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## Studying on Damage of Carob Moth in Three Pomegranate Cultivars of Isfahan (Iran)

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### Abstract

Carob moth (*Ectomyelois ceratonia* Zell Lepidoptera: pyralidae) is the most important reason of quantitative and qualitative reduction of pomegranate (*Punica granatum*) yield all over pomegranate cultivation regions of Iran like Isfahan province. Isfahan province with 7620.5 hectare pomegranate orchards is in third place of pomegranate production (after Fars and Markazi provinces) in Iran (3), and following cultivars are the most important cultivars in Isfahan: Naderi, Ravandi, red aril soursweet, Shahvar sweet, Ameneh Khatooni and Zaagh shirin. Carob moth's damage was studied for three cultivars (red aril soursweet, white skin sweet and red skin sour) in five regions (Natanz, Koohpayeh, Shahreza, Rooran and Najafabad) during 2010 year. In order to determine tolerant cultivars and damage levels of this pest in Isfahan province, primary sampling was conducted to define required sampling number and 60 tree numbers distinguished as required sample. Then 60 trees of each cultivar were selected randomly from orchards of each region which had same aged trees of all three cultivars and larger than five hectares, infected and non-infected fruits were counted and recorded. According to results, regions and cultivars had highly significant ( $p < 0.01$ ) effect on infection rate and Natanz had the highest infection whereas Najafabad showed the least and also sour cultivar showed the highest infection whereas sour sweet cultivar had the least.

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### 1. Introduction

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Large parts of our country located in central desert (Kavir desert and Loot desert) have dry and semitropical weather and pomegranate tree has a specific importance in this regions. Then, pomegranate cultivation has had special prosperity in central desert margins from old times and has a considerable cultivation area, cultivar diversity, crop yield and quality (4). The main pomegranate cultivation centers of Iran considering cultivation area are provinces: Fars, Markazi, Isfahan, Khorasan, Yazd, Kerman, Semnan, Kermanshah, Tehran, Bakhtiari, Sistan and Baluchistan, Khouzestan, Lorestan, Mazandaran, Zanjan, Kohgilouyeh Boyerahmad, Azarbaijan Sharghi, Gilan, Hormozgan, Boushehr, Ilam, Azarbaijan Gharbi, Kurdistan. Pomegranate is in third place (after apple and grape) in Isfahan province (2) and Kashan, Ardestan, Natanz, Shahreza, Naein, Najafabad and Isfahan are main regions of pomegranate production. Carob moth is the most important reason of pomegranate qualitative and quantitative reduction all over country. This pest is polyphage and attacks to fig-tree and pistachio too. This pest eats internal tissues of fruits and makes entrance of fungi and bacteria easier that will follow by fruit decaying. There is various statistics about damages of this pest which are sometimes exaggerated. Rahmani et al. (1998) estimated it about 50% in Khorasan province whereas Shahrokhi & Zare' (1998) reported that yield loss could be up to 80% in appropriate situations. But the fact is high variation of this moth in different years and cultivars. For example decaying of Gabri cultivar could reach to 90%, whereas infection of Isfahani (black aril) could rarely exceed by 20% (7), or Bright cultivar loss was over 50% whereas Atabaki cultivar had 15-30% infection (5). Results of this study will be a standard to select the best cultivars for decreasing damage of carob moth.

## 2. Materials and Methods

In order to damage evaluation of three important pomegranate cultivars of Isfahan province, sampling was done from July late to September of 2010. cultivars were *sour sweet with red aril*, *white skin sweet*, *red skin sour*, and regions were *Rooran*, *Koohpayeh* (both from Isfahan township), *Najafabad*, *Shahreza*, and *Natanz*.

Some of cultivars properties:

1-Red skin sour (summer cultivar): average fruit size, reddish-pink colored thin skin, big arils with bright red to pink colored, sour taste and juicy arils, not good for storing.

2-Sour sweet with red aril: this cultivar is the most known in Saveh. Not tall, very productive, with large and average sized fruits, red colored aril, thin skin and soursweet delicious taste, the cultivar is late mature and fruits can be stored for long time.

3-white skin sweet: large fruits, yellow skin, average arils with red to pink color, sweet taste and fairly big seeds.

Area selecting was done according to distance from province center and existence of many orchards, so that Natanz was located in north, Koohpayeh in east, Najafabad in west, Shahreza in south and Rooran was almost in center of province, and all of them were poles of pomegranate production. Some of geographical specifics of these regions are mentioned in table 1.

Table 1: geographical specifics of studied regions

Regions	Latitude	Longitude	Elevation
Isfahan	32-38	32-39	1570

Koohpayeh	42	52	1778
Najafabad	35	51	1655
Shahreza	42	51	1570
Natanz	33	51	1778

Most of the pomegranate orchards of mentioned regions have various cultivars which are planted disorderly. Orchards larger than five hectares with all three cultivars were selected to uniformity and possibility of sampling generalization.

