

COMPARISON OF THE EFFECT OF CUTTING OFF STAMENS OF POMEGRANATES AND RELEASING *TRICHOGRAMMA EMBRYOPHAGUM* WITH *ECTOMYELOIS CERATONIAE* (LEP.: PYRALIDAE) IN SAVEH REGION, IRAN

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ABSTRACT: Pomegranate (*Punica granatum*) is one of the most important crops in Iran. Markazi province has a lot of wide Pomegranate's orchards. However, there are some pests that can damage these crops. Carob moth, *Ectomyelois ceratoniae* Zell. (Lep.: Pyralidae) is the most important pest, especially in Iran. The damage by this pest can at times reach up to 80%. To control it, three methods are used in Saveh region: a) Releasing the eggs of *T. embryophagum* for biological control of this pest. b) Cutting off stamens of pomegranate. c) Using the two methods together. The purpose of this research was to compare the efficiency of these three methods. To achieve this objective, a one-hectare-orchard was chosen for each treatment. The containing treatments: Releasing *T. embryophagum*, cutting off stamens of pomegranate, using the two methods together and control. Cutting off the stamens of pomegranate was done two times and the release of *T. embryophagum* was done 10 times and once in every 10 days. Cutting off the stamens of pomegranate was done two times. 400 pomegranates were randomly picked out of each treatment (four repetitions of 100) and were kept for 2 months in the warehouse. The results of research showed that there was a significant difference between the treatments. Reduction of injury was observed in all of the treatments in comparison to the control. Infection amounts were 30% in control, 10.5% in releasing of *T. embryophagum*, 5.4% in cutting off the stamens of pomegranate and 4.5% in using the two methods together. There was no significant difference between cutting off the stamens of pomegranate and using the two methods together in the warehouse.

KEY WORDS: Pomegranate, Cutting off stamens, Biological control.

Pomegranate is a native Iranian fruit and Iran is the first producer of this product in the world. This crop suffers from some pests such as *Ectomyelois ceratoniae*, *Euzophera bigella* and some mites that decrease its production (Sadat Akhavi, 2004). Carob moth (*Ectomyelois ceratoniae*) has been reported on many crops (Farzaneh, 1987; Mehrnejad, 1992). It is the most important pomegranate pest in Iran (Shakerai & Sadat Akhavi, 2003). The appearance of black spots on the fruit is the first symptom of infection and the beginning of rotting and rancidity process of the fruit. The Damage caused by the pest varies remarkably depending on the species of the crops and the time of the year. The damage can at times reach up to 80%. This pest hibernates in different larve instars in the remaining fruits on the trees, fruits under the trees, under the bark of the trees and on other hosts (Ahmadian, 1997). In early spring, the larvae gradually change into pupa and because pomegranates don't blossom at this time, the insects move to other hosts or die. Moths start appearing simultaneous with blossoming and fruiting and prolong until the end of June or beginning of July (Shakeri & Sadat Akhavi, 2003). Moths mate and lay on anthers, filaments and at times on the sepals (Farzaneh, 1987). First instar larvae hatches out from the eggs and stays in the

crown of pomegranate. This pest penetrates into the fruit at its late second or third larve instar (Farzane, 1987), lowering the market value as a result of fungi attraction.

However, there are some methods that are used to control this pest in the country. According to Shojai, Esmaili and Najafi (1995) collecting infected pomegranates on and under the trees is the best way to control this pest. Noori et al. (1993), Nasrollahi (1998) and Mirkarimi (1999) contend that releasing *T. embryophagum* is a very effective method for controlling this pest. Shakeri and Sadat Akhavi (2004) consider using resistant species as the best method for controlling the pest. Mirkarimi (1999) states that filling the crown of the pomegranate with mud to prevent the pests from laying in the crown is an economic and safe method for controlling the pest.

Insecticides are not used against the insect in Iran because:

Spraying with insecticides kills the natural enemies.

The population of *Tenuipalpus* species increase after using insecticides.

Pomegranate trees are very sensitive to poisons.

Three methods are used to control this pest in Saveh including a) releasing *T. embryophagum*, b) Cutting off the stamens of pomegranate and c) using the two methods together. However, orchardists don't know which method is more effective. In this research, the co-efficiency of these three methods will be tested in the warehouse.

MATERIAL AND METHOD

Four orchards, approximately each one about one hectare, were chosen in Saveh. Saveh is one of the cities of Markazi province in the central part of Iran. The orchards were all similar (in terms of orchards age, species of pomegranate trees, soil tissue and etc). In Saveh cultivated species are often Malas (Mirjalili, 2003). Therefore, we chose orchards in which sweet-and-sour species are cultivated.

