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Orijinal araştırma (Original article)

Evaluation of the efficacy of different traps in capturing apple blossom beetle (*Epicometis hirta* (Poda, 1761)) (Coleoptera: Scarabaeidae)

Bakla zınnı (*Epicometis hirta* (Poda, 1761)) (Coleoptera: Scarabaeidae)'nın farklı tuzaklarla yakalanma etkinliğinin değerlendirilmesi

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Summary

This study was conducted to determine the most effective traps for capturing *Epicometis hirta* (Poda, 1761) (Coleoptera: Scarabaeidae) on the flowers of plum and pear trees in Yalvaç county of Isparta province in 2010. Different blue plastic traps (Sticky plate trap, funnel plus water and large bowl plus water) and also an attractant containing cinnamyl alcohol, trans - anethol, dipropylene glycol and 2 - propanol, 1, 1 - oxybis as a commercial preparation were used in the present study. Four different selected sites were chosen for each plum and pear orchard. The most individuals were captured in third pear orchard site followed by fourth pear orchard site. The highest number of beetles was captured by the blue funnel water traps with attractant in the pear orchards. The most individuals were captured in the fourth and second orchards in plum and pear, respectively. The highest number of beetles were captured by the blue funnel plus water traps with attractant in both plum and pear orchards. Result of our study showed that using of a blue funnel trap with an attractant is an effective biotechnical method for controlling *Epicometis hirta* on various trees when insecticide cannot be applied during the blooming period.

Key words: Pear, plum, attractant, funnel, trap, *Epicometis hirta*

Özet

Bu çalışma, erik ve armut ağaçlarındaki Bakla zınnı (*Epicometis hirta*) (Poda, 1761) (Coleoptera: Scarabaediae)'nın farklı tuzaklarla yakalanma etkinliğinin araştırılması amacı ile Isparta İli, Yalvaç İlçesi'nde 2010 yılında yürütülmüştür. Çalışmalar toplam 4'er adet erik ve armut bahçesinde, farklı mavi plastik tuzaklar (yapışkan levha, huni+su ve leğen+su) ve ayrıca cinnamyl alcohol, trans - anethol, dipropylene glycol ve 2 - propanol, 1, 1 – oxybis maddelerini içeren ticari preparatlar kullanılarak yürütülmüştür. En fazla ergin armutlarda 3 no'lu, eriklerde ise 2 no'lu bahçeden elde edilmiştir. Adı geçen bahçelerin her ikisinde de en fazla ergin "çekici+mavi huni+su" kullanılan tuzaklarla yakalanmıştır. Çalışma sonuçları, mavi huni tuzaklarının çekici ile birlikte kullanılması durumunda, insektisitlerin uygulanmasının sakıncalı olduğu çiçeklenme döneminde bu böceği baskı altına almada etkili bir biyoteknik yöntem olarak kullanılabileceğini göstermektedir.

Anahtar sözcükler: Erik, armut, çekici, huni tuzak, *Epicometis hirta*

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Introduction

While *Epicometis hirta* distributes in the Palaearctic spend the winter period in soil during its larval and adult stages in Turkey, spend only the winter in the soil as adult stage in Central Europe (Endrödi, 1956; Anonymous, 2009). Larval stage of the species feeds rotting plant materials. Adult is more harmful than its larval stage because it feeds on stamens and pistils of the flowers of various plants (Kara, 1992; Milenkovic & Stanisavljevic, 2003; Ertop & Özpinar, 2011; Perez & Traveset, 2011).

The adults emerging during the blossoming period of trees and other plants mostly feed on flowers in spring time. Female lays its eggs in humus - rich soils, and the larvae hatch 1 - 2 weeks after and feed on the roots of weeds. The adults are very dynamic in sunshine. Population density of adults is becoming highest at the end of the spring. In some regions the adults are active until the middle of July (Özbek et al., 1998; Anonymous, 2008; Özbek, 2008).

Adults of *E. hirta* emerge in spring and feed on male and female organ of the flowers of some plants such as fruit trees, strawberries, roses and grains. Adults also infrequently feed on young shoots, leaves and even fruits. Because of their high flying capabilities, they land on many different types of plants and continue harming. As a result, damaged flowers cannot produce fruits (İren, 1968; Anonymous, 2008; Özbek, 2008). Özbek et al. (1998) reported that coping with these insects is very challenging because blossoms are damaged; however, pesticides may be employed if the population becomes excessive. Nevertheless, this practice is neither suitable nor economically viable because the pesticide that would be used is harmful to flowers and honey bees as much as also other pollinators.

