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Research Article

Release Effect of Ladybird, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae) Against *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) on Eggplant in Laboratory Conditions

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Abstract

From sucking pests, whitefly *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) is a harmful pest on protected crops, especially on eggplants. It is necessary to determine the temperature range at which the predator can work well before considering any predator for a biological control program. This study has been set up to investigate effectiveness of lady bird, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae) on whitefly in a climatic room conditions (15 and 20^{o} C, 70%RH, 12 h photoperiod). The effectiveness of *S. parcesetosum* on whitefly by releasing 4 adults ladybird per plant was evaluated on potted eggplants placed in cages (110 x 50 x 80 cm) in climatic room conditions. In 15 ^{o}C constant temperature experiments, beetle larvae were never observed for 5 weeks and *B. tabaci* population in the cage receiving beetle adult was as the same as control cage. However, samplings of *S. parcesetosum* on eggplants revealed that it has successfully built up its population at constant 20 ^{o}C conditions. This species should be an effective predator of whitefly at a temperature above 20 ° C. It is important that revealing a natural enemy fed on whitefly on the eggplant because of the trichome, found on the leaves of the eggplants, has been determined to prevent the movement of predators, and limited number of natural enemies used in the biological control of whiteflies.

Key words: *Serangium parcesetosum*, *Bemisia tabaci*, eggplant.

Predatör, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae)'un Laboratuvar Koşullarında Patlıcan Bitkisi Üzerinde Beyazsinek, *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) ye Karşı Salımının Etkisi

Özet

Sokucu emici zararlılardan Beyazsinek, *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) örtü altında yetiştiriciliği yapılan ürünlerde, özellikle patlıcanlarda çok zararlı bir türdür. Biyolojik mücadele programlarına almayı düşündüğümüz herhangi bir avcıyı kullanmaya başlamadan önce söz konusu avcının hangi sıcaklık değerlerinde çalıştığını belirlemeye gerek duyulmaktadır. Bu çalışmada avcı, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae)'un beyazsinek üzerindeki etkinliği sabit 15 ve 20^{o} C sıcaklıkta 70% nisbi rutubetin ve 12 saat süreyle aydınlanmanın temin edildiği iklim odasında araştırılmıştır. Boyutları 110 x 50 x 80 cm olan kenarları tül ile çevrili kafesin içerisine 4 adet beyazsinek ile bulaşık patlıcan bitkilerinin her birine 4 adet ve toplamda bir kafese 16 adet *S. parcesetosum* erginlerini salmak suretiyle avcının beyazsinek üzerindeki etkinliği değerlendirilmiştir. 15 ^{o}C sabit sıcaklıkta 5 hafta süreyle avcının larvasına hiç rastlanmamış olup beyazsinek yoğunluğu avcı salınan ve salınmayan kafeslerde benzer seviyelerde gerçekleşmiştir. Ancak 20 ^{o}C sabit sıcaklıkta yürütülen çalışmada ise avcının başarılı şekilde bitkilerin üzerine yerleştiği ve çoğaldığı görülmüştür. Bu avcı türün sıcaklığın 20 ^{o}C'nin üzerinde seyrettiği ortamlarda Beyazsineğin etkili bir avcısı olabileceği düşünülmektedir. Patlıcan bitkisi yapraklarında bulunan trichome adı verilen yapılar avcının hareket etme yeteneğini azaltması ve beyazsineklerin biyolojik mücadelesinde kullanılan doğal düşmanların sınırlı sayıda olması sebebiyle patlıcan bitkisi üzerinde beyazsinekle beslenebilen bir avcının belirlenmiş olması önem arz etmektedir.

Anahtar kelimeler: *Serangium parcesetosum*, *Bemisia tabaci*, patlıcan.

Introduction

Vegetables can be grown all year round in protected area and open fields in the Mediterranean Region of Turkey and there are many pests of vegetables cultures (Yücel et al., 2002). From sucking pest, cotton whitefly, *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) is harmful on a large variety of vegetable crops in this region (Tunc and Gocmen, 1994; Ulubilir and Yabas, 1996; Bulut and Gocmen, 2000; Kececi et al., 2007, Malik and Karut, 2012).

The main method used to control whitefly populations is chemically in protected crop systems in Turkey. Solution to the problems of chemical dependency based on sustainable agriculture system especially via biological control technique is a challenge for researchers and growers in all around the world. It has been known for many years that ladybirds have been used in the biological control of various insects around the world and first example of ladybird used as biological control agents is the *Rodolia cardinalis*, which is used against Cottony cushion scale, *Icerya purchase* on citrus grows in California (Caltagirone and Doutt, 1989).

