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The Effects of Traps Hung in Different Places in the Cherry Orchard on the Capture and Flower Damage of *Tropinota* (*Epicometis*) *hirta* (Poda, 1761) (Coleoptera: Cetoniidae)

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Research Article

Abstract - In this study, the trapping effect of light blue traps suspended in the cherry orchard and also in four different directions was determined by using attractants of *Tropinota hirta* (Coleoptera: Cetoniidae) causing economic damage on the flowers of cherry trees. 1:1 ratio of trans-cinnamyl alcohol + trans-anethol included chemical attractants were used in all traps. All attractants were dripped on dental cottons by micro pipette. These cottons were placed in closed plastic falcon tubes of 3x13 cm dimensions with 0.3 mm diameter holes on the sides. Traps with attractants and water beneath them were located in the outer part of the orchard and on tree branches in all directions; They were hanged 1.5 m above the ground on the wire where attached to two poles in the middle of a row in the orchard and on one branch of five trees in the inside of the orchard. The number of trapped adults and the number of intact flowers on the same trees were recorded and they were compared with each other. As a result, the number of adult insects caught in traps where hung on wires in the orchard was higher. The number of intact flowers on all the trap-hung trees was higher than on the trees in the controls. In addition, as a result of hanging the traps on the trees, the rate of shedding of the flowers was higher.

Keywords: *Blue funnel, cherry, direction trap, Tropinota hirta*

1. Introduction

Tropinota hirta is a harmful species because it feeds on the reproductive parts of flowers, such as fruit trees, ornamental trees, shrubs and other plants. It can also cause damage to cereals (Toth, Schmera, & Imrei, 2004). Studies have found that *T. hirta* caused damage on the flowers of rose, cherry, apple, apricot, plum, peach, raspberry, blackberry, and spring blooming fruit trees (Schmera et al., 2004; Vuts, Szarukan, Subchev, Toshova, & Toth, 2009; Yaşar & Uysal, 2013; Güvenç & Yaşar, 2014). *Tropinota hirta* is harmful not only during the flowering period but also on the buds. This pest sterilize the plants by chewing their petals, stamens and stigmas of the flowers (Vuts et al., 2009).

Tropinota hirta can be seen in almost all of Europe, especially in Central and Eastern Europe, and in the north of Africa. Countries where *T. hirta* is frequently seen are Austria, Bosnia and Herzegovina, Croatia, Ukraine, Germany, France, Switzerland, Italy, Czech Republic, Slovakia, Albania, Hungary, Bulgaria, Lithuania, Poland, Portugal, Romania, Belarus, Greece, Spain, Turkey, Cyprus and Morocco (Catalogue of life, 2018; Anonymous, 2018). Stanek (1984) reported that this pest is common throughout Europe, Northern Asia, and North Africa. Although it is reported that this species is found in Adana, Afyonkarahisar, Ankara, Bursa, Çanakkale, Elazığ, İzmir, Isparta, Malatya, Mardin, Mersin, Kahramanmaraş, Karaman, and Yalova provinces in our country, it is thought that it is possible to find it in other provinces where no study have been conducted

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(Öztürk, Ulusoy, Erkılıç & Bayhan, 2004; Çetin, Hantaş & Erenoğlu, 2006; Bahadıroğlu, Akıncı & Kalkar, 2007; Özcan, 2008; Sağdaş & Yaşar, 2013; Gezer & Özpınar, 2015).

It is easier to control of the adults than their larvae because they live under the ground. However, it is very difficult to chemical control *T. hirta*. Because agricultural pesticides cannot be used during flowering not to affect negatively the honey bees and other pollinating insects. For this reason, in the control of this pest collectively catch adults by an efficient trapping system is an important alternative method. This pest can be controlled by traps using chemical and visual attractants. In the study, it was seen that blue colored traps were successful in controlling of this pest (Schmera et al., 2004).

