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GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

MASTER OF SCIENCE (MSc) DEGREE THESIS

DETERMINATION OF SEXUAL MATURITY OF PREDATORY INSECT *Anthocoris minki* Dohrn (HEMIPTERA: ANTHOCORIDAE)

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DEPARTMENT OF PLANT PROTECTION

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Doç. Dr. Mehmet MAMAY danışmanlığında, Yasser ALRAMADAN'ın hazırladığı **"Determination of Sexual Maturity of Predatory Insect *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae) – (Avcı Böcek *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae)'nin Eşey Olgunluğunun Belirlenmesi)"** konulu bu çalışma 20/12/2019 tarihinde aşağıdaki jüri tarafından oy birliği ile Harran Üniversitesi Fen Bilimleri Enstitüsü Bitki Koruma Anabilim Dalı'nda YÜKSEK LİSANS TEZİ olarak kabul edilmiştir.

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Under the supervision of Assoc. Prof. Mehmet MAMAY, thesis **“Determination of Sexual Maturity of Predatory Insect *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae)”** prepared by Yasser ALRAMADAN was accepted as a Master of Science thesis by the committee of the Graduate School of Natural and Applied Science of Harran University with the unanimous verdict on 20/12/2019.

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CONTESTS

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ÖZET

Yüksek Lisans Tezi

AVCI BÖCEK *Anthocoris minki* DOHRN (HEMIPTERA: ANTHOCORIDAE)'NIN EŞEY OLGUNLUĞUNUN BELIRLENMESI

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Harran Üniversitesi
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YIL: 2019, Sayfa: 28

Tarımsal zararlılara karşı pestisitlerin bilinçsiz ve yoğun kullanımı doğal düşmanların yok olmasına, zararlı böceklerin direnç kazanmasına ve zararlıların lehine doğal dengenin bozulmasına sebep olurlar. Ayrıca, yoğun pestisit kullanımı insan ve hayvan sağlığını tehdit etmektedir. Kimyasal mücadelenin bu dezavantajları ile birlikte pestisit kalıntısı ve gıda güvenliği konusunda artan duyarlılık alternatif yaklaşımlar gerektirmektedir. Bu alternatif yaklaşımlardan birisi de ilaçsız bir mücadele yöntemi olan ve zararlılara karşı insan katkısıyla birlikte predatör, parazitoit ve entomopatojenler gibi doğal düşmanların kullanımına dayanan biyolojik mücadeledir. *Anthocoris minki* (Hemiptera: Anthocoridae), Antep fıstığı bahçelerinde *Agonoscena pistaciae* Burckhardt ve Lauterer (Homoptera: Psyllidae) gibi birçok zararlının biyolojik kontrolü için umut vaat eden yerli bir predatördür. Bu çalışmada predatör *A. minki*'nin eşeysel olgunluğunun belirlenmesi amaçlanmıştır. Çalışmada, *A. minki*'nin besini olarak kullanılan *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) 'nin yumurtası ve predatörün yumurtlama materyali fasulye (*Phaseolus vulgaris* L.)'dir. Çalışmada *A. minki*'nin eşeysel olgunluğunu belirlemek için dişiler 1, 2, 3, 4 ve 5 günlük iken 3 günlük erkeklerle çiftleştirilirken aynı şekilde erkek bireyler de 1, 2, 3, 4 ve 5 günlük iken 3 günlük dişi bireylerle çiftleştirilmişlerdir. Çalışmanın sonucunda, farklı yaşlarda çiftleştirilen dişi bireyler için preoviposizyon bütün yaşlarda 5.30 günden daha kısa belirlenirken en uzun postovipozisyon süresi 5 günlük iken çiftleştirilen dişilerde belirlenmiştir. Benzer şekilde 5 günlük erkeklerle çiftleşen sabit yaşlı dişiler (3 günlük) için postoviposizyon süresi 7.90 gün olarak belirlenmiştir. En uzun ovipozisyon süresi 36.90 gün ve toplamda en fazla yumurta 144.4 ve 141.6 sayısı ile sırasıyla 4 ve 5 günlük dişilerin 3 gün sabit yaşlı erkeklerle çiftleştirilmesinden elde edilmiştir. Sabit yaşlı (3 günlük) dişiler 3 ve 5 gün yaşlı erkeklerle çiftleştirildiğinde ovipozisyon süresi sırasıyla 34.10 ve 32.90 gün olarak belirlenmiştir. Sonuç olarak, *A. minki*'nin kitle üretiminde ve predatörün biyolojisinin araştırıldığı bilimsel çalışmalarda dişilerin 4 gün yaşında ve erkeklerin ise 3 günlük yaşlarında çiftleştirilmeleri uzun ovipozisyon süresi ve daha fazla yumurta elde edilmesini sağladığı belirlenmiştir.

ANAHTAR KELİMELER: Biyolojik mücadele, *Anthocoris minki*, eşey olgunluğu, çiftleşme, *Ephestia kuehniella*

ABSTRACT

MSc Thesis

DETERMINATION OF SEXUAL MATURITY OF PREDATORY INSECT *Anthocoris minki* DOHRN (HEMIPTERA: ANTHOCORIDAE)

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ABSTRACT

The intense use of pesticides to control the agricultural pests endangered natural enemies, pests become resistant to pesticides and the natural balance deteriorated. In addition, human and animal health, and environment were negatively affected. Along with these disadvantages of chemical control, the increased sensitivity of pesticide residues and food safety necessitates alternative approaches. The most important of these methods is the biological control, which is a non-chemical based method and relies on using natural enemies (predators, parasitoids and entomopathogens) together with human contribution against pests. *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae) is a promising indigenous biological control agent for many pests like *Agonoscena pistaciae* Burckhardt and Lauter (Homoptera: Psyllidae) in pistachio orchards. In this study, it is aimed to determine of sexual maturity of predatory insect *A. minki*. The main materials of the work are the predatory insect *A. minki*, eggs of *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) as feeding source, and beans (*Phaseolus vulgaris* L.) as egg laying material. Female individual of *A. minki* were mated in 1, 2, 3, 4 and 5-days old with 3-days old male, similarly male individual of *A. minki* were mated in 1, 2, 3, 4 and 5-days old with 3-days old female, in order to determine the sexual maturity of the predatory insect. As a result of the study, the pre-oviposition period for different age of female were less than 5.30 days, and the shortest preoviposition period was obtained from mated in 5-days old female with 2.5 days. The longest post-oviposition period was 6.50 days for 5-day old female and 7.90 for the 5-day old male of *A. minki*. The 4-days and 5-days old female had the longest oviposition period with 36.90 days for both. Likewise, the highest total number of eggs during the oviposition period was determined for the 4- and 5-days old female with 144.4 and 141.6 eggs, respectively. The longest oviposition period was 34.10 and 32.90 when a female mated with the 3 and 5-days old male, respectively. As a result of the study, it was determined that the most suitable age for mating is 4-day old female with 3-day old male in mass rearing and scientific researches studies to reach the preferred oviposition period and maximum number of eggs.