Applying biotechnical control against related species with some of the attractive color and odor lures which influence their population negatively is much better than pesticide application because of the reasons (Toth et al., 2003b & 2009; Ortu et al., 2003). It was reported that it is possible to capture this pest if (E) - cinnamyl alcohol and (E) - anethol are used in combination along with blue and white traps (Schmera et al., 2004). Modified funnel traps were also used for the trapping of related scarabs and proved to be extremely effective (Imrei et al., 2001). According to the study of Schmera et al. (2004), using light blue color traps combined with (E) - cinnamyl alcohol and (E) - anethol at a ratio of 1:1 lures these insects into captivity. Vuts et al. (2009), reported that the most effective mixture in trapping *E. hirta* consists of (E) - anethol and (E) - cinnamyl alcohol and 4 - methoxyphenethyl alcohol at a ratio of 1:1:1. Sağdaş (2011) reported that the capture of apple blossom beetle was increased significantly in apple and cherry trees by using an attractant containing cinnamyl alcohol, trans - anethol, dipropylene glycol and 2 - propanol, 1, 1 – oxybis. Also, Sivcev et al. (2006) reported that the most effective color for the capture of *E. hirta* was light blue. On the other hand, Ortu et al. (2001) reported that a different species, *Epicometis squalida* (Scopoli) was captured effectively by a white colored trap. Plant phenology related shifts in color preferences of *E. hirta* in *Prunus* spp. orchards has been recently investigated (Aydin, 2011). According to the study's results, the largest numbers of *E. hirta* were captured by floral white-colored traps in both the pre-bloom and post-bloom periods. However during the blooming period, by a significant margin the largest numbers of *E. hirta* were caughted by the light sky-blue-colored traps. Sağdaş (2011), proposed that use of a blue funnel trap plus water together with an attractant is an effective biotechnical method for controlling *E. hirta.*

The controlling of these insects in this region has not been possible for years, but some farmers have been known to use blue bowls and others- although very few- use blue funnels. The aim of this study was to determine which type of trap is more effective in capturing apple blossom beetle, and to determine the effect of the use of this lure on the pest on plum and pear trees.

Materials and Methods

Pear and plum orchards were chosen in Isparta Province, Yalvaç County between 29 March and 21 May in 2010. Pear and plum orchards consisted of Deveci, Williams, and Stanley, Birton varieties, respectively. A blue sticky plate, a bowl, a funnel and an attractant were used to capture the insects. Upper diameter of funnels was 22 cm, lower hole diameter was 5 cm, lower diameter of bowls was 36 cm and their upper diameter was 48 cm. The size of the rectangular plates was 24 x 20 cm (Figure 1). Diligence was required in order to ensure that the blue colors used in this study matched the shade of blue known as Picasso blue #0276FD in the Hex Hub (Named Hexadecimal Color Codes for HTML). All the traps were checked and counted at least three times weekly until no insects could be caught. The study was conducted in four locations for both pear and plum trees and with at least one kilometer between each location. The ages of pear orchards were between 10-15, 10-15, 5-7 and 5-7 years, in locations I, II, III and IV, respectively. The ages of plum orchards were between 7-9, 8-10, 7-8 and 4-6 years, in locations I, II, III and IV, respectively. For this study a blue sticky plate, a bowl and a funnel were placed side by side with a distance of 1 km between them at each location and there being no pesticide having been applied during the blooming period. Similarly, those traps containing a lure were placed in each location at least 50 m apart from the other traps to prevent any interaction. Each of four orchards was equipped totally with six traps. Three of them contained a lure. A 5 L polyethylene bottle containing water at a ratio of 1/3 was put under each funnel. Then, very small holes through which insects could not escape were drilled on the upper part of the bottle at a ratio of 1/3 so as to allow for excess water pouring out during rainy periods. Afterwards, traps with a funnel were attached to branches of the trees by binding them with wires. Next, bowls were filled with water at a ratio of 1/3 as was done in the case of the funnels and placed on the ground. Sticky plates were hung among the branches of trees with the help of wires.

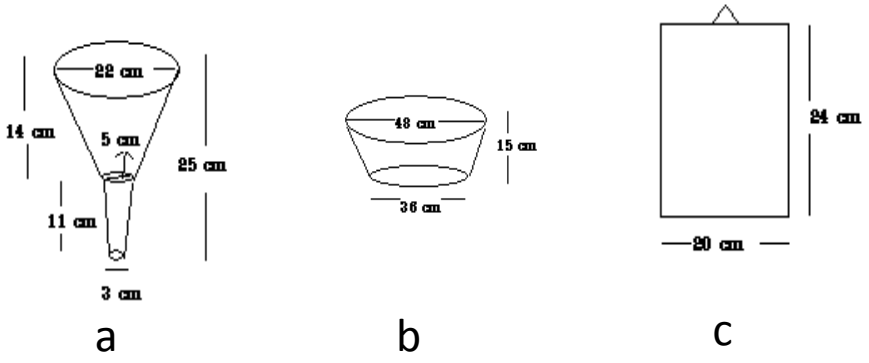

Figure 1. The trap sizes used present study. a) Funnel b) Bowl c) Sticky plate.

