuta absoluta* **(**Meyrick, 1917) (Lepidoptera: Gelechiidae) domates bitkisinin en önemli zararlılarından biridir. Zararlı ile mücadelede kimyasal mücadeleye öncelik verilmekte, bu durum çevre ve insan sağlığı risklerini de beraberinde getirmektedir. Mücadelede zaman zaman ticari biyolojik ajanlar kullanılsa da zararlının mevcut parazitoid ve predatörlerinin yoğunluğunun bilinmesi entegre mücadelenin etkinliği açısından önemli olmaktadır. Bu çalışmada, Antalya'da *T. absoluta*'nın istila ettiği domates bitkilerinden elde edilen yerli parazitoid, *Bracon* (*Habrobracon*) Marshall, 1900 (Hymenoptera: Braconidae)'ın yoğunluğu araştırılmıştır. Antalya/Elmalı'da 2019 yılı Ekim-Kasım aylarında seradan haftalık olarak toplanarak kültüre alınan domates yaprak örnekleri günlük olarak takip edilmiş ve ergin döneme ulaşan parazitoidlerle birlikte zararlı sayısı da kayıt altına alınmıştır. Sonuçlara göre 221 bulaşık yaprak örneğinden toplam 2004 adet *T. absoluta* ve 478 adet *B.* (*H.*) *concolorans* ergini elde edilmiştir. Ergin döneme ulaşan parasitoid sayısı en az 1.7 ergin/yaprak, en fazla 2.6 ergin/yaprak olarak belirlenmiştir. Çalışmada parazitoidin Antalya populasyonunun morfolojik karakterlerine ilişkin değerlendirmelere de yer verilmiştir. Buna göre parazitoid türün vücut uzunluğu erkek bireylerde ortalama 2.13 mm dişi bireylerde 2.37 mm olarak belirlenmiştir. Erkek ve dişi bireylerde anten uzunluğu sırasıyla ortalama 2,04 mm ve 1,80 mm, anten segment sayısı 20-23 ve 18-21 olarak saptanmış, ovipozitör uzunluğu ise ortalama 0,59 mm olarak bulunmuştur.

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Anahtar Kelimeler: *Bracon* (*H.*) *concolorans, Tuta absoluta*, örtüaltı, yoğunluk, morfolojik özellikler

Abstract: *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) is one of the most significant pests of tomato. Chemical pesticides are prioritized in pest control, and this poses risks to both the environment and human health. Although commercial biological agents are occasionally used for control, understanding the density of existing parasitoids and predators of the pest is crucial for the effectiveness of integrated pest management. In this study, the density of the native parasitoid *Bracon* (*Habrobracon) concolorans* Marshall, 1900 (Hymenoptera:Braconidae) collected from *T. absoluta* infesting tomato plants Antalya was investigated. Tomato leaf samples were collected weekly from a greenhouse in Elmalı/Antalya in October-November 2019, and cultured. The samples were monitored daily to record the number of pests and parasitoids that reached the adult stage. According to the results, 2004 *T. absoluta* and 478 *B.* (*H.*) *concolorans* adults were obtained from 221 infected leaves. The number of parasitoids reaching the adult stage ranged from 1.7 adults to 2.6 adults per leaf. The study also included determinations of the morphological characteristics of the Antalya population of the parasitoid. Accordingly, the average body length of the parasitoid was 2.13 mm in males and 2.37 mm in females. The average antenna length in males and females was 2.04 mm and 1.80 mm, respectively,and the number of antenna segments was 20-23 and 18-21, respectively.The average ovipositor length was 0.59 mm.

Keywords: *Bracon* (*H.*) *concolorans, Tuta absoluta*, greenhouse, density, morphological characteristics

Introduction

The tomato is an important cultivated plant and is susceptible to many pests. *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is one of the most important and destructive pest. *T. absoluta*, which originates from South America, was first observed in Argentina in 1964 and quickly spread to many countries due to its high damage potential (EPPO 2005; Desneux et al. 2010, 2011). This pest, which was unknown in Türkiye until 2009, has rapidly spread to all regions where tomato production occurs (Kılıç 2010; Doğanlar & Yiğit 2011; Karut et al. 2011; Ünlü 2011; Mamay & Yanık 2012; Aksu & Çıkman 2014; Aksu Altun & Çıkman 2021a; Aksu Altun & Çıkman 2021b; Portakaldalı et al. 2013; Erdoğan et al. 2014; Tatlı & Göçmen 2019). *Tuta absoluta*, which causes significant economic losses in Solanaceae family plants, mainly tomatoes, can damage all parts of the tomato plant except the roots. If left uncontrolled, product losses of up to 100% may occur (Biondi et al. 2018; Öztemiz 2012).