KEY WORDS: Biological control, *Anthocoris minki*, sexual maturity, mating, *Ephestia kuehniella*

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1. INTRODUCTION

The intensive pesticides application to control the agricultural pests in the field, made many pests resistance to these pesticides and the natural balance is disturbed by the disappearance or reduction of natural enemies. At the same time, have negative effect on human and animal health. The goal is to increase the environmental resistance in integrated pest management, which is described as "Integrated Pest Management (IPM)”. IPM is an ecologically-based strategy for pest control that depends on natural factors such as natural enemies, crop management and weather. Increasing the number of natural enemies’ populations and activities in the environmental resistance trials is an important issue (Öncüer, 1995).

Many methods are applied to control the agricultural pests. Chemical method is the most preferred because the chemical application is easier and has immediate results. Unfortunately, the chemical pesticide has not only impact on the agricultural pests but also environment and human health negatively. It causes destroying the natural balance, emergence of new pests, the pesticide resistance, water, soil and air pollution. For these reasons, studies on the protection of agricultural products all over the world have focused on the production of environmentally friendly pesticides as well as the production of alternative products to synthetic chemical pesticides. In this context, increasing awareness of pesticide residues and food safety in recent years has furthered the trend towards alternative methods. One of the most important of these methods is the biological control which is a pesticide-free method using a useful organism against harmful organisms (Öncüer, 1995).

Biological control is described in the form of the application of all necessary actions to keep the pest’s population below the economic threshold level, with the help of natural enemies present in the nature. In biological control, other insects aren't target as they are in the chemical control. The target pests aren't completely destroying in the biological control. In the biological control, the pest's density is kept below the threshold economic level, thus aiming to ensure the continuity of the natural enemies of the pests in nature. Biological control is the use a living organism to manage the population density of a pest. And similar control programs operate in different part of the world. Biological control agents (BCAs) include predatory insects and mites, parasitoids, and parasites and microbial pathogens, such as nematodes, fungi, bacteria, viruses and protozoa, which cause lethal infections. examples these agents such as the application of parasitoids to control whiteflies in greenhouses; use of viruses to control codling moth in apple orchards entomopathogen fungi to control plant diseases (Önder, 1982).

The most important factor for the biological control to achieve its goal is release enough natural enemies in the nature to control the pest at the intended time. For this, predators and parasitoids sometimes need to be multiplicated in big quantity (Özder and Sağlam, 2002). This process called mass rearing. The predator and parasitoid populations naturally found in agro-ecosystems are insufficient to keep the concentration of pest' population below the economic threshold level. Therefore, mass rearing and release of predators is necessary to manage the pest populations. Because of that sufficient natural enemies must be mass-reared and released. Mass rearing; insectariums, which are known to be useful in biological control. Mass rearing methods; host-hunter, dormancy and cold storage is the practical application of information provided by research studies (Van lenteren, 2000).

Most of the useful insects that are important in biological control are in the order of Coleoptera, Orthoptera, Heteroptera, Thysanoptera, Neuroptera, Diptera and Hymenoptera. The most important family in Hemiptera is Anthocoridae. Most Anthocoridae species are predators and feed on Arthropoda species.

Especially, Aphididae, Psyllidae and Cocoidae species of the homoptera order (Önder, 1982).

the population density of some insect species which have no economic importance, have become the main pest as a result of the deterioration of natural balance. Clear example is *Agonoscena pistaciae* (Hemiptera: Psyllidae) which was consider as secondary pest and did not require control in 1980s in the areas of Southeastern Anatolia region, but in 1990s considered as main pest, in 1992, 1 million 500 thousand trees were controlled against this pest in Şanlıurfa (Mart and Karaat, 1990; Altın et al., 1992). Among the pest insect species in pistachio in Şanlıurfa province, the most chemical control application was against pistachio psyllid (Altın et al, 1992; Yücel et al, 2000).

Pistachio psyllid (*Agonoscena pistaciae*) is an important pest that causes economic losses in pistachio (Mart et al. 1995; Mehrnejad 2001; Souliotis et al. 2002). It is difficult to control this specie because it's became resistant to pesticides (Mehrnejad, 2001). Therefore, it is very importance in biological control to keep psyllid under control. Insect from Anthocoridae consider as predators widely used in the biological control of pests such as psyllid, aphid, mites (Yanık and Ünlü, 2010). Also, there are other important predatory insect species found in pistachio and feed on pistachio psyllid such as *Campylomma lindbergi* Hoberlandt, *Deraeocoris pallens* Reuter (Hemiptera: Miridae) ve *Oenopia conglobata* (L.) (Coleoptera: Coccinellidae) (Yanık et al., 2011).

Anthocoris minki is an important biological control agent feeds on eggs and nymphs of pistachio psyllid (Çelik 1981; Mart et al, 1995; Bolu and Kornoşor, 1995; Bolu et al, 1999; Yanık ve Ünlü 2010). In Turkey *A. minki* is exist naturally in the orchard filed such as pistachio, pear, almonds, pine, apple, rose, oak and even in olive trees (Önder, 1982).

The family of Anthocoridae can be active during the winter when the weather is good (Önder, 1982). Also, Yanık and Uğur (2002) reported that they could mass reared both of *A. nemoralis* and *Orius* species in the laboratory during the year. Anthocoridae family species are feed on insects and other Arthropoda species such as Psyllidae, Aphididae and Coccoidea species of Homoptera are more preferred (Önder, 1982). Mass rearing of *A. minki* and release it to control pistachio psyllid showed good result (Yanık et al, 2007).