The containing treatments: releasing *T. embryophagum*, cutting off stamens of pomegranate, using the two methods together. For control group the release of *T. embryophagum* was done 10 times and once in every 10 days (Ahmadian, 1996; Mirkarimi, 1999). The wasps were purchased from insectariums of Plants Protection Office and transported to the orchards. Trichocards were kept dangling in the shades of the trees in the evening because sun rays decrease hatching eggs of parasitoid wasps. The wasps were put on the trichocards. They are kept at a temperature of 2-4 centigrade and transported to orchards at the time of release. Cutting off stamens of pomegranate was done two times. Pomegranate product flowers 3 times in a year. The first and the second time of flowering are more important. Since this method is expensive, cutting off the stamens of pomegranate is done only for the first and the second flowering. The machine used for cutting off the stamens was an electromotor with a brush on the tip, which rotates by a battery. When cutting off the stamens of pomegranate, the tip of the electromotor is put into pomegranate crowns. The rotating brush cuts out the anthers, destroying the haven for the insect to lay eggs. In the meantime, these two methods are used together in a separate garden.

For the comparison of the effect of the treatments in the warehouse, 400 pomegranates were randomly picked out of each treatment (four repetitions of 100) and were kept for 2 months in the warehouse). During this time period, the eggs of Carob moth hatch and penetrate into the pomegranates and infect the fruits. Infection symptoms usually appear in a month. After a month, infected

fruits are counted and separated from other fruits. After two months the infected fruits are counted again. Finally, the infection percentage for each treatment in each replication is determined.

SAS software version 6.12 was used for data analysis. Also, the test do in form of complete randomization design. The comparison of averages do dankan test.

RESULTS AND DISCUSSION

The analysis of the data shows that there are significant differences between the treatments. ($F= 398.69$; $df= 3, 12$; $P<0.001$).

The highest level of infection was observed in control treatment with 30%. There is a significant difference between control and other treatments.

The treatment of releasing *T. embryophagum* showed a 10.5% infection, while in comparison the control showed a 19.5% drop in infection. Therefore, releasing *T. embryophagum* showed lower infection in the warehouse. The treatment of releasing *T. embryophagum* showed a significant difference with control and using the two methods together at 0.05. However, no significant difference was observed in the treatment of cutting off stamens of pomegranate.

The treatment of cutting off stamens of pomegranate with 5.5% infection showed a 24.5% infection reduction in comparison to control. No significant difference was found between cutting off stamens of pomegranate and using the two methods together. But a significant difference was found between this treatment with control and releasing *T. embryophagum*. It showed that using the two methods together decreases the infection more. But there wasn't a significant difference in the reduction of injury in comparison to using the two methods together.

Finally, using the two methods together showed a 4.75% infection which means that this method was the best method in lowering the infection.

There wasn't any treatment in the warehouse. The analysis of the warehouse data showed that using the two methods together was the best one in lowering the infection. The second effective method was cutting off stamens of pomegranate and releasing *T. embryophagum*. Therefore, the three methods of control studied in the research were effective in lowering the injury.

Comparison effect of time and treatments in control of Carob moth in the warehouse:

Pomegranates were counted two times in the warehouse and the data was analyzed using factorial design with randomization. The results of the analysis showed that there are significant differences between the treatments in two times. ($F= 481.17, 847.45, 241.79$; $df= 3, 1, 3$; $P<0.001$).

The highest infection percentage 10.31% was observed at the end of October (first time of pomegranates counting). We have seen 2.25% infection at the end of November that showed 8.06% infection reduction in comparison to first time of pomegranates counting. There was a significant difference between the two times.

The comparison of the two time periods showed the highest level of infection in the first time of data collection in all the treatments and lower percent of infection in the second time of data collection. So, most insect appearance was observed a month after warehousing. The minimum level of infection was observed in using the two methods together and the second time of data collection. Most of the eggs hatch in a month and damages the pomegranates in the warehouse.

According to Kashkooli and Eghtedar (1975), the time span of egg incubation is 8-9 days and the time span of larvae appearance is 8-20 days, altogether making 16-29 days. For this reason, it takes a month for insects to appear.

The temperature in the warehouse is usually 25±5. Therefore, the maximum, minimum and optimum temperatures are 30, 20 and 25 respectively. When larvae grow, they penetrate into the fruit and feed on the core of the pomegranate, inside part of the pomegranate and outside the fruit bark. In a few days, some spots start to appear on the fruits, which are the symptoms of infection (Kashkuli and Eghtedar, p.54). Therefore, when symptoms appear on the fruit, it means that the larvae are in their third or fourth instar.

Based on Yusefi's (1381) study concerning the effect of temperature on life steps and act of the insect, in 25°C (the average of temperature in the warehouse), the average of eggs incubation is 6.7 days and the duration of larve stage is 33.4 days. As a result, this insect needs 40.1 days to complete incubation of eggs and larva stages. As already mentioned, when symptoms appear on the fruit, the larvae are in their third or fourth instar. Since no larve fifth instar has been reported in the references, subtracting larve fifth instar from 40.1, the symptoms can be observed in more than 30 days and less than 40 days. Also because eggs laid on stamens happen at different times, like hatching and the appearance of larvae, eggs laid earlier in the garden, hatch in the first month of keeping in the warehouse. Naturally in eggs laid later, larvae appear in the second month. Only the eggs that were laid some days before being kept in the warehouse showed symptoms of damage in the second month. Therefore, most of the eggs hatch in first month after being kept in the warehouse.

Farmers and exporters must sell pomegranates in a month. If they wish to keep them more than a month, they should keep them in a cold place because low temperature delays hatching of eggs and larvae appearance stages.

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