From ladybirds, *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae) was released to citrus groves to control citrus whitefly, *D. citri* in Turkey in 1992 (Yiğit et al., 2003). After a successful establishment of this ladybird on citrus grove and getting naturally under control the citrus whitefly (Yiğit et al., 2003), we thought this ladybird would be used to the control of cotton whitefly, *B. tabaci* on undercover grown eggplant system in Mediterranean Region of Turkey.

The structure of greenhouses, varying from the simple to the well-equipped and depending on the climate and the covering material impacts crop protection techniques, which are used against pest and disease. Basically, types of greenhouse depending on climate of the country on which country it is established are two. One of them common throughout costal area of the Mediterranean provide minimal climatic conditions for growing the crops (Gullino et al., 1999). Eggplants (*Solanum melongena*) are planted in late summer or early fall (September through October) and harvested from late fall through spring months into greenhouses consisting of simple plastic tunnels. On the other hand, eggplant may also have planted in late winter (February through March) to be harvested in late spring and early summer (Yılmaz et al., 2009). There is a lot of difference between night and day temperatures in plastic greenhouses. In the Mediterranean region of Turkey, where temperatures sometimes fall below 5-6°C during winter (Şensoy and Demircan, 2016), *B. tabaci* remains active, and its population growth is proportionately less affected by low temperatures in winter.

Before considering a predator to use against any pest, it is important to investigate its effectiveness under different temperatures. In this study, releases of *S. parcesetosum* to control whitefly, *B. tabaci* on potted eggplants placed in cages was evaluated in laboratory conditions in constant 15 and 20^{o} C, separately.

Material and Methods

Clean plant production

Eggplant are sown and grown singly in pots to produce robust plant which are ready for infestation with whitefly after 4-7 weeks.

Whitefly production

Two cheese-cloth covered cages approximately 110 x 50 x 80 cm were accommodated in a greenhouse. Fifteen plants were caged every week and they were moved to a constant temperature room (27^{o} C, 70% RH, 16 h photoperiod) and placed near the plants infested with whitefly.

Serangium parcesetosum production

For culturing the colony, approximately 15-20 individuals of *S. parcesetosum* were collected from Citrus orchards in in Erzin, Hatay province on 5 May 2004. One similar cheese-cloth cage was used to produce the predator. Every week 10 potted whitefly infested eggplants were introduced into a cage together with about 25 eggs or larvae + pupa per cm^2 of leaf area. The cages were kept in a room (25^{o} C, 70% RH, 16 h photoperiod). Ten to fifteen adults of *S. parcesetosum* were released in cage (Yigit, 1992).

Monitoring B. tabaci and S. parcesetosum Populations

This study was carried out on the eggplants in two separate cages in a climatic room at constant 15 and 20 °C, separately (70% RH, 12 h photoperiod). Four potted egg plants infested with *B. tabaci* were transferred to each cage on 4 May 2006.

To evaluate colonization and control efficiency of *S. parcesetosum*, predator adults (1-week-old) reared mentioned above were singly released directly on different plants at the rate of 16 adults per cage (4 adults per eggplant) into release cage; and no *S. parcesetosum* were released to the second cage, which used as a control. *S. parcesetosum* adults was augmented four times over the course of the experiment at 15 °C constant temperature, however it was augmented one time at 20 °C constant temperature. Whitefly intensity was 184.62 and 193.87 larvae + pupa / 10 cm² leaf at 15 and 20 °C, respectively at the beginning of experiment.

Sampling was started on 5 May and conducted weekly intervals to monitor the population dynamics of whitefly and the predator. Totally 5 sampling were conducted. All larval and pupal stages of whitefly on two leaves (totally 8 leaves per cage) selected from each plant were counted on 10 cm² section of each leaf with the aid of a magnifier glass (30x magnification). It provided an average measure of whitefly density per cage. A student *t*-tests was performed on whitefly populations in order to establish differences between in predator released and unreleased cages ($P<0.05$).

The numbers of predator per cage also were counted weekly to detect signs of survival, development, and reproduction by searching ten minutes (2.5 min per plant) per cage before picking up the leaves to count the whitefly.

Result and Discussion

At 15 ^{0}C, the mean number of *B.tabaci* was not significantly different between the release and control cages. This data shows that *S. parcesetosum* is not sufficient to suppress the population of whitefly at 15 ^{0}C constant temperature. Some of the released ladybird were seen occasionally, even though the intensity of whitefly in released cage was sufficient, and movements of them were very slow and they were often together. However, larvae of the ladybird were not seen (Table 1).