Optimum conditions may vary according to species in mass rearing of useful insects under laboratory conditions. *Anthocoris minki* is one of the most important biological control agents that can be used in biological control of agricultural pests and is a general predator who feeds on many pests. However, in order to achieve the most effective mass rearing of *A. minki* in laboratory conditions, it is necessary to determine the sexual maturity of predatory insect *A. minki*. For this purpose, the sexual maturiety should be evaluated in terms of preoviposition, oviposition, postoviposition, number of eggs, reproductive rate and male-female lifespan of the insect. In this study carried out in 2019 at Harran University, Faculty of Agriculture, Department of Plant Protection, Insect Mass Rearing Center, it was aimed to determine the sexual maturity of predatory insect *A. minki*.

2. LITERATURE REVIEW

Horton et al. (2000), conducted a study to compare the mating preferences, propensities, and some life history traits between a European and North American population of *Anthocoris nemoralis* (Hemiptera: Anthocoridae). The North American population colonized the source locale apparently between 10 and 30 years ago. females from UK were less likely to mate during a 30-min than females from California (regardless of male source); and males from California were less likely to mate than males from the UK (regardless of female source). 80% of females matured ovaries from all population crosses. Duration of copulation was shorter in pairings involving males from California than mating involving males from UK. The average of the pre-oviposition period was ≈ 3 d for females from UK and California.

Hemptinne et al (2001), studied the behavior of mature sexually of the female and male of *Adalia bipunctata* L. (Coccinellidae: Coleoptera). The new emerged males and females of *A. bipunctata* showed similar refractory periods in their mating behavior. The statistically indicate that the females are willing mating and store sperm for a short period prior to becoming sexually mature, whereas the males need to become sexually mature in order to mate. As the *A. bipunctata* has overlapping generations, the theory predicts that the most effective strategy for both male and female is to have similar period of sexual maturation. However, will depend largely on the rearing condition such as temperatures and the quality and quantity of food available.

Pervez et al (2004), conducted a research to study the effect of different age on the reproductive performance of the predator, *Propylea dissect* (Mulsant). (Coccinellidae: Coleoptera) The effect of different age (1-30 days) on reproductive of *P. dissecta* was studied using male and female beetles. All the different age (10 to 30 days old) female mated with similar ages of males, while only a fraction (0.29%) of younger females (1 to 5 days old) mated with males of similar or older age. The willingness to mate was depend on the age of the male, and increased sigmoidally with increasing the age. Adult males were more willing to mate with females regardless the age. Mating duration was longest among older adults (30-day-old males and 20-day-old females). Fertility was depending on the age of the female and increased with age up to 20 days and thereafter decreased. 20-day-old females were most fecund producing 867 eggs after a single mating. Offspring production was depending on the age of the male. Prolonged mating increased fecundity and egg viability. The results reveal that males of intermediate age were better mates.

Srivastava et al. (2004), conducted a study to determine different ages and reproductive senescence male and female of the seven-spotted ladybird, *Coccinella septempunctata* L. (Coleoptera: Coccinellidae). Different ages from (1-50) of adults of *C. septempunctata* were paired for mating to record the sexual maturity and onset of reproductive senescence in both the sexes. Mating commenced after 2 and 4 days of emergence of female and male, respectively, and 100% mating achieved in both cases (in the first 10 days). Willingness to mate decreased with increasing the age from 40 to 50 days of both male and female. Mating duration and per cent viability of eggs were depend on the male age, whereas the pre-oviposition and oviposition periods depended on mating stimulus. Oviposition period and fecundity depended on the female age. Fecundity was highest when 30-day-old male and 20-day-old female were paired. The reproductive senescence started at the age of 20 days in females and 30 days in males.

Tagaldeen (2015), studied the mating behavior of predator *A. minki*. The virgin females were never found to lay eggs, the minimum copulation duration to egg deposition was 4.13 minute. An adverse effect on egg deposition can be by additional copulation of *A. minki* female. In the presence of five virgin males, females deposited significantly fewer eggs than their absence. A virgin male was copulated sequentially with three virgin females in 1 day or with 1- or 2-day intervals between matings and they successfully inseminated all the tested females which indicate that males tend to be polygamous. The total number of eggs laid by the new emerged female to mate was significantly higher than the number laid by older females.

SÖNMEZ. (2016), Studied the effect of female age at mating on the reproductive traits of *Orius laevigatus* (Fieber) (Hemiptera: Anthocoridae). Virgin females aged 1, 5, 10, 15, 20 and 30 days were paired with 5-day-old males. Females of *O. laevigatus* that mated at the age of 1-15 days laid most eggs (135.8–180.0 eggs) and those mated when 30 days old the least (19.5 eggs). The age of the female at mating have significant effect on fecundity, oviposition periods, female longevity and reproductive rate of *O. laevigatus*. The maximum oviposition period per female per day were 12.9 eggs (7th day), 12.10 eggs (6th day), 11.2 eggs (7th day), 11.5 eggs (7th day), 7.20 eggs (6th day) and 4.0 eggs (6th day) at 1, 5, 10, 15, 20 and 30 days old mated female, respectively, thereafter gradually decreasing.

Rat, 2018, determined the suitable spawning material for producing *A. minki* in mass rearing in an economical, fast and efficient manner. Three spawning materials were studied, prey Bean. The researcher found that the total egg counts for beans, faba beans and peas were 430, 964 and 799, respectively. And the percent of these eggs were found as 80.5, 71.1 and 39.0 percent, respectively. Preoviposition was 5.75, 8.36, 7.31; oviposition was 7.83, 24.18, 19.63 and postoviposition was 7.83, 9.73 and 5.38 days for the bean, faba bean and peas, respectively. Consequently; Rat determined that faba bean is an economic and efficient spawning material in 3 spawning materials for mass rearing of *A. minki*.

3.MATERIAL and METHODS

2.1. Material

The main material used for this study were tested under the project by using eggs of *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) (Mediterranean flour moth), predator insect *A. minki*, and beans (*Phaseolus vulgaris* L.), Wheat bran and wheat flour. During mass rearing of *A. minki*, eggs of *E. kuehniella* glued on a black color carton, stereo binocular microscope, oven to sterilize the flour and bran mixture, transparent plastic containers, petri dishes, soft brushes, rubber and cartons were used as well.

