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Flight Activity of the Hairy Rose Beetle, *Tropinota squalida* (Scopoli) in Apple and Cherry Orchards in Southern Jordan

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Abstract

The hairy rose beetle, *Tropinota squalida* (Scopoli), is one of the important insect pests that attack pome and stone fruits in the southern part of Jordan. This destructive pest attacks the flowers of the crop where it feeds on the reproductive parts of the flowers. The present study was initiated to monitor the phenology and flight activity of the hairy rose beetle in an attempt to provide basic information for the development of safe and effective control measures for this economically important insect pest. The present study was conducted during 2009-2010 on two apple cultivars, Grany Smith and Royal Gala, and on Stella cherry. Capture of the beetles was performed via locally constructed traps that were improved by incorporation of the floral chemical attractants. Adults of the beetle were captured in apple orchards earlier than cherry orchards and disappeared earlier in the cherry orchard than that in the apple orchards. The flight activity of beetle started in the last week of January to the end of May in the apple orchards, but it was during mid-February to mid of May in cherry orchard. Positive relationships were obtained between the beetle flight activity the flowering pattern of the studied fruit crops.

Key words: *Tropinotasqualida*, hairy rose beetle, flowering, flight activity.

1. Introduction

The southern part of Jordan, mainly Ash-Shoubak region, 220 km south of Amman, is considered the main apple growing area in Jordan. The total area planted with apples is 4905 ha., with an annual production of 22833 ton (Ministry of Agriculture, 2014). Beside apples, other fruit trees, such as plum, cherry, pears and apricots, are also abundant in the region. Many insect pests were recorded to attack apples in Ash-Shoubak, such as the codling moth, *Cydia pomonella* (Madanat and Al-Antary, 2012), woolly apple aphid, *Eriosoma lanigerum* (Ateyyat *et al*., 2011; Ateyyat, 2012), the small red belted clear wing borer, *Synanthedon myopaeformis* (Ateyyat, 2006; Ateyyat and Al-Antary, 2006). One of the important insect pests of apples and other fruit trees in southern Jordan is the hairy rose beetle, *Tropinota squalida* (Scopoli). This destructive pest attacks the flowers of the crop where it feeds on the reproductive parts of the flowers. The feeding usually results in the damage of the anthers and stigma which affects fruit setting and prominently reduces the yield (Abdel-Razek and Abd-Elgawad, 2008). As for many insects that attack the crop during flowering, the hairy rose beetle is difficult to control (Vuts *et al.*, 2010). Currently, growers rely on two control tactics: hand picking of the adult beetle from the infested trees and application of chemical insecticides. Hand picking is practiced when few numbers are found on the flowering crop while insecticidal applications are implemented when large numbers infest the trees. Hand picking is time and labor consuming which makes it impractical when large numbers attack the trees. On the other hand, insecticidal applications should be avoided during flowering to prevent flower drop from spraying pressure and to conserve pollinators that are abundant on the trees during flowering (Schmera e*t al.*, 2004). Moreover, chemical insecticides are well known for their hazards to humans and the environment.

Many beetles in the subfamily Cetoniinae including the hairy rose beetle use both visual and olfactory stimuli from the flowers of the crop to locate its host. Depending on these stimuli, a funnel trap was developed to capture a closely related species; *Epicometis (Tropinota) hirta* and found effective in capturing the beetle (Ali, 1993; Schmera *et al.*, 2004). Afterwards, the trap was shown to effectively capture the hairy rose beetle (Toth *et al.*, 2009). The visual stimuli are affected by the color of the trap where the blue color was found the most attractive (Schmera *et al.*, 2004).

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Capture of the beetle with blue traps was considerably improved by incorporation of the floral chemical attractants: cinnamyl alcohol and trans-anethole at a ratio of 1:1 (Schmera *et al.*, 2004).

There are enormous studies on the use of trapping as a mean for monitoring insect flight activity. Similarly, the hairy rose beetle can be detected and monitored using the funnel trap baited with the floral attractants (Schmera *et al.*, 2004). Determination of the phenology and flight activity is a corner stone in the management of the hairy rose beetle. It will avoid unnecessary insecticidal applications and provide information on the magnitude of pest attack as well as the proper timing for the implementation of control measures. Therefore, the present study was initiated to monitor the phenology and flight activity of the hairy rose beetle in an attempt to provide basic information for the development of safe and effective control measure for this economically important insect pest.

2. Materials and Methods

The experiments were conducted in Al-Hashlamoun apple orchards (about 120,000 apple trees) during January 2009 to the end of May 2010 in Ash-Shoubak area (about 1300 m above sea level and 220 km south of Amman, the capital of Jordan). Orchardists were requested not to interfere with any pesticide application.

