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Relationship between the quantity of pollen grains as used in the pollination process and the infestation with *Arenipses sabella* (Lepidoptera: Pyralidae) and *Batrachedra amydraula* (Lepidoptera: Batrachedridae)

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Abstract:

Many of the interrelationships between date palm and its pests have not been determined yet, especially in the case of the greater date moth, *Arenipses sabella* (Hampson) (Lepidoptera: Pyralidae) and lesser date moth, *Batrachedra amydraula* (Meyrick) (Lepidoptera: Batrachedridae). So, this work aimed to investigate the effect of quantity of pollen grain as used in pollination process on the infestation with two early date palm pests, *A. sabella* and *B. amydraula* which are considered a key insect pest causing enormous damages to the crop. Hand pollination was achieved by using 7, 14, 21 and 28 fresh pollens strands per spathe. The obtained results indicated that, there is no significant effect in the initial fruit set as the pollen grains concentration is increasing. The greater date moth has a specific trend, where, the infestation rate increases severely when 28 fresh pollens strands per spathe was applied. On the other hand, the lesser date moth did not have a specific and clear trend, although the lowest rate of infestation was observed when the pollination was carried with 7 fresh pollens strands per spathe. The reduction in the fruit retention percentages with the increase in the number of pollen grains strands attributed to the relationship between the number of pollen grains strands as used in the pollination process and the infestation with two early date palm pests especially *A. sabella*. Perhaps, an increase in the amount of pollen is likely to have an attractive effect on both insects, especially the greater date moth.

Introduction

Date palm had great economic importance and agricultural uses throughout human history. Many arthropod species were recorded as a key pest attacking date palm successively during the grown season. For the success of the integrated management of date palm, it is necessary to study the interrelationships between the pests that cause economic damage and the plant host. Wakil *et al.* (2015) emphasized that, future research, attracts for several important

pests of date palm need to be identified, especially for the rhinoceros beetle, *Oryctes agamemnon* (Burmeister) (Coleoptera: Scarabaeidae), the greater date moth, *Arenipses sabella* (Hampson) (Lepidoptera: Pyralidae), and the date stone beetle, *Coccotrypes dactyliperda* F. (Coleoptera: Curculionidae) , that can cause significant crop damages.

A. sabella and lesser date moth *Batrachedra amydraula* (Meyrick) (Lepidoptera: Batrachedridae) are considered as an early date palm pest under New Valley region-Egypt as recorded by Gameel (2017) who found that, different larval instars of *A. sabella* were observed in full activity status in the frond bases during mid January. Unopened spadix of the date palm males recorded the earliest infestation during the last week of January. Over 80% of the inspected date palm were found infested with the pest. The general average of the cut bunch bases was about 10% (This value expresses the economic loss in the crop for the Saidy variety in the El-Kharga Oasis). Also, Gameel *et al*. (2017) recorded that, the direct date fruit losses ranged between (25 %) on Saidy and (45%) on Tamr (Dray date)in El-Dakhla Oasis. First damage is seen in March when young larvae are found eating the tips of unopened spathes. When the spathes open, the larvae enter and may strip the flowers and young fruits from whole strands. Their depredations are marked by a coarse silken tunnel, which becomes littered with grass and plant fragments, and which may be 3.5 cm long when the larva is full-grown (Wiltshire, 1957 and Hussain, 1963).

Concerning to the lesser date moth which attacks date fruits and causes several damages to dates, thus reducing the crop yield. The damage is caused by the larvae which bore deep tunnels into the fruit ultimately the fruit dries and drops. Infestation can be easily recognized by turning brown and remaining attached to the fruit stalks by a silken thread. Infestation may cause more than 40% loss of fruits (Saleh, 1974; Venezian and Blumberg, 1982; Temerak *et al.*, 2007; Kinawy, 2012; Gameel *et al*., 2014 and Sayed *et al*., 2014).

Several efforts have been accomplished to improve date palm production through facing production problems and improving agricultural practices as the efficiency of the pollination process. Therefore, it is required to ensure good fruit production through understanding some horticultural practices that affect tree growth and productivity. Pollination is one of the major practices in this concern (Ream and Furr, 1970; Shaheen, 1986; Gasim, 1993 and Kotb, 1993). Hand pollination is considered the common and traditional way for date production and is necessary for successful fruit set and fruiting (Nixon, 1951 and Ream and Furr, 1970). It is executed by inserting the male strands into the female flower cluster (Dawson, 1956; Ahmed, 1959; Goor, 1967; Sial, 1980; Kataab, 1985 and Hamood *et al*., 1986).