2.1.1. ***Anthocoris minki*** **Dohrn (Hemiptera: Anthocoridae)**

The adult body has yellow and brownish red colors. Flat-shaped, the head is black color. Body length is 3.0-3.6 mm (Figure 3.1). The nymph passes through five instar stage before becomes an adult (Figure 3.2.). The egg is long and sausage-shaped and are embedded in the plant tissue with the cover part (operculum) outward. (Figure 3.3.) (Önder, 1982).

Figure 3.1. Nymph of *Anthocoris minki* and exuviae.

Figure 3.2. Adult of *Anthocoris minki*.

Figure 1.3. Mating of *Anthocoris minki* (Female and male)

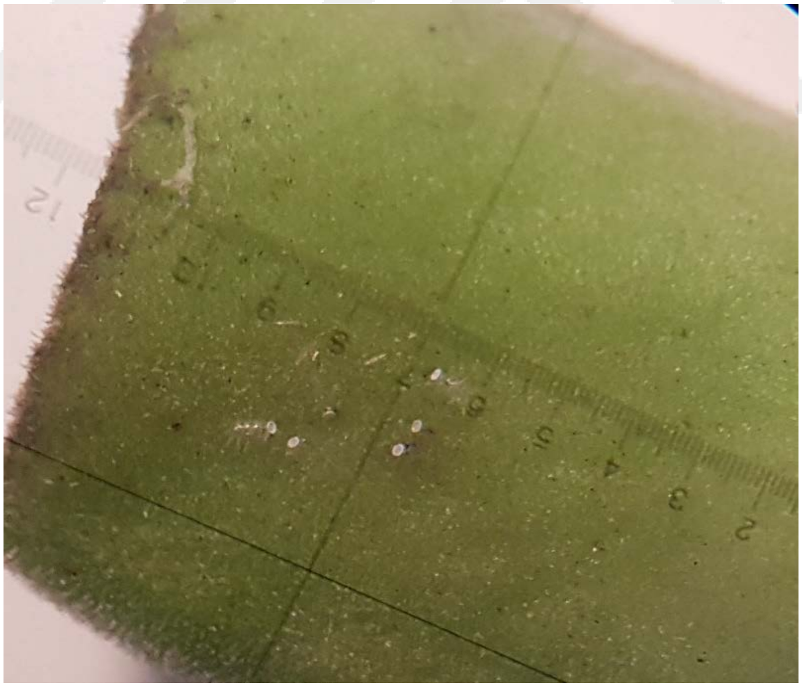

Figure 3.4. Eggs of *Anthocoris minki*.

2.1.2. *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae)

The wingspan 18-27 mm; long forewings with rounded wing tips, pale-grey or brownish-grey, suffused with darker grey, two darker zig-zag fascias, sometimes indistinct. Head, thorax and abdomen grey. (Figure 3.5). Adults live 1-2 weeks. Eggs are oval, light yellow and hatch in 3-5 days at 27 ° C. The average size of the eggs is 0.57x0.30 mm. The Larva is head reddish- or yellowish-brown, body pinkish-white or yellowish-white and covered with hairs. Mature larvae are 12-19 mm in length (Figure 3.6). The matured larvae leave the food environment, and Moving towards crevices, recesses, etc. and turns into pupa (Figure 3.7), (Demirsoy, 2006).

Figure 3.5. Adult of *Ephestia kuehniella.*

Figure 3.6. Larvae of *Ephestia kuehniella.*

Figure 3.7. Pupa of *Ephestia kuehniella*.

3.2. Methods

3.2.1. Mass rearing

3.2.1.1. Mass rearing of *Ephestia kuehniella*

Ephestia kuehniella were grown at 25 ± 1 ° C, 65 ± 5% humidity and 16: 8 h L:D photoperiod-controlled conditions. mixture of flour and bran (2:1) were used as a feed for breeding (Bulut and Kılınçer, 1987). Flour-bran mixture were stored in the refrigerator after being sterilized at 60 °C for 3-3.5 hours. During mass rearing of *E. kuehniella*, approximately 1 kg of this prepared mix placed into the plastic tubs (27x37x7 cm). Each plastic tub, approximately 75 mg of *E. kuehniella* eggs were sprinkled, and the top of the tub was covered with muslin (Karakuş, 2018). Adults, emerging after 35-40 days, were collected by an aspirator and taken to plastic ovulation containers covered both side with a wire metal mesh for the eggs. These containers were placed side-by-side with plastic tubs with white paper underneath. Eggs were taken from these tubs every two days. Some of the fresh eggs collected were used again for *E. kuehniella* culture, while the rest was stored in deep freeze to fed *A. minki*.

3.2.1.2. Mass rearing of *Anthocoris minki*

Predator insect *A. minki* was mass reared at a temperature of 25 ± 1 ° C, 65 ± 5% relative humidity, 16: 8 h L:D photoperiod. In the production of stock larvae and adults of natural enemy *A. minki*, *E. kuehniella* eggs were used as feed source. *Anthocoris minki* adults were grown in plastic containers that are transparent and covered with muslin. *Anthocoris minki* individuals separated feeds on *E. kuehniella* eggs which loaded into black cardboard strips in container and beans (*Phaseolus vulgaris* L.) for laying eggs on their pods. Spawning materials with *A. minki* eggs on controls performed every day; In another container containing *E. kuehniella* egg strips transferred, exiting nymph grown in these containers until they are mature.

3.2.2. Determination the sexual maturity of predatory insect *Anthocoris minki*

The genders of the adults from the nymphs determined and the experiment conducted for each gender. The genders mated separately in 1, 2, 3, 4 and 5 days.

3.2.2.1. Determination of the female sexual maturation

Twenty-four hours old female (1 d old) transferred to 5x5.5 cm containers (10 replicates carried out) then added 3-day old male to the containers contain female for mating purpose for 24 hours. Then the male and female separated and female were fed by *E. kuehniella* eggs, bean pods were added to enable female laying eggs on it. The female was monitored on daily basis to check laying eggs or not. Number of eggs were counted on daily basis. In this way, preoviposition, oviposition, postoviposition, male and female life span, total and average egg number were determined.

This process was applied for the 2, 3, 4 and 5-days female separately.