The management of *T. absoluta* is quite challenging. Promising predators (Cabello et al. 2009a; Molla et al. 2009; Desneux et al. 2010; Calvo et al. 2012; Portakaldalı et al. 2014) and parasitoids (Luna et al. 2007; Molla et al. 2008; Cabello et al. 2009b; Zappala et al. 2012; Chailleux et al. 2013) against *T. absoluta* were revealed to be insect species. Among the parasitoid species, in addition to egg

parasitoids, larval parasitoid Braconid species are also important. Braconidae (Hymenoptera) is a large group of 1103 genera and approximately 21223 described species (Yu et al. 2016). Studies in Türkiye show that some braconid species are parasitoids of *T. absoluta*. Doğanlar & Yiğit (2011) conducted research on *T. absoluta* in the areas of Hatay province where intensive tomato cultivation is practiced and identified the species *Bracon* (*Habrobracon*) *didemie* Beyarslan and *Bracon* (*Habrobracon*) *hebetor* (Say) as effective parasitoids. Effective parasitoids of *T. absoluta* were investigated in the Southeastern Anatolia Region, and *B. (H.) hebetor* and *Apanteles* sp. were recorded (Bayram et al. 2014). Natural enemies of *T. absoluta* were investigated in the tomato growing areas of Şanlıurfa, and *Bracon* (*Habrobracon*) *concolorans* Marshall, *B. (H.) didemie*, *B. (H.) hebetor*, *Bracon* (s. str.) *intercessor* Nees, and *Apanteles* sp. (Hymenoptera: Braconidae), were found to be effective braconid parasitoids (Altun & Çıkman 2019). Topakci et al. (2022) recorded *B.* (*H.*) *concolorans*, and *Bracon (*s.str.*) variegato*r Spinola, as the natural enemies of *T. absoluta* in their research conducted in the Antalya tomato cultivation areas. In research conducted in tomato cultivation areas in Adana, *B. (H.) didemie* and *Apanteles (Dolichogenidea*) *appellator* Telenga, (Hymenoptera, Braconidae) species, which are natural enemies of *T. absoluta* and promising species for control, were recorded (Karut et al. 2023). Yüksekyayla et al. (2023) detected *B. didemie* as the sole larval parasitoid of *T. absoluta* in tomato greenhouses across various districts of Antalya province.

Bracon (Habrobracon) concolorans Marshall (syn. *Bracon Habrobracon nigricans* Szépligeti) is a species distributed in the Oriental and Palaearctic Zoogeographic regions. Distribution in Türkiye: Adıyaman, Edirne, İcel (Beyarslan 1999), Aegean region (Beyarslan et al. 2002a), Imbros (Beyarslan et al. 2002b), Kastamonu (Beyarslan et al. 2005), Amasya, Çorum, Tokat (Beyarslan et al. 2008), Türkiye (Papp 2008), Türkiye (Beyarslan et al. 2010), Bayburt, Gümüşhane (Beyarslan & Cetin Erdogan 2010), Amasya, Ankara, Bayburt, Cankırı, Elazığ, Eskisehir, Gumushane, Kayseri, Kırıkkale, Konya, Malatya, Niğde, Samsun, Sivas, Tokat, Yozgat (Beyarslan & Cetin Erdogan 2012), Diyarbakır, Mardin, Şanlıurfa (Beyarslan et al. 2014), Ardahan, Erzurum, Iğdır, Kars (Beyarslan 2016), Antalya (Topakcı et al. 2022).

Although there are studies on the presence, density, and parasitism status of the larval parasitoid *Bracon* species of *T. absoluta* in Türkiye, few studies have been conducted on *B.* (*H.*) *concolorans*. This study aimed to determine the density and morphological characteristics of *B.* (*H.*) *concolorans* detected in the tomato greenhouse in Elmalı, Antalya.