Lures, which were used in traps, were hung by a wire from the upper part of the traps up to middle part of them. Commercial lures used in the study contained (*E*) - anethol, (*E*) - cinnamyl alcohol, 2 - propanol, 1, 1 - oxybis and dipropylene glycol.

Weeds in the orchards were removed before they began to inhibit the visibility of the traps and to prevent coverage. The locations were checked three times per week and the captured insects were counted. They were killed by using potassium cyanide in killing bottles and labeled according to their sex.

Relevant locations, trap type and date were written on each label and the sexes were separated under a binocular microscope by removing their genitalia. The sexual index was calculated by the formula; females / total beetles, for each location and also traps.

The results were assessed through the analysis of variance (ANOVA) technique which is a collection of statistical models, and their associated procedures, in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation. The data obtained by counting under different conditions with respect to the properties under study, were made subject to $\sqrt{(x + 3/8)}$ transformation and analyzed through the unidirectional variance analysis technique. The DUNCAN test was used to find the difference between the means of the groups.

Results and Discussion

In present study in pear and plum orchards in Yalvaç County in Isparta province in Turkey, he emergence of the first apple blossom beetle was observed on March 29th, 2010 at an average temperature of 8 ^{0}C with a 60% relative humidity in the traps.

Adults of apple blossom beetle in plum orchards were collected in a ratio of 52%, 21%, 18% and 9% in location IV, II, III and I, respectively. The highest number of beetles captured in pear orchards was achieved in location III. The possible reasons for this may be due to the fact that the trees in this orchard are younger (5-7 years old) than the other orchards. Another reason may have been that this orchard is located near uncultivated areas. The differing results in the other orchards were found to be statistically significant ($P < 0.05$) (Table 1).

Adults of apple blossom beetle in pear orchards were collected in a ratio of 43%, 25%, 23% and 9% in location III, IV, I and II, respectively. The highest number of beetles captured in pear orchards was achieved in locations III. The possible reasons for this may be due to the fact that the trees in this orchard are younger (5-7 years old) than the other orchards and also to be made the organically farmer in that orchard. The differing results in the other orchards were found to be statistically significant ($P < 0.05$) (Table 1). Secondly, the close results were obtained from pear orchards in locations I and IV in spite of existing young trees (4-6 years old), as well.

Table 1. Mean number of adults of blossom beetles captured daily by all traps in each location in plum and pear orchards

Locations	Number of adults (Means ± SE)/trap/day*				
	n	Plum orchards		Pear orchards	
I	28	0.89 ± 0.28	b	7.96 ± 2.35	ab
II	28	2.03 ± 0.74	ab	3.14 ± 1.07	b
III	28	1.67 ± 0.72	b	15.00 ± 7.07	a
IV	28	4.89 ± 1.38	a	8.82 ± 3.32	ab

*Means within a column followed by a different letter are significantly different (DUNCAN test; $P < 0.05$).

During the present study, the highest number of caught insects in plum orchards was obtained by funnel + lure traps in location IV. The differing results in the other traps were found to be statistically significant ($P < 0.05$) (Table 2), for this location. The same result was obtained through the traps in location I. On the other hand, the most insects in the second location were captured by only funnel trap. Also, equal numbers of insects were captured by both funnel + lure and funnel traps at the third location.

The differing results in the other traps were statistically significant (P < 0.05) (Table 2). The funnel traps with and without lures were found to be more effective than the other traps in all plum orchards.

During the study, the beetles were captured by the funnel + lure traps in a ratio of 59%, the only funnel traps traps in a ratio of 27% , the bowl + lure traps traps in a ratio of 9% and the only bowl traps traps in a ratio of 4% in all plum locations.

Sticky plates captured very few specimens in any of the plum locations so statistical analyses were not conducted.