3.2.2.2. Determination of the male sexual maturation

Twenty-four hours old male (1 d old) transferred to 5x5.5 cm containers (10 replicates carried out) then added 3-day old female to the containers contain male for mating purpose for 24 hours. Then the male and female separated and female were fed by *E. kuehniella* eggs, bean pods were added to enable female laying eggs on it. The female was monitored on daily basis to check laying eggs or not. Number of eggs were counted on daily basis. In this way, preoviposition, oviposition, postoviposition, male and female life span, total and average egg number were determined.

This process was applied for the 2, 3, 4 and 5-days male separately.

Statistical Analysis

A one-way ANOVA analysis was used to evaluate the effect of sexual maturity of predatory insect *A. minki* female and male on different parameters including the (pre-oviposition, oviposition and postoviposition) periods, for both average and total egg number, reproduction rate and lifespan. Tukey’s multiple comparison test was used to determine the difference between these parameters.

4. RESULT and DISCUSSION

In this study, the effect of the sexual maturity of predatory insect *A. minki* female and male on the pre-oviposition, oviposition and post-oviposition periods, total and average egg number, reproduction rate and lifespan were investigated.

4.1. The Effect of Different Ages of the Female of *Anthocoris minki* on Preoviposition, Oviposition and Postoviposition Periods

The effect of different ages of the female of *Anthocoris minki* on preoviposition, oviposition and postoviposition periods are given in (Table 4.1).

Table 4.1. The effect of different ages of the female of *Anthocoris minki* on Preoviposition, Oviposition and Postoviposition Periods

Female age (day)	Pre-Oviposition (day)	Oviposition (day)	Post-Oviposition (day)
1 day old	4.10 ± 0.66 a	34.90 ± 0.84 ab	4.90 ± 0.55 b
2 day old	3.60 ± 0.54 ab	34.60 ± 0.97 b	4.90 ± 0.60 b
3 day old	3.80 ± 0.44 ab	34.50 ± 0.81 ab	5.10 ± 0.41 ab
4 day old	2.70 ± 0.15 ab	36.90 ± 0.35 a	5.80 ± 0.42 ab
5 day old	2.50 ± 0.17 b	36.90 ± 0.43 a	6.50 ± 0.54 a
	F = 2.5354 P = 0.0531	F = 2.9242 P = 0.0312	F = 1.8801 P = 0.1304

*The difference between the means bearing the same letter is insignificant at the level of 5%.

The average day of the pre-oviposition period for the 1, 2, 3, 4, and 5-day ages of female were 4.10, 3.60, 3.80, 2.70 and 2.50, respectively. According to this data, there is no statistically significant differences in the period of the Pre-oviposition period for the different age of female ($p>0.05$).

The Post-oviposition period is similar to the pre-oviposition as the average days for the 1, 2, 3, 4, and 5-day old female were 4.90, 4.90, 5.10, 5.80 and 6.50, respectively. Similarly, like preoviposition period, there is no statistically significant difference in the period of the post-oviposition period for the different age of female ($p>0.05$).

In contrary of the pre-oviposition and post-oviposition period the oviposition period was significantly different according to the different age of female (F: 2,9242; $p<0.05$) (Table 4.1). The average days of the oviposition period for the 1, 2, 3, 4, and 5-day old female were 34.90, 34.60, 34.50, 36.90 and 36.90, respectively. The 4-days and 5-days old female had the longest oviposition period with 36.90 days for both. Likewise, the highest average number of eggs during the oviposition period was determined for the 4- and 5-days old female.

In this study, preoviposition, oviposition and postoviposition periods of females mated at the age of 1 day were 4.10, 34.90 and 4.90 days, respectively. Where in the study conducted by Mamay and Rat (2019) in order to determine suitable material for egg laying of *A. minki*, 0-24 hours females were mated and these periods were determined as 5.75, 7.83 and 7.83 days, respectively. Where in the study conducted by Sönmez (2016), the preoviposition, oviposition and postoviposition periods of *Orius laevigatus* females mated at the age of 1 day were 1.1, 24.4, and 6.8, respectively.

4.2. The Effect of Different Ages of the Female of *Anthocoris minki* on Egg Number, Reproduction Rate and Lifespan

The effect of different ages of the female of *A. minki* on total and average eggs numbers according to the lifespan and oviposition period obtained from the study were given in (Table 4.2).

The total number of eggs during the lifespan for the 1, 2, 3, 4, and 5-days old female were 122.8, 118.1, 124.7, 144.4 and 141.6, respectively. there was statistically significant difference in the total number of eggs during the lifespan for the different age of female ($P<0.05$).

Table 4.2. The effect of different ages of the female of *Anthocoris minki* on egg number

Female age (day)	Total number of eggs during lifespan	Average number of eggs during lifespan	Average number of eggs during oviposition (Reproduction rate)
1 day old	122.8 ± 6.29 ab	2.46 ± 0.13 ab	3.52 ± 6.29 a
2 day old	118.1 ± 3.34 b	2.37 ± 0.07 b	3.48 ± 3.34 a
3 day old	124.7 ± 5.97 ab	2.49 ± 0.12 ab	3.61 ± 5.97 a
4 day old	144.4 ± 3.21 a	2.89 ± 0.06 a	3.91 ± 3.21 a
5 day old	141.6 ± 7.93 a	2.83 ± 0.16 a	3.84 ± 7.93 a
	F = 4.4111 P = 0.0043	F = 4.3522 P = 0.0046	F = 1.7009 P = 0.1665

*The difference between the means bearing the same letter is insignificant at the level of 5%.

Similarly, the average number of eggs during the lifespan for the 1, 2, 3, 4, and 5-days old female were 2.46, 2.37, 2.49, 2.89 and 2.83, respectively. There is statistically significant difference in the total number of eggs during the lifespan for the different age of female (P<0.05).

In the contrary of the average and total number of eggs number during lifespan, the average number of eggs during the oviposition for the 1, 2, 3, 4, and 5-day old female were 3.52, 3.48, 3.61, 3.91 and 3.84, respectively. There is no statistically significant difference in the average number of eggs during the oviposition for the different age of female (P>0.05).

Also, the 4 and 5-days old female were the highest number of eggs during the lifespan were 144.4 and 141.6, respectively. And same for the average number of eggs during lifespan were 2.89 and 2.83, respectively which is very important for the mass rearing of *A. minki*.