Traditional pollination with seven strands/ spathe which the recommended method (Ahmed *et al*., 2016). But farmers applied high rates of strands for each spathe to conduct the pollination process. So, this study aims to find out is there a relationship between the amount of pollen used in the pollination and insect infestations.

Materials and methods

This study was conducted during 2020 and 2021seasons in a date palm orchard situated at El-Kharga

Oasis, New Valley Governorate on 16 years old Saidy (As a semi dry date palm cv). These palms were produced through conventional propagation by offshoots as well as characterized by regular bearing. Also, they are uniform in vigour, healthy and good physical conditions. All selected palms (16 palms) received the common and usual horticultural practices that already applied in the orchard except those dealing with hand pollination. Bunches/leaf was adjusted to1:6 according to Ahmed (2002). Hand pollination of all the selected palms was achieved by inserting fresh male strands into the center of one female spathe using the same source of pollens to avoid resides of metaxenia according to (Al-Tahir and Asif, 1983 and Hussein *et al.,* 1985). The pollen grains viability was tested before carrying out pollination with acetocarmine staining. One drop of 1.0% acetocarmine was dispersed. Pollens were micro scopicany examined colorless or unstained pollen grains were considered non viable, according to Moreira and Gurgel (1941) and Furr and Enriquez (1966).

Hand pollination with 7, 14, 21 and 28 fresh pollens strands per one spathe was applied and carried out three days after female spathe cracking. Each treatment was replicated four times(one palm per each). The experiment was set up in a complete randomized block design with four replications.

Inspection times were conducted at two weeks interval from the mid of April until beginning of July. Ten fruit strands were randomly marked on each palm. In each strand, the infested fruits with the greater and lesser date moths, the naturally fallen fruits, initial fruit sit, and fruit retention were examined (El-Salhy *et al*., 2010; Ahmed, 2014 and Sayed *et al*., 2014).

1. Initial fruit set (I.F.S) percentage:

It was determined after 4 weeks from pollination time for ten fruit strands. Then the (I.F.S) was calculated according to the following equation:

$$\text{Initial fruit set}(\%) = \frac{\text{Av. number of set fruit per strand}}{\text{Av. number of set fruit} + \text{Av. number of flower scars}} \times 100$$

2. Fruit retention:

In the first week of July, the previous 10 strands were inspected and counted then the percentage of retention fruits was calculated. Data were statistically analyzed by F-test and the means were compared according to Duncan's Multiple Range Test (Snedecor and Cochran, 1971).

Results and discussion

The relationship between pollination with four rates of pollen grain (7, 14, 21 and 28 fresh pollens strands per bunch) and the infestation levels with *A. sabella* and *B. amydraula* during 2020, and 2021 seasons was indicated in Table (1). The highest rates of infestation with the greater date moth (10.22 and 11.27%) were obtained when (28 fresh pollens strands per bunch) applied during 2020 and 2021, respectively. There are insignificant differences between the infestation rates when 7, 14 and 21 fresh pollens strands per bunch were applied during the two successive seasons. Regarding the lesser date moth during the first season, the maximum rates of infestation (2.68 %) followed by (2.00%) were obtained with 14 and 21 fresh pollens strands per bunch treatment during 2020, respectively. The pest induced the minimum rate of damage (1.23%) when 7 fresh pollens strands per bunch was applied. In 2021 season, the high rates of infestation with

B. amydraula (2.78 and 2.61%) were obtained when (14 and 21 fresh pollens strands per bunch) applied, respectively. Meanwhile, the minimum rate of damage (1.34%) when 7 fresh pollens strands per bunch was applied. The effect of the pollination levels on the fruit set and fruit retention percentages in 2020, and 2021 seasons was indicated in Table (2).

Table (1): Infestation (%) with *Arenipses sabella* and *Batrachedra amydraula* after the treatment with different quantities of pollen grain in Saidy date palm cultivar.