Table 1. The comparison of mean number of *Bemisia tabaci* (larvae+pupae) per 10 cm^2 section of leaf in *Serangium parcesetosum* released vs unreleased cages and mean numbers of *Serangium parcesetosum* per cages observed in 10min visual search in a climatic room at constant 15 ^{0}C conditions.

Sampling date	Control cage *B. tabaci* Mean±SE per 10 cm² leaf area	Released cage *B. tabaci* Mean±SE per 10 cm² leaf area	*S. parcesetosum* mean adults and larvae per plant observed in 10 min visual search
04.05.2006	182.87±9.35	184.62±6.83	4.00
11.05.2006	190.37±9.50	203.62±7.81	1.00
18.05.2006	222.00±7.02	225.50±5.84	0.50
25.05.2006	258.87±12.43	283.50±9.42	2.75
02.06.2006	278.37±15.26	295.75±9.30	3.00

*) Means compared by student *t*-tests; significance was assessed at P=0.05 on each date.
Means within an arrow followed by different letters for each experiment are significantly different at P>0.05 (Student's t-test).

Table 2. The comparison of mean number of *Bemisia tabaci* (larvae+pupae) per 10 cm^2 section of leaf in *Serangium parcesetosum* released vs unreleased cages and mean numbers of *Serangium parcesetosum* per cages observed in 10min visual search in a climatic room at constant 20 ^{0}C conditions.

Sampling date	Control cage *B. tabaci* Mean±SE per 10 cm² leaf area	Release cage *B. tabaci* Mean±SE per 10 cm² leaf area	*S. parcesetosum* mean adults and larvae per plant observed in 10 min visual search
04.05.2006	214.50±7.15 a	193.87±6.51 a	4.00
11.05.2006	236.00±6.64 a	210.62±6.95 b	2.75
18.05.2006	251.12±6.19 a	223.25±7.50 b	18.50
25.05.2006	262.25±6.68 a	111.62±17.72 b	21.00
02.06.2006	281.00±7.14 a	82.12±14.64 b	2.50

*) Means compared by student *t*-tests; significance was assessed at P=0.05 on each date.
Means within an arrow followed by different letters for each experiment are significantly different at P>0.05 (Student's t-test).

As seen in Table 2, the density of *B. tabaci* at the constant temperature of 20 °C differs significantly when comparing to control cage. Whitefly intensity in the predator released cage gradually decreases, but, it increases in control the cage. However, as can be understood from the values (Table 2), the intensity of the *B. tabaci* in the cage which is predator released is low compared to the control cage, but it is high when economic threshold of whitefly is taken into consideration. The population of *B. tabaci* began to fall a week after the increase of the larvae of *S. parcestosum* in the released cage on 18.05.2006. However, as the larvae, which cannot move fast, continue to feed on the leaves, the population of cotton whitefly continued to increase in the plants where no larvae were found. Thus, once in the initial concentration of 193.87 larvae + pupae / 10 cm^2 leaves at 20 ° C, the release of adults *S. parcesetosum* was found to be insufficient to prevent the population of *B. tabaci*. Adults of the new generation *S. parcesetosum* were seen on 12.06.2006. In control cage, counting was not done because the plants had died due to the increase of the intensity of whitefly. On the other hand, it is understood that the new off spring *S. parcestosum* on predator released the cage, is seen 38 days after the first release (Table 2). Sengonca et al. (2004) report that *S. parcesetosum* is grown on cotton plants at a constant temperature of 18 ° C (egg-adult) in 42-43 days.

Conclusion

The results of laboratory study indicated that *S. parcesetosum* failed to control *B. tabaci* population and to build up its population on eggplants at constant 15 ^oC, even plenty of food when the ladybird population was augmented six times over the experiment. However, *S. parcesetosum* has successfully built up its population at constant 20 ^oC conditions. This species should be considered to be an effective predator of whitefly at a temperature above 20 ° C. Zhou et al (2017) found that optimal temperature range was between 23 °C and 29 °C for *Axinoscymnus apioides* (Coleoptera: Coccinellidae), another whitefly predator.

Solanaceous species, including eggplant are not preferred by natural enemies because of their hairy trichomes, which prevent the movement of predators and parasitoids, (Bottrell and Barbosa 1998; Cortesero et al. 2000). Since the number of natural enemies used in the biological control of whiteflies is limited, the *S. parcesetosum* has a positive result in terms of biological control, which is promising at temperatures above 20 ° C on the eggplant.

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