Materials and Methods

Sampling

In this study, leaf samples were taken from tomato plants (Do-pink variety) which were heavily damaged by *T. absoluta* in a plastic greenhouse covering

approximately 1300 m^2,in the Elmalı district of Antalya Province (36°48′13.0″N, 30°01′21.4″E) at the end of the 2019 production season. Pheromone traps (0.5 mg (EZZ-3,8,11) -Tetradecatrienyl Acetate (95%) + EZ-3,8-tetradecadienyl acetate (5%) / capsule + Delta Trap) were changed weekly (1 trap/greenhouse) for *T. absoluta* in the greenhouse, from the beginning of the season, and the use of traps ended on 23.10.2019. In addition, 35% chlorantraniliprole, 5% emamectin benzoate and 25 g/l deltamethrin were used during the production season. However, there was no pesticide application during the leaf sampling period toward the end of the production season. On each sampling date, a minimum of 45 composite leaf samples, each 15-20 cm long, that had been damaged by various larval stages of *T. absoluta*, were collected.. These samples were placed in a paper bag, then transferred to a polyethylene bag, and finally brought to the laboratory at Akdeniz University Vocational School of Technical Sciences. To obtain tomato moths and adult parasitoids, leaf samples were cultured separately at ambient temperature in glass containers covered with thin gauze, with a maximum of five composite leaf (with 4-5 leaflets) samples in each container (Figure 1). Emerged parasitoids were aspirated from the containers and placed in Eppendorf tubes containing 70% alcohol. The specimens were then sent to the Trakya University, Faculty of Science, Department of Biology (Entomology) for identification. Each tube was numbered, and relevant information was recorded.

The diagnosis of specimens

Adult braconids were identified based on their morphological characteristics by the second author. Relevant literature (Belokobylskij & Tobias 2000; Beyarslan & Fischer 1990; Papp 1990, 2000, 2008; Samartsev 2011, 2013; Samartsev & Belokobylskij 2013; Tobias 1986; van Achterberg, 1993) and comparison material in the second author's collection were used to identify the samples.

The study also included measurements of the morphological characteristics of the *B.* (*H.*) *concolorans* obtained from greenhouse production under plateau conditions. For this purpose, 25 male and female individuals were examined under a microscope, and the data were evaluated. Leica DM1000 and DMSZ7PZB microscopes were used to capture digital images and take measurements. The specimens were deposited at the Trakya University, Faculty of Science, Department of Biology (Entomology) in Edirne and Akdeniz University Vocational School of Technical Sciences in Antalya.

Numbers of *Bracon* (*Habrobracon*) *concolorans* and *Tuta absoluta*

To monitor the emergence of both *T. absoluta* and parasitoid adults, glass containers were checked twice daily, in the morning and evening. Both moth and parasitoid adults were collected from the containers by using a mouth aspirator. The mean number of individuals per leaf was determined by dividing both the total number of moths and adult parasitoids about the total number of leaves. The

monitoring of the samples continued until approximately one month after the emergence of adults began.

Figure 1. Cultured leaf samples infested with *Tuta absoluta*

Results and Discussion

Morphological studies

The only parasitoid to emerge from *Tuta absoluta* was *Bracon* (*Habrobracon*) *concolorans.* Figure 2 shows images of the dorsal, ventral and lateral views, as well as the thorax, abdomen, antenna, and wing structures of male and female individuals from the Antalya population of species *B.* (*H.*) *concolorans*.