It was reported that this pest can be caught by white or blue traps (Toth, Klein, & Imrei 2003; Toth et al., 2004). Schmera et al. (2004) put forth that this species was catched by the mixture of trans-cinnamyl alcohol and trans-anethol in a 1:1 ratio and it was a strong tendency towards blue colored traps. Vuts et al. (2009) noticed that using 1:1:1 ratio of trans-anethol, trans-cinnamyl alcohol and 4-methoxyphenethyl alcohol is the most effective mixture to catch Apple blossom beetle. Jozsef (2010) reported in his study that the effectiveness of traps which used against the adults of *T. hirta* can be increased with chemical attractants. Mitko, Teodora, Radoslav, Vilina, Vasilina, Teodora, Nikolina, Petko, & Dimitar (2011) indicated that *T. hirta* adults were caught significantly by using traps with a color similar to parliamentary blue, named as "VARb3". Sağdaş & Yaşar (2013) stated that blue colored funnels with attractants used in orchards without applied any pesticides during the flowering periods can be used as an effective method to control of this pest. Yaşar & Uysal (2013) declareted that the use of an attractant together with a blue funnel filled with water was effective in catching *T. hirta* on plum and apricot trees during the flowering periods of young trees. Also, they indicated that this pest preferred plum trees much more than apricot ones because of that more adults were caught by traps in the plum orchards.

Generally, only the number of caught individuals is taken into account in the studies of trapping insects. However, in our previous studies, we observed that the insects attracted to the traps also caused damage in the surrounding plants. In this study, we were aimed to find out How many the adults of Apple blossom beetles would be caught by the traps both of the trees and on the wire. In this study, we were aimed to find out How many the adults of Apple blossom beetles may be caught by the traps in trees and on the wire. At the same time, we also tried to determine the flower damage on the trees where the traps hung.

2. Material and Methods

The material of the present study is Apple blossom beetle, which is harmful to flowers in cherry orchards, and different attractants that are used to attract this pest and dripped onto cotton in falcon tubes placed on light-colored blue funnel traps. Traps containing trans-cinnamyl alcohol + trans-anethol were used in all traps. Both of attractors were mixed in a 1:1 ratio.

The traps were hung two weeks before the trees bloomed in the cherry orchard in 2018 in Isparta Province, and the attractants were placed in the traps when the first adults were seen. Although, the effects of the attractants in the traps continued for a long time, they were replaced once in every three weeks. All the attractants used were dropped on dental cottons with high liquid absorbency and 20 mg each with the help of a micro pipette. These cottons were placed in the plastic falcon tubes at 3x13 cm dimentions with 10 holes of 0.3 mm in diameter, which the smell of attractants allow outside and also to prevent of the rain to enter inside at the same time. These tubes were perforated just under the cover part and connected to the edges of the funnels by passing a stainless wire through them. Due to their tendency for water, the adults approaching the attractants were falled into in the plastic bottle (Figure 1).

Figure 1. The blue funnel trap

All the funnels used in the study were painted with the hexadecimal code #C6DEFF and the RGB decimal code 198, 222, 255 and named as "Light steel blue 1" (Yaşar, Çeşme, Baydar, Aysal, & Yazır, 2013). During the studies, a total of five traps with a distance of 10 m from each others were tied on a stretched wire attached to poles at a height of 1.5 m from the ground in the middle of a row in the same orchard. The same traps were hung on tree branches at a height of 1.5 m from the ground, a total of five in all directions on the outside of the orchard. In addition, the traps were hung at a height of 1.5 m from the ground inside of the orchard, on the branches of five trees in the south direction. The distance of the traps between in the inner area and the outside of the orchard was at least 20 m (Figure 2).

A 0.5 L plastic bottle was placed under the blue funnels in the traps. It was tried to prevent insects from escaping from the traps by filling the plastic bottle with 1/3 of water and opening holes in the upper 1/3 of the bottle so small that insects could not escape because of overflowing the water in case of rain.

Generally, in the previous studies that the trap effectiveness were tried to explained with the number of insects caught in traps. However, in our previous studies, we noticed in spite of the high catching rate by traps, the insect damage on the flowers was high too. Therefore, in this study, we also tried to determine the damage rates in the flowers of the trees which the traps were hung. For this purpose, one-meter-long on the branches of alive buds and fruit sets in two branches of each trees where the traps were hung in all directions of the orchard were counted. Thus, the flowers shedding rates of the trapped and non-trapped trees were obtained. The same counting prosedures were also conducted on the five trees for trapping, non-trapping, and the nearest to the traps on the wire (Figure 2). The climate data in the study were obtained from the Isparta Meteorology Provincial Directorate.

