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Identification of parasitoids of *Apomyelois ceratoniae* (Zeller) (Lepidoptera, Pyralidae) on pomegranate in Isfahan province

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Abstract
The carob moth, *Apomyelois ceratoniae* (*Zeller*) (Lepidoptera, Pyralidae), is the most important pomegranate pests in Iran and make wasted and unusable about 30-40% of annual average of pomegranate production in storage and on the tree stages. During the study for determining carob moth from Ardestan, shahreza, Najafabad which are located in Isfahan, specimens were taken in agricultural season in 2014 .The fruits dissected in the laboratory and larvae and pupae were put in separate vials and parasites emergence from these samples were collected. It was found that there is some active parasitoid in the area which was identified as follows:
Larval parasitoids: Apanteles myeloenta Wilkinson (Braconidae) and *Bracon hebetor*. Say (Braconidae)
Pupal parasitoid: *Brachymeria minuta* (Linnaeus) (Chalcididae). Mentioned species for the first time reported from Shahreze, Najafabad and Ardestan (cities in Isfahan). The present study was planned to identify the active parasitoids in State the region.

Keywords: *Apomyelois ceratoniae*, parasitoid, Isfahan province, carob moth

1. Introduction
As mentioned in authentic old books, antiquity of pomegranate is very high and it can be attributed to date of the sacred books like Torah and the Gospel. It is also mentioned in some verses of the Holy Quran. Different pests and diseases cause qualitative and quantitative damage to pomegranate. The main pest of the crop is carob moth. The insect is also found in many other parts of the world, including Hawaii and the tropical and subtropical regions of the Americas [9], have multiple hosts [13] and is active on the pomegranate and pistachio in Iran [2]. The pest was first found in the orchard of Kashmar in 1971. The average percentage of worm damage in the whole country and in different years is estimated at 25-30 percent. Now it is the most important pomegranate orchard Iran and has 3-4 generations per year. These pests attack by creating holes in inner crown area inter the pomegranate and during entering transfer several elements of fungi, bacteria, yeasts into the fruit. These pathogens can provide fast or slow putrefaction and corruption of pomegranate fruit in garden and then destroy it. Fungi of the genus *Aspergillus* and *Penicillium* make the most important pathogens, and in more than 90% of cases, carob moth is the porter of the pathogen into the pomegranate fruit [14]. Therefore controlling carob moth can play a key role in reducing fruit rot in the orchard and warehouse. This winter pest at different larval instar remains in pomegranate fruits on the trees or shed at the foot of the trees [14]. Due to the considerable damage and hidden activities larvae of this pest is virtually impossible to make use of pesticides [2]. Therefore the use of alternative methods including biological control is one of the logical and fundamental strategies to combat carob moth, especially in the long term [13]. Unfortunately there is very little information about natural enemies of this pest inside and outside of the country, so far all efforts for biological control of this pest depend on employing and using egg parasitoids, and active parasitoids in other life stages of this pest have been neglected [11]. There are few reports about carob moth in Iran. During sampling of pomegranate fruit that was conducted in Fars province, one species of parasitoid in larval stage was collected, and detected as *Goniozus legneri Gordh* (Hymenoptera; Bethylidae) [3]. Kishani Farahmani *et al.* by examining the larval parasitoid of carob moth overwintering in the three regions of Iran found that this pest includes many wasps of Braconidae and Ichneumonidae [10]. Based on research of Kishani Farahani *et al*, Two species of parasitoid flies of the family Tachinidae were collected from of carob moth in pomegranate orchard of Qom and Zanjan province [9]. During studies on the natural enemies of

carob moth in larval stages that were conducted in Qom province, one species of hyperparasitoid wasps called *Pachycrepoideus vindemmiae* (Hymenoptera; Pteromalidae) was collected of the pupal cocoon of larval parasitoid of witch moth, *Apanteles sp.* (Hym; braconidae). Collecting this species wasp first report from Iran. According to Ksentini *et al*. four species of *Trichogramma* of egg carob moth parasitoid including *Trichogramma evanescen, T.cacoeciae, T.oleae voegele, T. bourarachae,* have been found in pomegranates orchard in Tunisia and *T. evanescens* has been first reported in Tunisia. *T. bourarachae* had the lowest distribution and *T.cacoeciae* had the highest distribution. In light of the above information [11], the present study was planned to identify the active parasitoids in State the region.

2. Materials and methods

Collections of both pest and parasites were obtained from pomegranate fruits during fruiting season 2014. Fruits were collected from various pomegranate orchard of Isfahan province. The fruits dissected in the laboratory and larvae and pupae were put in separate vials (10×5×5) and marked the vials according to collection areas and collection date and kept in laboratory conditions, 16:8 (LD), 50% ± 10 (RH), 25±1 °C and allowed to host development and daily observation were recorded for parasites emergence and parasites emergence from these samples were collected and transferred for identification [8, 9]

3. Results and discussion

The larval parasitoid wasps and pupal parasitoids collected during sampling were identified as follows:

Larval parasitoid:

1- *Apanteles myeloenta* Wilkinson (Braconidae), (homonymous with *Iconella myeloenta* (Wilkinson)) were collected from Shahreza and Ardestan and identified by Dr Gavin Broad (natural historical museum, London).
2- *Bracon hebetor* Say (Braconidae) were collected from Najafababd and Ardestan and identified by Dr. Ehsan Rakhshani (Zabol University).

B- Pupal Parasitoid:

1- *Brachymeria minuta* (Linnaeus) (Chalcididae) were collected from Shahreza and Ardestan and identified by Dr. Ebrahim Ebrahimi (Iranian Research Institute of Plant Protection).

Species: *Apanteles myeloenta*

Supr family: Ichneumonoidea

Family: Braconidae

Sub family: Microgastrinae

It is one of internal parasitoid and Koinobiont. This species was already collected by Gothilf (1969) as one of larval *Apomyleois ceratoniae* on Acacia, Carob and Citrus. This species has been reported from Iran [7].

Fig 1: Adult Parasitoid of *Apanteles myeloenta*

Species: *Bracon hebetor*

Supr family: Ichneumonoidea

Family: Braconidae

Sub family: Braconinae

This species is a larval external parasitoid that is group and polyphagus. And also it is idiobiont and can live everywhere.
Al- maliky & Al- Izzi reported this species as a larval parasitoid of carob moth from Iraq [1].
This species is an everywhere live parasitoid and distributed in some countries such as Australia, West Asia, America and some European countries [15]. This parasitoid is also active on stored pests such as *Galleria mellonella* and *Ephestia kuehniella* and also on *Helicoverpa armigera* in tomato farms in Khuzestan Province [4, 5].

Fig 2: Adult Parasitoid of *Bracon hebetor*

Species: *Brachymeria minuta*

Supr family: Chalcidoidea

Family: Chalcididae

This species is an internal parasitoid and koinobiont. Al-maliky & Al-Izzi reported this species as a pupal parasitoid of carob moth from Iraq [1]. This species has been reported from Iran [7].

Fig 3: Adult Parasitoid of *Brachymeria minuta*

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