Figure 2 continued

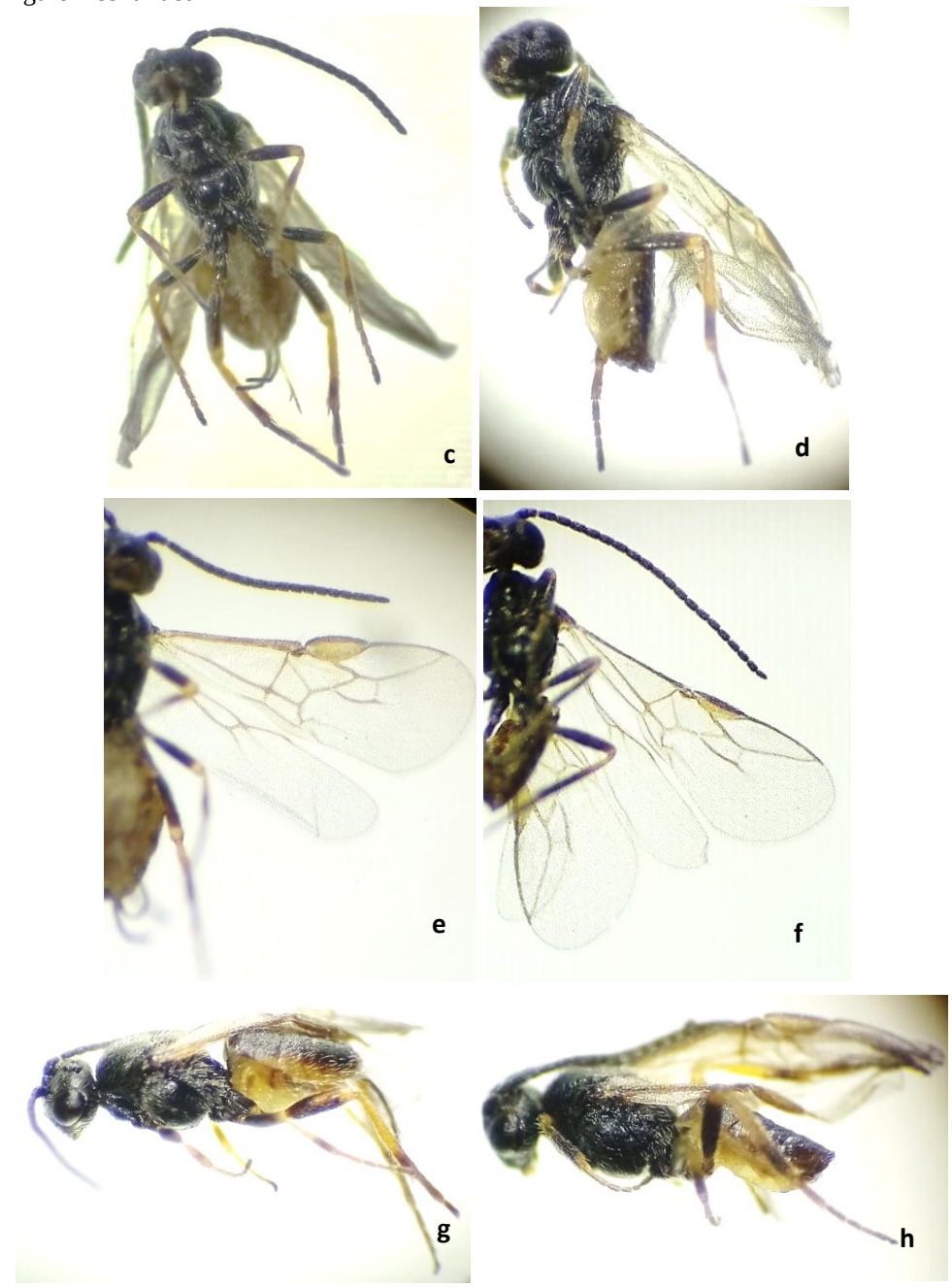

Figure 2 continued

Figure 2. *Bracon (Habrobracon) concolorans* a-b: dorsal (female-male), c-d: ventral (female-male), e-f: antenna and wing (female-male), g-h: lateral (female-male), k-l: thorax-abdomen (female), m-n: thorax-abdomen (male)

The measurements forbody length, head length, mesosoma length, metasoma length, ovipositor length and antenna length of both male and female *B.* (*H.*) *concolorans* are shown in Table 1. The average body length of *B.* (*H.*) *concolorans* males was 2.13 mm whereas the average body length of the females was 2.37 mm. The average antenna length in male and female individuals was 2.04 and 1.80 mm, respectively. In addition, the number of antenna segments was determined to be 20-23 in males and 18-21 in females.