Table 2. Mean numbers of adults of blossom beetle daily captured by the different traps in each plum location

Traps	n	Number of adults (Means ± SE)/trap /day*							
		Location I		Location II		Location III		Location IV	
Funnel	28	0,25 ± 0,08	ab	1,00 ± 0,36	a	0,78 ± 0,34	a	0,53 ± 0,30	b
Sticky plate	28	0,00 ± 0,00	b	0,00 ± 0,00	c	0,00 ± 0,00	b	0,07 ± 0,04	c
Bowl	28	0,03 ± 0,03	b	0,17 ± 0,14	b	0,10 ± 0,05	ab	0,07 ± 0,04	c
Funnel + lure	28	0,53 ± 0,24	a	0,85 ± 0,37	a	0,78 ± 0,38	a	3,46 ± 1,19	a
Sticky plate + lure	28	0,00 ± 0,00	b	0,00 ± 0,00	c	0,00 ± 0,00	b	0,00 ± 0,00	c
Bowl + lure	28	0,07 ± 0,07	b	0,00 ± 0,00	c	0,00 ± 0,00	b	0,75 ± 0,38	b

*Means within a column followed by a different letter are significantly different (DUNCAN test; P < 0.05).

During the present study, although the highest number of caught insects in pear orchards in location III was obtained by funnel traps without lure, there was no difference between the funnel + lure and funnel without lure (P < 0.05) (Table 2) The differing results among these traps and the other traps were statistically significant (P < 0.05) (Table 2) for this location. The highest numbers of the insect were obtained by the funnel + lure traps in locations I and III. The results in the other traps in locations I and II were found to be statistically significant (P < 0.05) (Table 2). Also, equal numbers of insects were captured by both the funnel + lure and the funnel without lure in the fourth location. The funnel traps with and without lures were found to be more effective than the other traps in all pear orchards.

Table 3. Mean number of adult blossom beetles captured daily by different traps ateach pear location

Traps	n	Number of adults (Mean ± SE)/trap/day*							
		Location I		Location II		Location III		Location IV	
Funnel	24	1,07 ± 0,34	b	0,60 ± 0,23	ab	8,11 ± 4,16	a	2,46 ± 0,96	a
Sticky plate	24	0,03 ± 0,03	c	0,00 ± 0,00	c	0,07 ± 0,04	c	0,00 ± 0,00	b
Bowl	24	1,00 ± 0,54	c	0,32 ± 0,20	b	0,67 ± 0,43	b	2,75 ± 1,35	a
Funnel + lure	24	5,58 ± 2,03	a	2,10 ± 0,86	a	5,64 ± 2,53	a	2,46 ± 0,83	a
Sticky plate + lure	24	0,00 ± 0,00	c	0,00 ± 0,00	c	0,00 ± 0,00	c	0,00 ± 0,00	b
Bowl + lure	24	0,29 ± 0,22	c	0,10 ± 0,10	c	0,50 ± 0,00	c	1,14 ± 0,69	ab

*Means within a column followed by a different letter are significantly different (DUNCAN test; P < 0.05).

During the study, the beetles were captured by the funnel + lure traps in a ratio of 45%, the only funnel traps in a ratio of 35% , the only bowl traps traps in a ratio of 14% and the bowl + lure traps traps in a ratio of 6% in all pear locations.

Sticky plates captured very few specimens in any of the plum locations so statistical analyses were not conducted.

During the study, number of females was higher than males in all traps in pear locations. The sex ratios were found to be 0.63, 0.62, 0.60 and 0.54 in locations I, II, IV and III, respectively. The same results were obtained from plum locations. While the sex ratios were found to be 0.68, 0.56 and 0.55 in locations II, I and IV, respectively, however, it was found as 0.40 in location III,

Table 4. The mean number of females and males of the apple blossom beetle daily captured by the different traps in all plum and pear orchards

Traps	Number of adults (Means ± SE)/trap/day*			
	Plum orchards		Pear orchards	
	♂	♀	♂	♀
Funnel	1,18±0,30 b	1,39±0,46 b	5,75±2,03 a	6,50±3,13 ab
Bowl	0,18±0,07 c	0,21±0,12 c	1,54±0,60 b	3,21±1,24 b
Funnel + lure	2,39±0,68 a	3,25±1,00 a	6,57±2,33 a	9,21±2,90 a
Bowl + lure	0,43±0,29 bc	0,39±0,13 c	0,71±1,65 c	1,32±0,61 c

*Means within a column followed by a different letter are significantly different (DUNCAN test; P < 0.05).

The results among traps in both pear and plum orchards were found to be statistically significant (P < 0.05) (Table 4). The most numbers of adult were captured in funnel + lure traps for all orchards.

The funnel + lure traps generally captured more beetles than the other traps in both plum and pear orchards and he differences between them were statistically significant in both of plum and pear orchards. (P < 0.05) (Table 5). Secondly, the funnel traps without lures were more effective than the bowl traps in catching the beetle.