Treatment	*Arenipses sabella* infestation%		*Batrachedra amydraula* infestation%	
	2020	2021	2020	2021
Hand pollination with 7 fresh pollens strands (T_1)	1.25 b	1.24 b	1.23d	1.34 b
Hand pollination with 14 fresh pollens strands (T_2)	1.18 b	1.22 b	2.68 a	2.78 a
Hand pollination with 21 fresh pollens strands (T_3)	1.28 b	1.300 b	2.00 b	2.61 a
Hand pollination with 28 fresh pollens strands (T_4)	10.22 a	11.27 a	1.56 c	1.69 ab

***Means followed by the same letter in each column are not significantly different at 0.05 level of probability.**

Table (2) : Effect of different quantities of pollen grain on initial fruit set and fruit retention (%) of Saidy date palm cultivar during 2020 and 2021 seasons.

Characteristics	Initial fruit set (IFS) %		Fruit retention %	
	2020	2021	2020	2021
Hand pollination with 7 fresh pollens strands (T_1)	87.30a	84.72a	85.59a	83.64a
Hand pollination with 14 fresh pollens strands (T_2)	88.77a	86.00a	82.50b	81.78a
Hand pollination with 21 fresh pollens strands (T_3)	87.53a	85.41a	80.00b	78.79a
Hand pollination with 28 fresh pollens strands (T_4)	86.22a	84.33a	75.29c	73.05b

***Means followed by the same letter in each column are not significantly different at 0.05 level of probability**

Concerning to the initial fruit set ratio, the obtained results in 2020 indicated that, there are insignificant differences between the values with different treatments (7, 14, 21 and 28 fresh pollens strands per bunch) which recorded (87.30, 88.77, 87.53 and 86.22%), respectively. Nearly the same trend of results was recorded during 2021season. Regarding fruit retention percentage, there are significant differences in different levels of treatments during 2020 season. The maximum rate of fruit retention (85.59%) recorded when 7 fresh pollens strands per bunch was applied. Meanwhile, the minimum rate of fruit retention (75.29%) recorded when 28 fresh pollens strands per bunch was applied. In 2021 season, the high values of the fruit retention(83.64, 81.78 and 78.79%) were recorded after the treatment with 7, 14 and 21 fresh pollens strands per bunch, respectively. On the other hand, the low value of the fruit retention(73.05%)was recorded with 28 fresh pollens strands per bunch.

It is clear that, during 2020 and 2021, the high values of fruit retention (85.59 and 83.64%) were obtained after the treatment with 7 fresh pollens strands per bunch, respectively.

Meanwhile the lowest fruit retention percentage values (75.29 and 73.05%) were recorded after 28 fresh pollens strands per bunch were applied, respectively.

Finally, it can be concluded that: **a.** *A. sabella* caused the most damage if compared with the rate of infestation with *B. amydraula*. This is consistent with what Gameel *et al.*, 2014 and Gameel, 2017 emphasized in previous studies in the same province that the greater date moth is the main pest in the New Valley. b. The greater date moth has a specific trend, where, the infestation rate increases severely when 28 was applied. On the other hand, the lesser date moth did not have a specific and clear trend, although the lowest rate of infestation was observed when the pollination was carried with 7 fresh pollens strands per spathe. **c.** Concerning to the initial fruit set ratio, the obtained results indicated that, there are insignificant differences between the values with different treatments (7, 14, 21 and 28 fresh pollens strands per bunch). **d.** The reduction in the fruit retention percentages with the increase in the number of pollen grains strands attributed to the relationship between the number of pollen grains strands as used in the pollination process and the infestation with two early date palm pests especially *A. sabella*. Perhaps, an increase in the amount of pollen is likely to have an attractive effect on both insects, especially the greater date moth. Levi-Zada *et al.* (2014) mentioned that, copulation in the laboratory was observed only in the presence of date palm tissue, thus suggesting that sexual communication and mating of GDM moths probably occurs in the crown of date palms. Also, Wakil *et al*. (2015) emphasized that, future research, attracts for several important pests of the date palm need to be identified, especially for the rhinoceros beetle, *Oryctes agamemnon* (Burmeister), the greater date moth, *A. sabella*, and the date stone beetle, *Coccotrypes dactyliperda* F., that can cause significant crop damages. **e.** It can be emphasized that, the greater date moth has become one of the most important pests on the date palm, and it needs the cooperation of researchers to conduct more investigations ecological and biological studies to understand the behavior of this insect.

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