In this study, the total number of eggs during the lifespan of *A. minki* for the 1-day old female was 122.8 eggs, where the total number of eggs during the lifespan in the study conducted by Mamay and Rat (2019) was 35.38 eggs for the 1-day old *A. minki* female mated with fixed age male. Where the total number of eggs laid by

Orius laevigatus, in the study conducted by Sönmez (2016) was 180 eggs for the 1-day old female mated with fixed age male.

In this study, the reproduction rate for 1-day old female of *A. minki* mated with fixed aged male was 3.52, where the reproduction rate of the 1-day old female mated with fixed age male in the study conducted by Mamay and Rat (2019) was 4.72. Where in the study conducted by Sönmez (2016), The reproduction rate for 1-day old female *Orius laevigatus* mated with fixed age male was 7.2

Table 4.3. The effect of different ages of the female of *Anthocoris minki* on lifespan

Female age (day)	Female lifespan (day)	Male lifespan (day)
1 day old	44.80 ± 0.83 ab	12.30 ± 0.47 a
2 day old	44.30 ± 0.70 b	11.70 ± 0.47 a
3 day old	44.40 ± 0.52 ab	13.20 ± 0.44 a
4 day old	46.40 ± 0.50 ab	11.50 ± 0.34 a
5 day old	46.90 ± 0.50 a	12.20 ± 0.51 a
	F = 3.7278	F = 2.1398
	P = 0.0105	P = 0.0914

*The difference between the means bearing the same letter is insignificant at the level of 5%.

The number of lifespan days for the 1, 2, 3, 4, and 5-days old female were 44.80, 44.30, 44.40, 46.40 and 46.90, respectively. There is statistically significant difference in the total length of lifespan for the different age of female ($P<0.05$). In the contrary, the number of lifespan days for the 3-days old male were 12.30, 11.70, 13.20, 11.50 and 12.20, respectively. There is no statistically significant difference in the total length of lifespan for the male when mated with different aged female ($P>0.05$) (Table 4.3).

The life span of the 1-day old female of *A. minki* mated with fixed aged male was 44.8 day where the lifespan in the study conducted by Mamay and Rat (2019) was 24.7 day for 1-day old female mated with fixed age male of *A. minki*, where in the study conducted by Sönmez (2016) the lifespan for 1-day old female *Orius laevigatus* mated with fixed age male, was 33.3 day.

4.3. The Effect of Different Ages of the Male of *Anthocoris minki* on Preoviposition, Oviposition and Postoviposition Periods

The effect of different ages of the male of *Anthocoris minki* on female preoviposition, oviposition and postoviposition periods are given in (Table 4.4).

Table 4.4. The effect of different ages of the male of *Anthocoris minki* on the female preoviposition, oviposition and postoviposition periods

Male age (day)	Pre-Oviposition (day)	Oviposition (day)	Post-Oviposition (day)
1 day old	5.30 ± 0.54 a	30.10 ± 0.69 bc	6.30 ± 0.34 ab
2 day old	4.40 ± 0.27 ab	29.90 ± 0.84 c	6.50 ± 0.27 ab
3 day old	3.30 ± 0.37 b	34.10 ± 0.62 a	5.50 ± 0.50 b
4 day old	3.70 ± 0.40 b	31.30 ± 0.37 abc	6.50 ± 0.43 ab
5 day old	3.20 ± 0.36 b	32.90 ± 1.04 ab	7.90 ± 0.71 a
	F = 4.9097	F = 5.255	F = 3.3493
	P = 0.0023	P = 0.0006	P = 0.0175

*The difference between the means bearing the same letter is insignificant at the level of 5%.

The average day of pre-oviposition period for the 1,2, 3, 4, and 5-day old male were 5.30, 4.40, 3.30, 3.70 and 3.20, respectively. According to this data, there is statistically significant difference in the period of the female pre-oviposition period for the different age of male ($P<0.05$).

The post-oviposition period is similar to the pre-oviposition as the average days for the 1, 2, 3, 4, and 5-days old male were 6.30, 6.50, 5.50, 6.50 and 7.90, respectively. Similarly, like preoviposition period, there is statistically significant difference in the period of the female pre-oviposition period for the different age of female ($P<0.05$).

Similarly, like the pre-oviposition and post-oviposition period, the oviposition period was significantly different according to the different mating age of male (F: 5.255; $p<0.05$) (Table 4.4). The average days of the female oviposition period for the 1, 2, 3, 4, and 5-day old male were 30.10, 29.90, 34.10, 31.30 and 32.90, respectively. The 3 and 5-days old male were provided the longest female oviposition period with 34.10 and 32.90, respectively.

4.4. The Effect of Different Ages of the Male of *Anthocoris minki* on Egg Number, Reproduction Rate and Lifespan

The effect of different ages of the male mated with fix aged female (3 day old) of *A. minki* on total and average egg numbers laid by female according to the lifespan and oviposition period obtained from the study were given in (Table 4.5).

Table 4.5. The effect of different ages of the male of *Anthocoris minki* on the female egg number

Male age (day)	Number of eggs (lifespan)	Average number of eggs during lifespan	Average number of eggs during oviposition (Reproduction rate)
1 day old	112.5 ± 5.92 a	2.25 ± 0.12 a	3.73 ± 0.15 a
2 day old	109.6 ± 6.86 a	2.19 ± 0.14 a	3.66 ± 0.19 a
3 day old	112.2 ± 6.36 a	2.24 ± 0.13 a	3.28 ± 0.16 a
4 day old	109.4 ± 6.63 a	2.19 ± 0.13 a	3.48 ± 0.18 a
5 day old	107.4 ± 4.02 a	2.15 ± 0.08 a	3.30 ± 0.17 a
	F = 0.1240 P = 0.9731	F = 0.1172 P = 0.9757	F = 1.3966 P = 0.2504

*The difference between the means bearing the same letter is insignificant at the level of 5%.

Total number of eggs during the lifespan for the 1, 2, 3, 4, and 5-days old male were 112.5, 109.6, 112.2, 109.4 and 107.4, respectively. There is no statistically significant difference in the total number of eggs during the lifespan for the different age of male (P>0.05).

Similarly, the average number of eggs laid by female during the lifespan for the 1, 2, 3, 4, and 5-days old male were 2.25, 2.19, 2.24, 2.19 and 2.15, respectively. There is no statistically significant difference in the total number of eggs laying by female during the lifespan for the different age of male (P>0.05).