Table 5. Mean numbers of adults of blossom beetles daily captured by traps with and without lures in both plum and pear orchards

Traps	Number of adults (Means ± SE)/trap/day*			
	Plum orchards		Pear orchards	
Funnel	2,57±0,71	b	12,25±5.08	ab
Bowl	0,39±0,17	c	4,75±1.67	b
Funnel + lure	5,64±1,64	a	15,79±5.07	a
Bowl + lure	0,82±0,38	bc	2,04±0.83	c

*Means within a column followed by a different letter are significantly different (DUNCAN test; P < 0.05).

The results of the present study were similar to the study of Toth et al. (2003a) as regards lures using (*E*) - cinnamyl alcohol and (*E*) - anethol at a ratio of 1:1 being effective in capturing *E. hirta.* Vuts et al. (2009) stated that combining (*E*) - anethol, (*E*) - cinnamyl alcohol and 4 - methoxyphenethyl alcohol, the most common lure for *E. hirta,* at a ratio of 1:1:1, increased the rate of capture significantly. The commercial preparation, which was provided for present study in aready - to – use form, contains 2 - propanol, 1,1 - oxybis and dibutylene glycol, in addition to (*E*) - anethol and (*E*) - cinnamyl alcohol. Also,

Sağdaş (2011) indicated that the capture of the same beetle increased significantly in apple and cherry trees with the same lure used in the present study.

According to results of the present study, the highest number of beetles captured in pear orchards was achieved in location III. The possible reasons for this may be due to the fact that the trees in this orchard are younger than in the others and that it is an organic orchard. That contention is supported by Kutinkova & Andreev (2004) who reported that *E. hirta* can cause damage of up to 70% in young cherry trees in Bulgaria. Also, Sağdaş (2011) indicated that this beetle is more harmful on younger trees than old ones in Turkey.

The same results were obtained from plum orchards. The highest numbers of beetles were captured in location IV. The same reasons for this orchard may be due to the fact that the trees are younger than the others. On the other hand, the other reason may have been that this orchard is located near uncultivated or grain growing areas. Schmera et al. (2004) reported that the adults of *E. hirta* feed non - agricultural area such as the meadows in Hungary. Also, Sağdaş (2011) reported that this beetle was captured much more near uncultivated or grain growing areas in Turkey.

In this study, 978 adults were captured in all pear orchards from all traps whereas in the plum orchards only 266 individuals were captured between 29 March and 21 May in 2010. Sağdaş (2011) stated that this beetle was captured much more frequently in cherry orchards than apple orchards in Turkey. These findings infer that the flowers of some trees may be more attractive than others to this beetle.

Schmera et al. (2004), noted that the sex ratio did not differ in traps and that the male to female ratio decreased as the season progressed. Nonetheless, during the study, the numbers of females captured in pear and plum locations were higher than males in all traps. The mean of sex ratios was found to be 0.60 in pear and 0.55 in plum orchards. Sağdaş (2011) stated that the mean of sex ratios of *E. hirta* captured by all traps were 0.61 in apple and 0.79 in cherry orchards in Turkey. It therefore appears that the females of this beetle prefer the flowers of some trees much more than the males.

In addition that both females and males were captured in funnel + lure traps for all orchards. Also, the similar results for the beetle were expressed in cherry and apple orchards in Turkey by Sağdaş (2011).

The funnel + lure traps at bothf pear and plum locations captured the most adults. Hence the funnel trap may be more effective trap than the rest of the traps used in the present study. Also, Vuts et al. (2010) captured *E. hirta* in CA – baited traps, generally..

This is the advantage of using funnel traps because the beetle cannot easily escape from funnel trap.

In conclusion, the most apple blossom beetles were captured in blue funnel traps in the present study and that the blue bowls that farmers usually use, are not the most effective to capture adults of *E. hirta*. However, it should be noted that the water under funnels and in bowls is another significant factor in attracting these species since the blue flapped sticky traps captured hardly any adult beetles at all. In addition, commercial lures, which are manufactured in Turkey, increased the number of beetles captured by 3-4 times in the orchards.

It is clear that the number of beetles captured in the pear and plum orchards depends on the age of the trees and on whether the orchards is near uncultivated or grain growing areas. It is also possible to

say that this species prefers pear trees' flowers much more than plum trees'. Use of a blue funnel which has a bottle with water plus a lure is an effective and inexpensive biotechnical method in the blooming period, especially for young trees, in controlling this insect since pesticides cannot be used at this time. Unfortunately, this lure is not easily obtained so only the blue funnel trap under apolyethylene bottle containing water is available for capturing this insect effectively.

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