The development and growth of parasitoids developing in hosts fed different diets also differ. For example, there were differences in adult sizes of *B. hebetor* adults reared on larvae of *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) feeding on nine different host plants (Nivedita et al. 2021). In earlierstudies, the morphological evaluation of *B.* (*H.*) *concolorans* was conducted based on location information rather than the hosts from which it was obtained. Therefore, in this study, the parasitoid could not be compared morphologically with individuals obtained from different hosts. However, the morphological measurements obtained were compared with the similarities and differences revealed in earlier studies.

Similar to this study, in Iran, Ameri et al. (2014) determined that the body of *B. nigricans* is generally dark brown with yellowish brown spots, metasoma yellowish brown on the dorsal surface, the head width is approximately twice the head length, and the mesonotum is densely covered with uniform hairs. Unlike the data obtained in this study, they determined that the ovipositor had a length of 0.7-0.8 times the metasoma length, and that the antenna of females were 34-segmented. In our study, the ovipositor was approximately 0.6-0.7 times the length of the metasoma. In addition, the number of antenna segments was a maximum of 21 in females and 23 in males.

In South Korea, Smartsev & Ku (2021) determined that the antenna was 21-23 segmented in females and bodies of what species mainly brownish black. Yu et al. (2016) determined that the ovipositor length of *B.* (*H.*) *concolorans* was 0.7 -0.8 of the metasoma length. Females had 20-34 antenna segments and males had 22-28 antenna segments, and the body length was 2.0-3.2 mm in females and 2.0-3.1 mm in males, and the head width was 1.7-1.9 times head length. In the current study, the body length range was 1.8-2.4 mm in males and 2.1-2.7 mm in females, and head width was approximately 1.9 times head length.

Table 1. Morphological measurements of male and female *Bracon (Habrobracon) concolorans* collected in Antalya Province, Türkiye

Species characteristics	**Average measurements (mm) (male)**	**Measurement range (mm) (male)**	**Average measurements (mm) (Female)**	**Measurement range (mm) (Female)**
Body length	2.13±0.035	1.8-2.4	2.37±0.030	2.1-2.7
Mesosoma length	0.81±0.014	0.7-0.9	0.93±0.011	0.8-1.0
Metasoma length	0.97±0.018	0.8-1.1	1.07±0.023	0.8-1.3
Head length	0.32±0.008	0.3-0.4	0.37±0.009	0.3-0.4
Head width	0.59±0.009	0.5-0.7	0.65±0.011	0.5-0.7
Antenna length	2.04±0.023	1.9-2.3	1.80±0.026	1.6-2.1
Ovipositor length	-	-	0.59±0.008	0.5-0.7

In Türkiye, besides *Trichogramma* species which are egg parasitoids of *T. absoluta*, predominantly species of Eulophidae, and Braconidae were identified as larval parasitoids in open field and greenhouse tomato production areas in Hatay, Izmir, Antalya, Şanlıurfa, Diyarbakır, and Mardin Provinces (Doğanlar& Yiğit 2011; Öztemiz 2013; Bayram et al. 2014; Keçeci & Öztop 2017; Altun & Çıkman 2019; Topakcı et al. 2022; Çaylak & Başpınar 2022; Karut et al. 2023; Yüksekyayla et al. 2023).

Density of *Bracon (H.) concolorans*

The larval ectoparasitoid *B.* (*H.*) *concolorans* was athigh population densities across all three surveyed weeks from October to November. The 2004 *T. absoluta* adults and 478 *B.* (*H.*) *concolorans* were obtained from 221 plant samples (Table 3). The emergence of *T. absoluta* and *B.* (*H.*) *concolorans* was 825 and 248 individuals in the first sampling week, 733 and 113 individuals in the second week, and 446 and 117 individuals in the third week, respectively. (Table 3). After the leaf samples were cultured, parasitoid emergence started within 2-4 days (with an average of three days), and adult emergence was completed within 15-20 days. *Tuta absoluta* adult emergence started within 9-12 days (average 11 days) after the leaf samples were cultured and continued for 10-18 days (average 14 days).