Primary sampling:

In order to determine required samples for study, we did primary sampling and five trees of each cultivar were selected, then infected and non-infected fruits of each tree were counted and required samples number was calculated using following formula (required sample calculating formula for one difference in ratios and groups with the same size) (11):

$$N = \frac{P_1(1 - P_1) + P_2(1 - P_2)}{(P_1 - P_2)^2} * C_p^{power}$$

Which  $P_1$  and  $P_2$  are proportions in two groups, and  $C_p^{power}$  constant is:

$$C_p^{power} = \left( \frac{Z_{\alpha} + Z_{\beta}}{2} \right)^2 = 7.84888$$

$$\alpha = 0.05 \quad \beta = 0.2$$

Number 58.21 was obtained for  $n$  in this study, and then 60 samples for each cultivar were studied. After selecting the orchard, sampling was done in garden diameters (every five meters) because of disorder cultivation of trees and we tried to cover all orchard for sampling. 60 trees for each cultivar were defined and their fruits (infected and non-infected) were counted and recorded in a table.

Data analysis : Infection percentage data was converted by *Arc sin* formula:

$$\text{Arc sin} = \sin^{-1} \sqrt{0.01 * p} \quad p = \text{Infection percentage}$$

Analysis of data was performed using Mstat-c program and where f-value was found to be significant, Duncan's multiple range test was used to compare treatment means at  $p=0.01$ . Excel program was used to graph drawing.

### 3. 3. Results and discussion

Variance analysis results are shown in table1. According to results, regions had highly significant ( $p<0.01$ ) effect on infection rate (table2).

Table2-Variance analysis of experimental data

Source of Variation	P	F	SS	Df	Mean of squares	
					Infection	
Region	< 0.001	4.9		0.27	4	0.067**
Cultivar	< 0.001	53.7	1.46	2		0.730**
Region * Cultivar	< 0.001	13.2	1.43	8		0.179*
Error			12.04		885	0.014
Total					89	

\* and \*\* are significant in 5% and 1% probability levels, respectively

Then various regions of study didn't have equal infection and showed significant difference. Mean comparison showed that the high infection (9.34%) was belonged to Natanz whereas Najafabad had the lowest infection (5.44%), although there was no significant difference between Koochpayeh (5.56%) and this region.

The reason may be ecological and climatic specifics of regions. Natanz is warmer than regions like Najafabad (Agricultural report. 2008), that causes relatively temperate winters too. Probably, weather of this township increased pest generations and caused significant difference but regions with dry and cold winters like Koochpayeh, had less infection because bad climate of winter has affected overwintering of pest and decreased pest population (3). On the other hand, not considering sanitation of orchards helped the infection apparently and because there isn't enough in manpower Natanz and similar townships for collecting all fruits from trees and ground, pests find a good place for overwintering and reproduction, (10). Allzzi (1985) reported also that the highest rate of damage was observed in orchards with low sanitation and cleaning. There was highly ( $p < 0.01$ ) significant difference between infection of cultivars (table 1) and mean comparison showed that cultivar with sour taste had the highest infection (9.83%), whereas the least infection (5.2%) was observed in sour sweet cultivar (fig. 1), although there was no significant difference between sweet cultivar and this cultivar. The reason of differences between pomegranate cultivars may be variety in their internal properties. Apparently, skin of sour cultivar's fruit cracks in ripening time more than the others, and then insect can enter easier and lay its eggs inside the fruit. On the other hand, sour sweet cultivar reaches to maturity later than the other cultivars that can be reason of its less infection and being healthier. In conducted researches on cultivars of various regions, sour sweet pomegranate of Saveh has known as the best cultivar which is recommendable from shape, taste and storing ability aspects. So, this cultivar has been the luckiest cultivar in home market and worldwide markets (9).

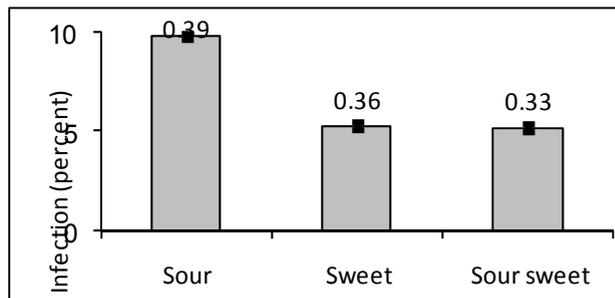


Fig. 1- Infection percentage of various pomegranate cultivars

Interaction of regions and cultivars was significant (table1) and mean comparison showed that the highest infection was belonged to Rooran and sour taste cultivar whereas sour sweet cultivar in Koohpayeh had the least infection (table3).

Table3: Mean of infection percentage in various regions and cultivars of Isfahan

Cultivar	Regions	Najafabad (A2)	Koohpayeh (A4)	Shahreza (A1)	Rooran (A3)	Natanz (A5)	Mean
Sour sweet(B3)		5.67	2.69	6.22	4.42	8.22	5.20
Sweet(B2)		4.66	5.14	3.72	4.49	9.85	5.28
Sour(B1)		6.96	8.93	8.94	13.50	9.67	9.83
Mean		5.44	5.56	6.27	7.59	9.34	

Considering the results of this study, Natanz Township showed the highest infection to carob moth which was because of its appropriate weather for producing more generations of this pest. Plus that, not observing sanitation by farmers is the other reason. But, in other regions like Koohpayeh, because orchards are not large, farmers can check them better and spray pesticide if is necessary, then infection will be less. On the other hand, Sour cultivar is sensitive to fruit skin cracking too, which makes pest entrance and infection prevalence easier. Therefore, considering results of this study, appropriate weather condition for producing more pest generations and also fruit properties like early maturity and sensitivity to skin cracking can be two main reason of infection increase.

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