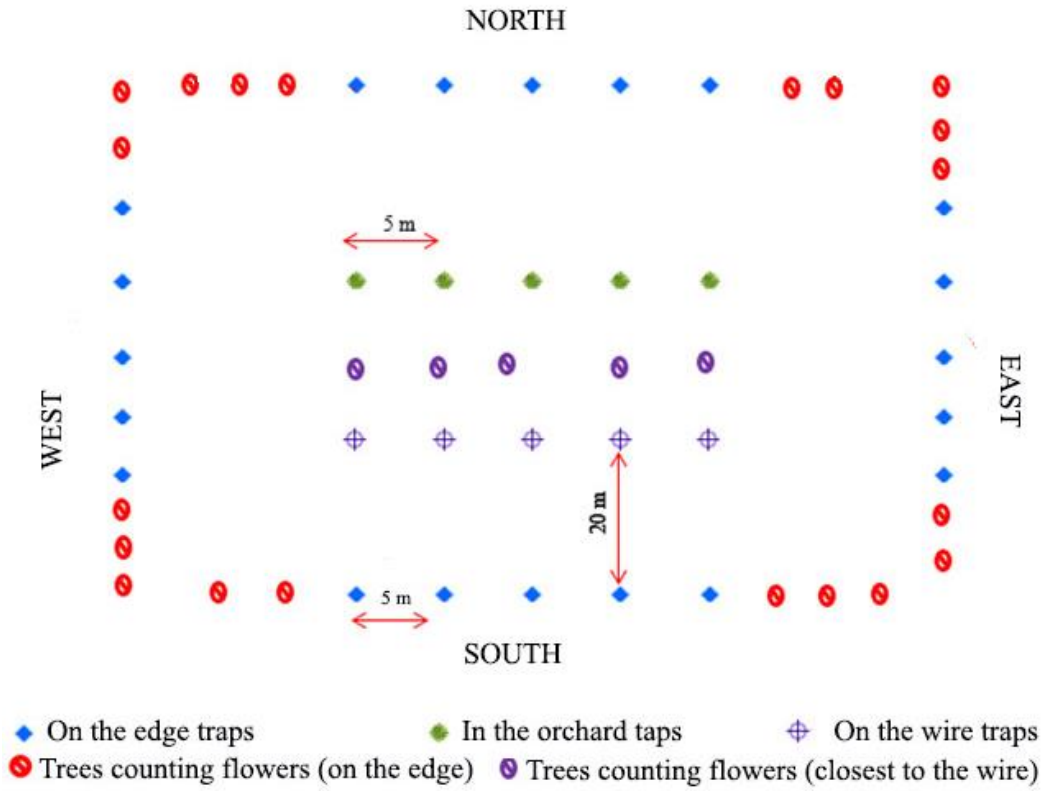

Figure 2. Locations of hanging traps and control trees in cherry orchard

Square root transformation was applied to the insect number values obtained in the traps and one-way analysis of variance (ANOVA) was performed on these transformed values using the SPSS package program, followed by Tukey's HSD multiple comparison test ($p<0.05$). The values given in Table 1 are untransformed values. Multivariate numerical analysis (MVSP) was use for percentage similarity index programme.

3. Results and Discussion

The number of the insects caught in traps hung for different directions and inside the cherry orchard is given in Table 1. When the number of adults caught in the traps in the cherry orchard were examined according to the all directions and different inside areas. The number of insects in the traps hanging on the wire was higher than the others, and as a result of the statistical analysis, the difference between all other traps were found to be significant ($p<0.05$) (Table 1, Figure 3). It is thought although these results were the same in all traps and had the same attractive colors, the fact that they could be seen by insects caused an increase in the rate of catching by the traps.

Table 1
Number of adults caught in traps in cherry orchard according to directions and on the wire (Mean±SH)*

Directions and fields	
On the wire	12.84±3.09 a
North	3.31±1.44 b
East	3.22±1.42 b
Souht	3.06±1.12 b
West	2.42±1.17 b
In the orchard	2.00±0.88 b

*The difference between the numbers shown with the same letter in the same column is not statistically significant ($p<0.05$)

According to these data, it is revealed that the blue colored traps on the trees in or around the orchard cannot be seen easily by this adult insects. But the traps on the high wire are easier to see and the adult insects attracted to these traps, although they are inside the orchard. In addition to this, in general, the number of adults caught per day was lower than in our previous studies. We think that the reason for this is the fact that all the orchards in the area where the study is carried out are regularly plowed every year. Schmera et al. (2004) reported since the larvae of this species live in unploughed areas in proportion to ploughed ones. So, such as pasture the damage of this species is more important in the orchards that near to those areas. Similarly, Yaşar & Uysal (2013) noticed that the adults of this insect are more likely to be caught near uncultivated soils.