The trees at the experiment site were planted in 1994, and trained under the central-leader system to an average height of 3 m (range 2.5.–3.5 m), with a mean butt diameter of approximately 30 cm. All apple trees were planted on Merton-Malling Series (MM) 106 rootstock. Planting distances were based on a 5 by 5 m grid. The experiment was conducted on two cultivars of apple of different characteristics; Royal Gala and Granny Smith. Also,the flight activity of hairy rose beetle was studied in Stella cherry orchard in which trees were planted in 1996.

The hairy rose beetle trap (HRBT, Fig. 1)) was used to catch the adults of the insect pest. This trap consists of three main parts: a landing and collecting platform, a container, and an attracting dispenser. The landing platform is a funnel (21 cm diameter X 25 cm height) made from plastic. The container serves to hold the captured insects that fill into the trap and was made from empty pesticides plastic bottles (1L. in size). The crew cap of the bottles constituted the base of the container so that it can be opened and emptied if the trap is full of beetles. The landing platform and the container were adhered together using plastic glue. The dispenser was prepared using the floral attractants of another species, *Epicometis* (*Tropinota*) *hirta*. The attractants were (E)-cinnamyl alcohol (3-phenyl-2-propenyl alcohol) and (E)-anethole ((E)-4-propenylmethoxybenzene) in 50% dichloromethane solution (Sigma Aldrich, Eu.) at a ratio of 1:1 (Toth *et al.*, 2004). One hundred mg of each attractant were added to 2 x 2 x 1 cm cotton pieces. The cotton pieces were then placed in 150µm polyethylene bags and the bags were heat-sealed. The dispensers were individually wrapped in aluminum foil and stored at -20ºC until used. When used in the field, the dispensers were adhered to the inner surface of the funnel using grey duct tape and then punctured 5 times using size 2 insect pin.

Figure 1. Hairy Rose Beetle Trap

For each plant species/cultivar, 3 traps were placed between rows of trees. The traps were white in color and supplied with one dispenser. They were separated by approximately 100 m. The traps were fastened on 100cm wooden sticks so that the base of the trap was approximately 20 cm above ground. Numbers of captured adults of the hairy rose beetle were counted in each trap weekly post placement of the traps. SAS program (2012), version 9 was used to find Pearson correlation data of weather factors (minimum, maximum and average temperatures, and relative humidity) with number of captured adults of *Tropinota squalida* on Grany Smith and Royal Gala apples and Stella cherry orchards in Ash-Shoubak area.

3. Results and Discussion

The effectiveness of the employed sampling method has a strong effect on the quantification of an ecological community (Campos *et al.*, 2000). The trap effectiveness in catching Hairy rose beetle was studied previously by Al-alawi *et al.* (unpublished work) in the same experimental site. These field trials showed that the beetles were highly attracted to blue, white and yellow traps compared to green and orange colors. White traps placed on the ground attracted more beetles than traps hanged on the tree. Accordingly, we used white traps that were placed on the ground as described above.

In 2009, the flight activity of the Hairy rose beetle started within the first one-third part of February on Granny Smith orchard, and after one week traps installed in the Royal Gala orchard started to capture the adults of the beetle (Fig. 2). Flight activity of beetles delayed in

Stella cherry orchard in which traps started to capture adults within the first week of March (Fig. 2). No adults were captured after May 3 in the cherry orchard, but traps continued to capture adults until May 11 in the two apple orchards. The flight activity of the Hairy rose beetle was shown to be shorter in the cherry orchard (10 weeks) than that in the two apple orchards, Granny smith and Royal Gala (14 and 13 weeks, respectively). This might be attributed to variations in flowering periods that was shorter in cherry compared with apple. The highest captured numbers of adults were on April 13 in the Granny Smith and Royal Gala apples, and Stella cherry in which 287, 224 and 368 adults per trap were caught, respectively.

In 2010, adults were captured in apple orchards earlier than that recorded in 2009, in which they started their flight activity within the last week of January (Fig.3). The same scenario was obtained with Stella cherry orchard as adult flight activity was recorded after mid-February (Fig. 3). One distinguished peak was recorded for both apple cultivars that was on March 8 in which 459.3 and 478.3 adult/trap were caught in Granny Smith and Royal Gala orchards, respectively. The highest peak of flight activity was recorded within the last week of March in the cherry orchard (497.5 adults/trap). Flight activity of beetles continued until May 26 in the apple cultivars, but it stopped earlier in the Stella cherry orchard in which the last recorded activity was in mid-May (Fig. 3). In Egypt, the flight activity of *T. squalida* was reported during the last week of January to the last week of April of 2005/2006 (El-Sayed-Darwish, 2007).