Table 2. Number of *Bracon* (*H.*) *concolorans* and *Tuta absoluta* obtained from tomato leaves

Sampling Date	**Number of leaf samples**	**Number of *Tuta absoluta* reared**	***Tuta absoluta/ leaf***	**Number of *Bracon* (*H.*) *concolorans* reared**	***Bracon* (*H.*) *concolorans*/ leaf**
23.10.2019	108	825	7,6	248	2,3
30.10.2019	68	733	10,8	113	1,7
07.11.2019	45	446	9,9	117	2,6
Total	221	2004	9,1	478	2,2

Management of *T. absoluta* is generally carried out using chemical methods. The development of resistance to chemicals (Yalçın et al. 2015, Lietti et al. 2005), the presence of larvae in the tissues, and the ability to reproduce rapidly make it difficult to control the pest (Keçeci & Öztop 2017). Therefore, aligning with integrated pest management practices and leveraging natural enemies is crucial for successful pest control.

Many natural enemies of *T. absoluta* are egg parasitoids (Cabello et al. 2009a; Chailleux et al. 2013) In addition, larval parasitoids of *T. absoluta* across the world include *Diadegma ledicola* Horstmann, *Diadegma pulchripes* (Kokujev) (Hymenoptera: Ichneumonidae), *Bracon (Osculobracon) osculator* Nees, *Pseudapanteles dingus* (Muesebeck) (Hymenoptera: Braconidae), *Necremnus* sp.*;* near *tidius* (Walker), *Necremnus* sp. *near artynes* (Walker), *Neochrysocharis formosa* (Westwood), *Pnigalio soemius* s.l. (Walker), *Pnigalio cristatus* (Ratzeburg), *Pnigalio incompletus* (Boucek) (Hymenoptera: Eulophidae), *Halticoptera aenea* (Walker) (Hymenoptera: Pteromalidae) (Luna et al. 2007; Mollá et al. 2008; Lara et al. 2010; Riciputi 2011; Zappala et al. 2012).

Biondi et al. (2013b) stated that *B. nigricans* (syn. *B.concolorans*) should be considered as a potential biological control agent in newly invaded areas of the Palaearctic Region. In this study, the parasitoid species obtained from all leaf samples was *B. concolorans*. In the current study, the number of *T. absoluta* adults per leaf was 9.1, while the number of *B. concolorans* was 2.1. Sampling was carried out at the end of the tomato growing season. Therefore, since no pest management was conducted during this period, *T. absoluta* was found to be abundant on the leaves. It can be assumed that the population of parasitoids increased in response to the number of pests. In open-field tomato growing areas in Adana, *T. absoluta* was found at a maximum of 4.21 individuals per leaf. In comparison, the parasitoid *B. didemie* was found at a maximum of 28 individuals per 100 leaves (Karut et al. 2023).

Bracon (*H.*) *concolorans* is an idiobiont ectoparasitoid of mature larvae of *T. absoluta* (Biondi et al. 2013b). Parasitoids significantly reduce the population of *T. absoluta* through stinging and host feeding a(Biondi et al. 2013b). Under laboratory conditions, *B. nigricans* produced a higher number of offspring in fourth instar larvae of *T. absoluta* compared to third instar larvae, and deaths due to stinging behavior or host feeding were significantly higher in third instar larvae (Idriss et al. 2018). Zappala et al. (2012) determined that *B. nigricans*, along with *Necremnus* sp. and *Neochrysocarys formosa* Westwood, were the most dominant species in northern Italy. *Bracon (H.) concolorans* has been identified as one of the natural enemies of *Tuta absoluta* in Jordan (Al-Jboory et al. 2012).

In a study investigating the local natural enemies of *T. absoluta* in France, in addition to predatory and egg parasitoid species, two eulophid species and the braconid *B. nigricans* were identified as larval parasitoids. (Biondi et al. 2013a). *Bracon* (*H.*) *concolorans* is one of the larval parasitoids of *T. absoluta* in open-field tomato production in Iraq (Al-Gerrawy 2021). One of the two larval parasitoids of *T. absoluta* detected in Kenya's open field and greenhouse tomato production areas was identified as *B.(H.) nigricans* (Mama Sambo et al. 2022). In Türkiye, this species was determined to be a parasitoid of *T. absoluta* in Şanlıurfa (Altun & Çıkman 2019) and Antalya (Topakci et al. 2022). *Bracon* (*H.*) *concolorans* was obtained from *Etiella zinckenella* (Treitschke) (Lepidoptera: Pyralidae), *Pexicopia malvella* (Hübner) (Lepidoptera: Gelechiidae), *Cnephasia (Cnephasia) sedana* (Constant) (Lepidoptera: Tortricidae), (Beyarslan et al. 2005),

apple ermine moth, and *Yponomeuta malinellus* Zeller (Lepidoptera: Yponomeutidae) (Narmanlıoğlu & Çoruh 2017) but not *T. absoluta* in Türkiye.