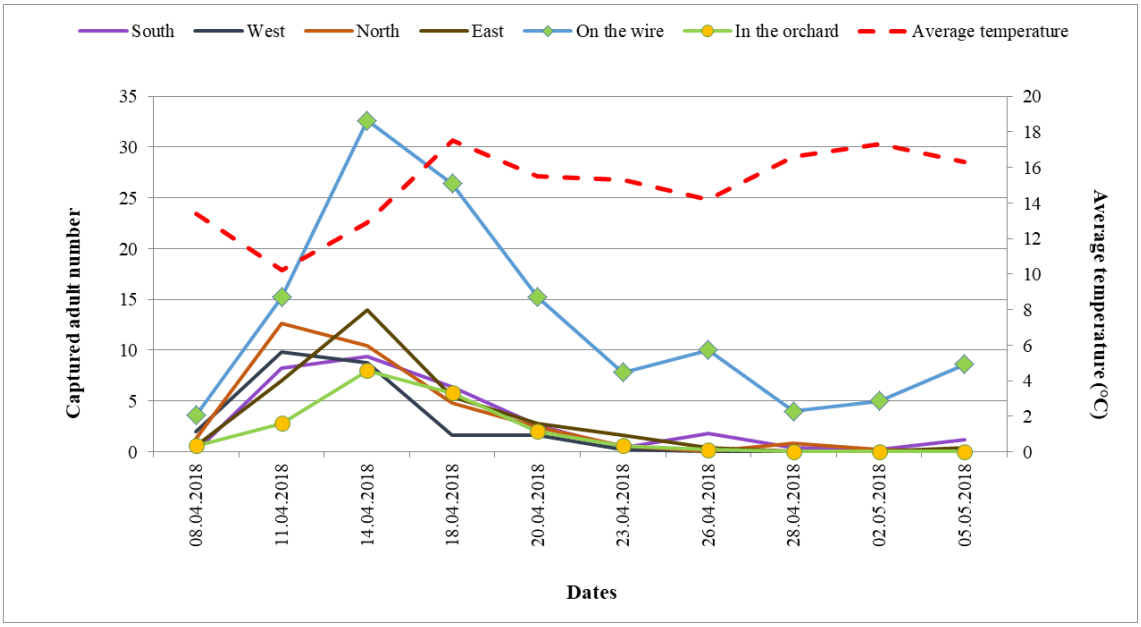

Figure 3. The number of adults caught in the traps according to the directions and areas and the average temperature values

According to the percent similarity analysis results obtained from the number of insects caught in the traps, the ones hanging on the wire showed 35.65% similarity to all other places where the traps were hung. In other words, it was 64.35% different from them (Figure 4).

While those from the other groups in the East and South directions show 81.52% similarity to each other, and 81.32% similarity to each other in the North and West directions. So, it is seen that these two groups are 76.63% similar to each other. It was revealed that this group and the traps on the trees in the orchard were 72.19% similar to each others.

Ražov, Barić, & Dutto (2009) reported on peach trees that the optimum trap height should be 120-150 cm from the ground and the distance between the traps should be 15 m. In a study conducted by Güvenç & Yaşar (2014) to catch *T. hirta* adults on cherry trees in Isparta Province, it was noticed that the most adult individuals were caught in light blue colored funnel traps with attractant, 150 cm high from the ground. Yaşar & Uysal (2013) was stated that during of blooming to use of attractants together with the blue colored funnel trap under a 5 L plastic bottle filled with water is more effective. It was reported that more adults were caught than apricots. Okudan-Erdoğan (2016) reported that blue colored funnel traps on the trees caught more adults than those on the ground. Mitko et al. (2011) reported that *T. hirta* adults were caught in a significant amount by the traps, as it has parliament blue color.

In the previous studies, traps were used by placing them on the ground or hanging them on trees to catch the adults of this pest. In this study, the effectiveness of the traps was investigated by hanging the traps in all directions and especially between the rows of trees in the orchard. As can be seen in Figure 1 and Table 1, the number of individuals caught in traps on wires in the orchard was much higher than in all other directions.