It was noticed that the appearance and disappearance of *T. squalida* adults coincided with the appearance and disappearance of flowers of plants in the studied fruit crops. Attempts to find the correlations between the flight activity of the hairy rose beetle and both the temperature and relative humidity, showed very weak correlations (Table 1; Figs. 2 and 3). These results disagree with Hassanein and Salman (2009) who found that the minimum temperature and relative humidity are the main weather factors affecting the density of *T. squalida*. However, it was noticed that winds played a major effect as low numbers of adults were captured during the weeks in which windy days were recorded.

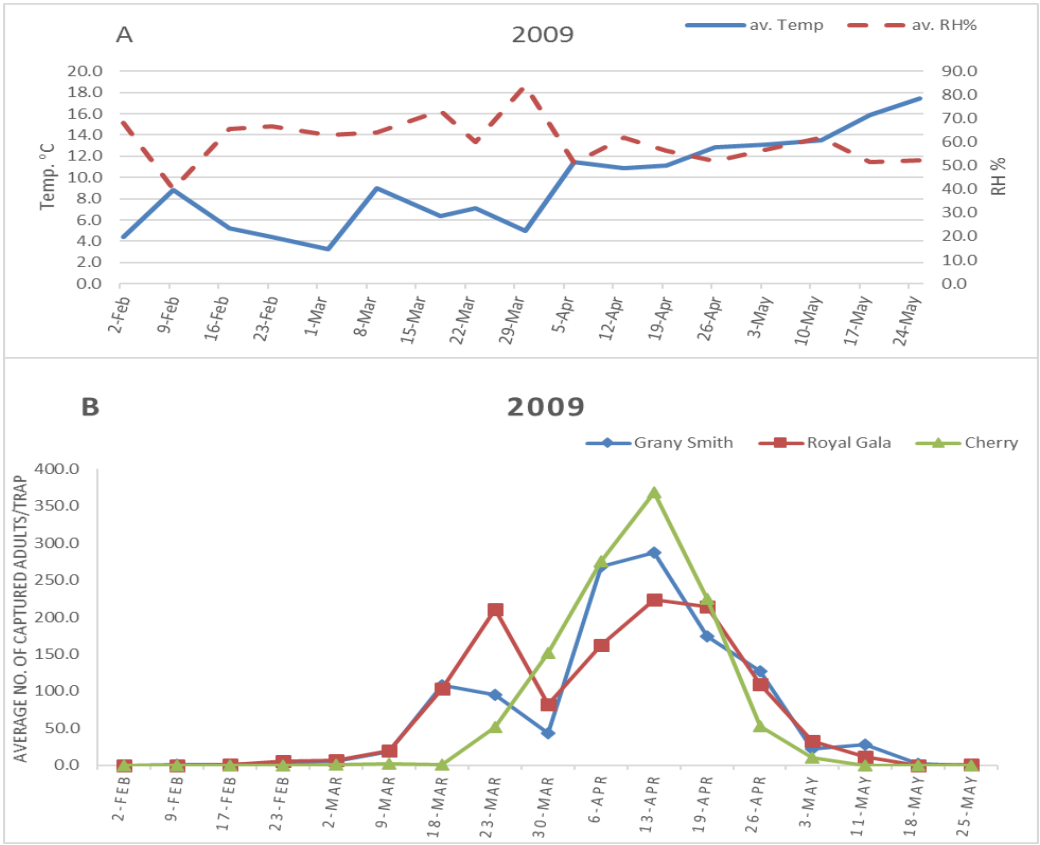

Figure 2. (A) Average temperature (°C) and average relative humidity (RH%) in Ash-Shoubak area during 2009. (B) Number of captured adults of *Tropinota squalida* on Grany Smith and Royal Gala apples and Stella cherry orchards in Ash-Shoubak area in 2009.