Likewise, the average number of eggs laid by female during the oviposition for the 1, 2, 3, 4, and 5-days old male were 3.73, 3.66, 3.28, 3.48 and 3.30, respectively.

There is no statistically significant difference in the average number of eggs laid by female during the oviposition for the different age of male (P>0.05).

The 1 and 3-days old male were provided the highest number of eggs laid by female during the lifespan with 112.5 and 112.2 eggs, respectively. Similarly, for the average number of eggs during lifespan 2.25 and 2.24 eggs, respectively. Which is very important for the mass rearing of *A. minki*. where the highest average number of eggs laid by female during the oviposition period was obtained when 1 and 2-days old male mated with fixed aged female (3-day old).

Table 4.6. The effect of different ages of the male of *Anthocoris minki* on lifespan

Male age (day)	Female lifespan (day)	Male lifespan (day)
1 day old	42.70 ± 0.62 ab	12.00 ± 0.26 bc
2 day old	41.80 ± 0.88 b	14.20 ± 0.47 a
3 day old	43.90 ± 0.94 ab	14.00 ± 0.61 ab
4 day old	45.00 ± 0.61 a	12.90 ± 0.64 abc
5 day old	45.10 ± 0.86 a	11.00 ± 0.60 c
	F = 3.2937	F = 6,3805
	P = 0.0189	P = 0,0004

*The difference between the means bearing the same letter is insignificant at the level of 5%.

The number of lifespan days for the 1, 2, 3, 4, and 5-days old male were 12.00, 14.20, 14.00, 12.90 and 11.00, respectively. There was statistically significant difference in the total length of lifespan for the different age of male (P<0.05). The fix aged (3-day) female lifespan were 42.70, 41.80, 43.90, 45.00 and 45.10, respectively when mated with male in different age and they were different from each other statistically (P<0.05) (Table 4.6).

5.CONCLUSION and RECOMMENDATIONS

5.1. Conclusions

In this study, it is aimed to determine the sexual maturity of predatory insect *A.minki*. In the scope of the study, the effect of the sexual maturity of predatory insect *A. minki* female and male on the pre-oviposition, oviposition and post-oviposition periods, total and average egg number, reproduction rate and lifespan were investigated.

As a result of the study, fix aged (3-day old) females had statistical differences in the preoviposition, oviposition and postoviposition periods when mated with different ages (1, 2, 3, 4, 5-day old) of male of *A. minki*. Similarly, there was statistical difference in the Pre-oviposition, Oviposition and Post-oviposition Periods for different ages (1, 2, 3, 4, 5-day old) of female of *A. minki* when mated with the fix aged (3-day old) male.

Short preoviposition period, long oviposition period and maximum egg number were the most preferred criterion in mass rearing of biological agents such as predators. In this study, the shortest preoviposition period, the longest oviposition period and the maximum egg number were 2.70 days, 36.90 days, 144.4 eggs, respectively for the 4-day old female when mated with fix aged (3-day) old male.

5.2. Recommendations

As a result of the study, it was determined that the most suitable age for mating of female was 4-days old and for male is 3-days old in mass rearing and scientific research studies to reach the preferred oviposition period and maximum number of eggs. Therefore, in scientific research studies, *A. minki* individuals should not be mated as soon as they reached maturity.

REFERENCE

ALTIN, M., YÜCEL, A. and BOLU, H., 1992. Güneydoğu Anadolu Projesi (GAP) uygulama sahası antepfıstığı alanlarında entegre mücadele çalışmaları öncesi zirai mücadelenin bugünkü durumu, karşılaşılan sorunlar ve çözüm yolları, Uluslararası Entegre Zirai Mücadele Sempozyumu, İzmir, ZMAE Müdürlüğü, 15-17 Ekim, İzmir.

ANONYMOUS, 2019. Invasive Species Compendium. www.cabi.org/isc/datasheet/21412. (Access date: 24/12/2019)

BOLU, H. ve KORNOŞOR, S., 1995. Şanlıurfa ilinde iki farklı antepfıstığı çeşidinde *Agonoscena pistaciae* Burckhardt and Lauterer (Homoptera: Psyllidae) nin populasyon değişimi. GAP Bölgesi Bitki Koruma Sorunları ve Çözüm Önerileri Sempozyumu, 27-29 Nisan, Şanlıurfa, 165-176.

BOLU, H., KORNOŞOR, S., ve ALTIN, M., 1999. Güneydoğu Anadolu Bölgesi'nde Antepfıstığı (*Pistaciae vera* L.) alanlarında bulunan *Agonoscena pistaciae* Burckhardt and Lauterer (Homoptera: Psyllidae) ve avcı Heteroptera türleri ile nimf parazitoidinin populasyon değişimlerinin belirlenmesi. Türkiye 4. Biyolojik Mücadele Kongresi, 26-29 Ocak, 7-16, Adana.

BULUT, H. ve KILINÇER, N., 1987. Yumurta Paraziti *Trichogramma* spp. (Hymenoptera: Trichogrammatidae)'nin Un Güvesi (*Ephestia kuehniella* Zell.) (Lepidoptera: Pyralidae) Yumurtalarında Üretimi ve Konukçu Parazitik İlişkileri. Türkiye I. Entomoloji kongresi, 12-14 Şubat, İzmir, s.13-16.

ÇELİK M. Y., 1981. Gaziantep ve çevresinde antep fıstıklarında Psylloidea'ya Bağlı Önemli Zararlı Türlerin Tanınmaları, Yayılışları, Konukçuları, Kısa Biyolojileri ve Doğal Düşmanları Üzerinde Araştırmalar. T.C. Tarım ve Orman Bakanlığı Araştırma Eserleri Serisi, No. 51, Ankara, 108s.

DEMİRSOY, A., 2006. Yaşamın Temel Kuralları, Omurgasızlar / Böcekler, Entomoloji. Cilt II / Kısım II Meteksan A.S., Ankara, 960s.

HEMPTINNE J.L., DIXON A.F.G., ADAM B. 2001, Do Males and Females of the Two-Spot Ladybird, *Adalia bipunctata* (L.), Differ in When They Mature Sexually? Journal of Insect Behavior, Vol. 14, No. 3.