Although, these results were the same in all traps which had the same colors and same attractants, the fact that they could be seen easily by insects caused an increase in the rate of insects that caught in the traps.

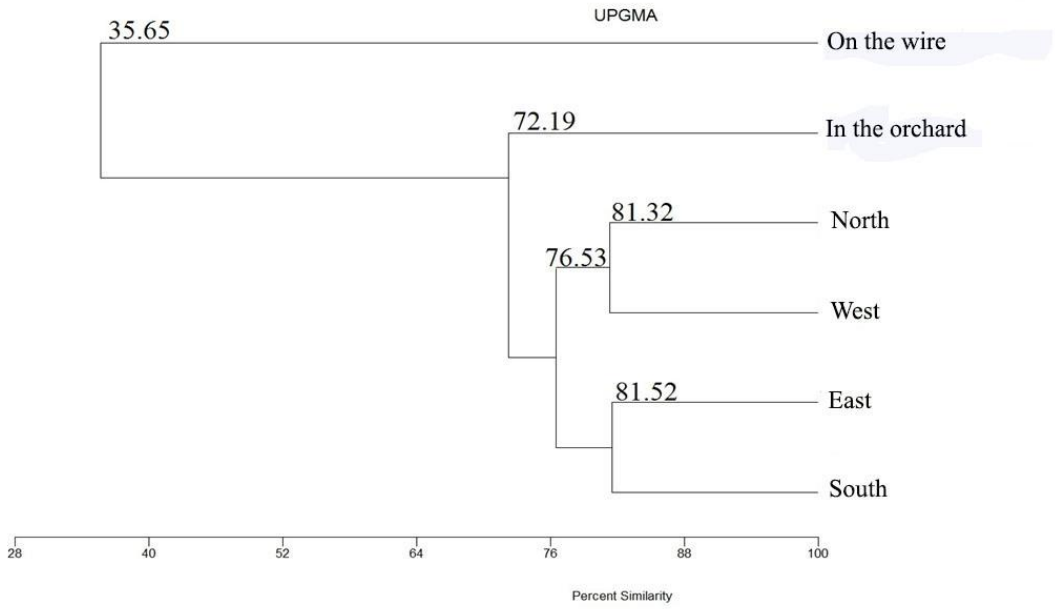

Figure 4. The percentage similarity analysis results (MVSP) of adult numbers caught in traps in cherry orchard according to directions and areas

Our study is by determining the number of flowers on the trees trapping and non-trapping (Table 2). The flower buds counted at the beginning of the study in all trees, and the percentage of flowers that fell at the end of the study was found. Except for the traps on the wire, the numbers of shedding flowers in all trees on the traps were higher than those in the controls without traps. Considering that the physiology of the plant and natural events are the same for all trees, it is possible to say that this difference is due to the damage caused by the insects attracted by the traps. Moreover, although the traps on the wire were five-meter distance from the nearest trees in the orchard, the rate of shedding flowers on these trees were at the highest level.

Table 2
The number of shedding flowers and the total number of insects caught in the trees trapping and non-trapping according to the directions and different areas in the orchard

Directions and areas	**Numbers of shedding flowers in trap hang trees (%)**	**Number of shedding flowers on trees in the non-trapping (control)**	**Total number of caught insects**
North	92.95	28.63	33.1
In the orchard	90.10	25.28	20.0
West	70.73	18.75	24.2
South	48.25	30.71	30.6
East	32.95	30.65	32.2
On the wire	-	90.83	128.4

4. Conclusion

In the light of this information, it has been revealed that hanging traps in visible places is an important factor in catching *T. hirta* adults. However, hanging traps in visible areas is only important in terms of attracting and catching more insects. Although no study has been reported so far on the relationship between trap-flower damage about this species before, in this study has reported for the first time. It is to say that as a result of this

study, the more attracted of the insects towards the traps, the more the rate of damage increases for flower buds on trees and for reproductive organs on them. It is possible to say that the most appropriate place where the traps to hang should be on wire or poles around the orchard and if it is possible away from the trees and before the adults enter the orchard. We think that this problem can be solved by conducting more detailed studies on this issue.

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Author Contributions

Veli Burak Çelik: Collected data.

Bülent Yaşar: Designed the study and performed analysis.

Conflicts of Interest

The authors declare no conflict of interest.

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