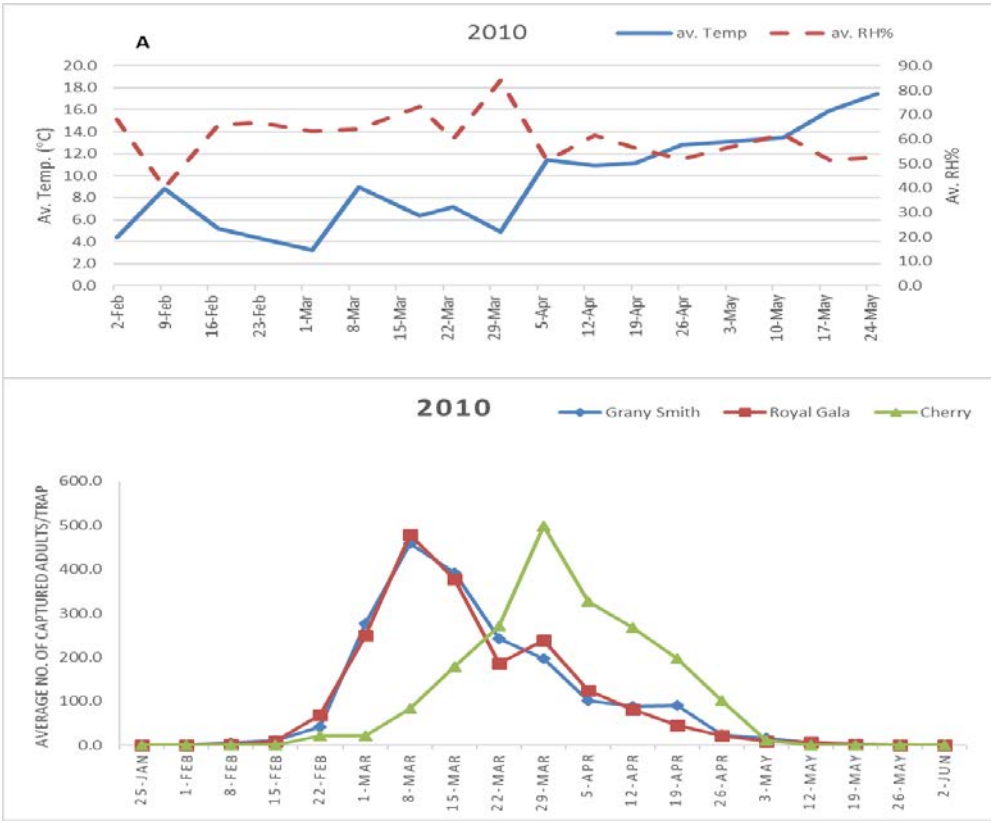

Figure 3. (A) Average temperature (°C) and average relative humidity (RH%) in Ash-Shoubak area during 2010.(B) Number of captured adults of *Tropinota squalida* on Grany Smith and Royal Gala apples and Stella cherry orchards in Ash-Shoubak area in 2010.

Table 1: Pearson correlation data of weather factors (minimum, maximum and average temperatures, and relative humidity) with number of captured adults of *Tropinota squalida* on Grany Smith and Royal Gala apples and Stella cherry orchards in Ash-Shoubak area

Pearson Correlation Coefficients, N = 35 Prob> |r| under H0: Rho=0						
	min temp	max temp	av. Temp	min RH%	max RH%	av. RH%
Grany Smith	0.11856	0.00913	0.05556	0.30977	-0.26353	0.09153
	0.4976	0.9585	0.7512	0.0702	0.1261	0.6010
Royal Gala	0.08717	-0.02353	0.02194	0.39594	-0.32718	0.12305
	0.6185	0.8933	0.9004	0.0186	0.0550	0.4813
Stella Cherry	0.10322	0.02098	0.05517	0.15359	-0.04663	0.09462
	0.5552	0.9048	0.7529	0.3784	0.7902	0.5887

In Jordan, *T. squalida* is a monovoltine pest that overwinters in soil as adults and emerges in early to mid Feb. to feed on male and female organs of the flowers of some plants such as fruit trees. Adults are known also to occasionally feed on young shoots, leaves and even fruits. Because of their high flying capabilities, they land on many different types of plants and continue feeding. As a result, damaged flowers cannot produce fruits (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. However, the use of pesticides using pressure sprayers during bloom usually results in flower dropping before pollination. In addition, insecticides have negative impacts on the environment and their application during the flowering period of the crop is limited due to the presence of pollinators foraging the crop during bloom (Schmera *et al.*, 2004). Al-Alawi (2014) showed that using the essential oils of both eucalyptol and fir plants caused valuable mortality to the hairy rose beetle with low toxicity to honey bees, but it is difficult to use these oils at large scale plantations. Therefore, mass trapping of adults using the HRBT that showed valuable catching ability to adults provides safe and pollinator friendly control measure for effective management of the target pest. In Jordan, these traps could be installed in the fields in mid-January to the end of May. For effective control of this insect pest, the following studies are required: (1) Determine the

recommended density of the traps per unit area; (2) studying the correlation to wing speed with the flight activity; (3) Searching for the hosts or microhabitats of larvae in order to destroy the pest during this stage if that is possible; and (4) doing some ecological studies related to the migration distances of adults.

4. Conclusions

The findings obtained from the present study about the phenology and flight activity of the hairy rose beetle provide valuable information that might form the basis for establishing benign control measures such as mass trapping and better timing of application of these tactics to maximize its effects. It also opens new avenues for more research on the different biological and ecological aspects of this economically important insect pest, taking into consideration the scarcity of the published studies on this insect, particularly on fruit trees.

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