HORTON, D., HİNOJOSA, T., and LEWİS, T., 2000. Mating Preference, Mating Propensity, and Reproductive Traits in *Anthocoris nemoralis* Fabricius (Heteroptera: Anthocoridae): A Comparison of California and United Kingdom Populations. Annals of the Entomological Society of America, 93(3):663-672.

KARAKUŞ, H., 2018, Determination of suitable nutrient thickness and egg spreading amount in mass rearing of the Mediterranean flour moth, *Ephestia kuehniella* zeller (Lepidoptera: Pyralidae). MSc. Thesis, Harran University, Page: 33.

MAMAY, M. and RAT, I., 2019. Determination of suitable egg laying material in mass rearing of predator A*nthocoris minki* Dohrn (Hemiptera: Anthocoridae) in biological management. World Conference on sustainable Life sciences (WOCOLS), June 30- July 07, Budapest/Hungary, 27.

MART, C., and KARAAT, S., 1990. Güneydoğu Anadolu Bölgesi antepfıstığı alanlarında entomolojik sorunlar. Türkiye I. Antepfıstığı Sempozyumu. 11-12 Eylül, Gaziantep.

MART, C., UYGUN, N., ALTIN, M., ERKILIÇ, L. and BOLU, H. 1995. General review on the injurious and beneficial species and pest control methods used in pistachio orchards of Turkey. ActaHorti culturae, 419, 379–385.

MEHRNEJAD, M. R., 2001. The current status of pistachio pests in Iran. Options Méditerranéennes- CIHEAM, 56: 315-322.

ÖNCÜER, C. 1995**.** Tarımsal zararlılarla savaş yöntemleri ve ilaçları. Ege Üniversitesi Basımevi, İzmir, s.333.

ÖNDER, F., 1982. Türkiye Anthocoridae (Heteeroptera) Faunası Üzerinde Taksonomik ve Faunistik AraĢtırmalar. Ege Üniversitesi Ziraat Fakültesi Yayınları no: 459 Bornova-Izmir. 159 s.

ÖZDER, N., SAĞLAM, Ö., 2002. Derin dondurucuda depolanmış *Ephestia kuehniella* Zell. (Lep.; *Pyralidae*) yumurtalarından elde edilen *Trichogramma cacoeciae* March. (Hym.; Trichogrammatidae)nin bazı biyolojik özellikleri. Türkiye 5. Biyolojik Mücadele Kongresi Bildirileri. Atatürk Ünv. Ziraat Fak. Bitki Koruma Böl., Erzurum, 181 – 188. Türkiye

PERVEZ, A., OMKAR and RICHMOND, A. S. 2004. The influence of age on reproductive performance of the predatory ladybird beetle, *Propylea dissecta*. 8pp. Journal of Insect Science, 4:22.

SRIVASTAVA, S. and OMKAR, 2004. Age specific mating and reproductive senescence in seven spotted ladybird *Coccinella septempunctata*. J. Appl. Entomol. 128: 452-458.

SÖNMEZ, C. 2016. Influence of maternal age on reproductive potential of *orius laevigatus* (Hemiptera: Anthocoridae) under laboratory condition. MSc Thesis, Harran University. Page: 23.

SOULIOTIS, C., MARKOYIANNAKI-PRINZIOU. D. and LEFKADITIS, F., 2002. The problems and prospects of integrated control of *Agonoscena pistaciae* (Hom.,Sternorrhyncha) in Greece. Journal of Applied Entomology, 126: 384- 88.

TAGALDEEN, A. 2015, the mating behavior of predator bug anthocoris minki dohrn (heteroptera: anthocoridae), MSc Thesis, Harran University. Page: 23.

VAN LENTEREN, J. C., 2000. Measures of success in biological control of arthropods yaugmentation of natural enemies, Kluwer Academic Publishers, 77-103.

YANIK, E. and UĞUR, A., 2002. Avcı *Anthocoris nemoralis* (F.) (Heteroptera: Anthocoridae)in laboratuar koşullarında yetiştirilmesi ve bazı biyolojik özelliklerinin belirlenmesi üzerinde araştırmalar. Türkiye V. Biyolojik Mücadele Kongresi, 3-7 Eylül, Erzurum, 109-116.

YANIK E., ÜNLÜ L. and YÜCEL A. 2007. Antepfıstığında *Agonoscena pistaciae* Burck. and Laut. (Hom.: Psyllidae)'nın biyolojik mücadelesinde *Anthocoris minki* Dohrn (Het.: Anthocoridae)'nin kitle üretimi ve salımı. Türkiye II. Bitki Koruma Kongresi Bildirileri, 27-29, Isparta, s.10. (Özet).

YANIK, E., and UNLU, L., 2010. The effects of different temperatures and relative humidity on the development, mortality and nymphal predation of *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae). Phytoparasitica, 38: 327–335.

YANIK, E., and ÜNLÜ, L., 2011. Influences of Temperature and Humidity on The Life History Parameters and Prey Consumption of *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae). Appl Entomol Zool, 46:177–184.

YÜCEL, A., ÖZPINAR A., GÜLDÜR, M.E., YANIK, E., ÜNLÜ, L., BÜKÜN, B., EF8L, L., and GÜNES, A., 2000. Güneydoğu Anadolu Projesi (GAP)Bölgesinde Antepfıstığında Entegre Mücadele Sisteminin Yerleştirilmesi Üzerinde Araştırmalar. Türkiye Tarımsal Araştırma Projesi Sempozyumu,20-21 Eylül, s.22-23, Şanlıurfa.

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ALRAMADAN, Y. and MAMAY, M. 2019. The Importance of Entomopathogenic Fungi in the Control of Agricultural Pests and Promising Fungal Entomopathogens

in the Field Application. 1st International Gobeklitepe Agriculture Congress, 25-27 November, Şanliurfa, p.30-34.

ALRAMADAN, Y., MAMAY, M. 2019. The Importance of Entomopathogenic Nematode and their Role in the Control of Agricultural Pests. 1st International Gobeklitepe Agriculture Congress, 25-27 November, Şanliurfa, p.35-41.

ALRAMADAN, Y., MAMAY, M. 2019. What is the Role of Entomopathogenic Viruses in the Control of Agricultural Pests and their Future in the Field Application? 1st International Gobeklitepe Agriculture Congress, 25-27 November, Şanliurfa, p.42-47.