In Hatay, it was determined that *C. clarus* had the highest rate of parasitism at 37.0%, and the parasitism rates of *B. hebetor* and *B. (H.) didemie* were 1.1% and 7.0%, on *T. absoluta*, respectively (Doğanlar & Yiğit 2011). A study conducted in greenhouse and open field tomato fields in Kenya revealed that *B. nigricans* parasitized *T. absoluta* at a rate of up to 21% (Mama Sambo et al. 2022). *Bracon* (*H.*) *concolorans*, whose parasitism rate on *T. absoluta* was 12%, 18%, and 23.5% in open field tomato production in 3 different regions in Iraq, has the highest parasitism rate among parasitoid species (Al-Gerrawy 2021). In Türkiye, the parasitism rate of *B. concolorans* on a different host, the apple ermine moth, *Y. malinellus* was similarly determined to be 19% (Narmanlıoğlu & Çoruh 2017). Luna et al. (2007) found the parasitism rate of the braconid *P.dignus*, which they reported as the most important natural enemy of *T. absoluta* in South America, to be 30% under laboratory conditions. Sanchez et al. (2009) revealed that *P. dignus* in Argentina had a 26.47% parasitism rate in organic fields and 45.95% under greenhouse conditions. Idriss et al. (2018) reported that the indigenous parasitoid species *B. (H.) nigricans and A.(D.) appellator*) in Sudan could be very promising, with parasitism reaching 55% of *T. absoluta* under laboratory conditions. It has been reported that parasitism rates vary between sanplingareas and regions (Mama Sabo et al. 2022). Although no calculation was made on the parasitism rate, numerical data of the parasitoid species were obtained from leaf samples. The ectoparasitoid *B. concolorans* female first paralyzes and kills larvae of *T. absoluta* and lays her eggs on or near the host.

AS adult individuals obtained from cultivated tomato leaves were evaluated in this study, the density of *B. concolorans* was determined from the number of adults. Accordingly, 117-248 parasitoid *B. concolorans* were obtained from at least 45, and at most, 108 tomato leaves, and no other species was identified. Yüksekyayla et al. (2023), in their study conducted in Antalya Province, determined the number of the parasitoid *B. didemie* obtained from 100 tomato leaves taken weekly as 24 at most and did not encounter any other species. Karut et al. (2023) identified *B. (H.) didemie* and *A.(D.) appellator* as parasitoids of *T. absoluta* in open-field tomato production in Adana and determined that *B. (H.) didemie* was much more common, constituting 93.2% of the total parasitoids.

Conclusion

Pesticides are used extensively against *T. absoluta*, which causes significant damage in tomato cultivation. The intensive use of pesticides has many negative effects on human health and the environment. Since chemical control alone is insufficient, integrated pest management, including biological control, should be applied for effective control of *T. absoluta.* Determining the natural enemies of *T. absoluta* and their activities contributes to sustainable, environmentally friendly control.

This study revealed the numbers of *Bracon* (*H.*) *concolorans* in a tomato greenhouse infested with *T. absoluta*. During the sampling period, which occurred towards the end of the production season, no control methods wereapplied against *T. absoluta*. However, chemical control was applied against the pest throughout the majority of the production season. Despite this, an average of 2.2 parasitoid individuals per leaf was recorded.

In future studies, it would be helpful to evaluate the mass rearing and releasing techniques of native, natural enemies and to conduct studies on the effects on this species of pesticides applied in tomato greenhouses. In addition, natural enemies may show some different morphological characteristics in different locations, and the extent to which they may affect their biological activity could also be evaluated. Determining the natural enemies of pests in their environment and evaluating the parasitism status of local natural enemies will support integrated control efforts.

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