



## STUDY OF FAILURE OF FERTILIZATION IN DATE PALM (*PHOENIX DACTYLIFERA* L.) BARHI CV.

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### Abstract

Fertilization is necessary to generate a new fruits in juvenile palm tree. This study was conducted on the date palm Barhi cv. during 2018 and 2019 seasons, respectively. Which is characterized by the failure of fertilization 15 years old Growing in sandy soil In the Agricultural Research Station, Qassasin Egypt. there is the apparent failure of fertilization in the orchards of date palms barhi cv. thought that the reason for this phenomenon is the impossibility of flower for fertilization prospect absence and atrophy of ovule, deformity of stigma and absence embryo sac. of failure fertilization in barhi date palm or production of fruit undeveloped. So conducted study the an abnormal flowers which caused the failure of fertilization in date palms cv. To improve fruit set, where there is pure fertilization failure of the success of the set of the carpel which has an egg dissection of the female flower that was carried out from the palm tree which is fertilized failure. Absence and atrophy of ovule, deformity of stigma and absence embryo sac. leads to failure of fertilization in barhi date palm or Production fruit undeveloped most of the Parthenocarpic fruits on bunches and have significant influence on the economic value of fruits in this physiological type.

**Keywords:** Date Palm, Barhi, Pollination, Fertilization and Parthenocarpic fruits

### Introduction

Date palm (*Phoenix dactylifera* L.) is one of the most important fruit trees that all palm farmers in the world are interested in because of their high economic and nutritional importance. Egypt occupies the first place globally in production, so attention is paid to the behavior of pollination and fertilization, which leads to an increase in the amount of crop. date palm is a dioecious plant show separate male and female trees. Both female flowers of the date palm are formed in a special type of inflorescence called a spadix, staminate flower consists of 3 carpels surrounded by a short perianth. Pollination occurs by wind and by artificial transferring of pollen grains collected from male strands onto female inflorescence. The fertilized carpel grows and develops faster than the other two carpels, carpels degenerate and drop shortly after pollination (Osman *et al.*, 1974). The formation of abnormal multi-carpel flowers and fruits become a mature fruit, whereas the remaining two with 6 to 7 carpels were reported by Cohen *et al.* (2004) and Al-Khalifah *et al.* (2007). Cohen *et al.* (2004) characterize a low fruit setting phenotype which was found widely among tissue culture-produced date palms of Barhi cultivar. Most flowers in such trees turn into Parthenocarpic fruit lets having three carpels. Moreover, supernumerary carpels are formed in severe cases, and other flower domination of the fertilized carpel to become fruit over the remaining two carpels due to a competition on space and nutrition; embryo abortion of the other two carpels shortly after fertilization. abnormalities include distortions of carpels and stigmas can be detected revealed the development of one carpel only and a reduction in size of the adjacent two carpels. It can be seen also that the septa located between carpels are formed by the fusion of their margins. However, this fusion is incomplete, forming cavities, one per septum, arranged radially from the base of the ovary to the base of the stigma. Therefore, it can be concluded that the abnormal behavior of the developing fruits

may be due to: the absence of the zygote; the damage occurring in the embryo sac and endocarp layer; the reduction in embryo tissue which become the main reason of embryo growth failure (Ali and Sahar, 2015). Female flowers of date palm have three carpels surrounded by a short perianth. After fertilization, one of the carpels grows and develops to reach the final growth phase. Carpels may continue to grow and develop into seedless fruit even if they are not pollinated. These fruits either drop or remain on bunches until the maturity stage. This was due to the unsuccessful fertilization of the carpels in which they grow to form fruits. Such fruits are called parthenocarpic or poly carpels fruits, However, under normal conditions, only one carpel develops into a fruit, no clear answer is provided to explain the development of a single carpel at the expense of the two adjacent carpels. Investigators confirmed that two carpels degenerate after pollination Osman *et al.* (1974) studied the development of date palm fruit at very early stages of development, and found that the fertilized carpel grows and develops faster than the other two carpels, and the carpel started to enlarge in size at the end of the third week of pollination. On the other hand, parthenocarpic fruits were observed on date palm plants propagated by tissue culture almost in all experimental trees (Damankeshan and Panahi, 2013). The trees derived from tissue culture in comparison to trees consequent from offshoot showed much more primary flowers, but an increase in the number of seedless fruits or on the other hand the high percentage of parthenocarpic fruits were observed.

### Failure of fruit set

Off-types are quite common among tissue culture-produced date palm trees which are often characterized with a low fruit setting capacity. Most flowers in such trees turn into parthenocarpic fruitlets having three carpels. In severe cases, supernumerary carpels are formed. Other flower abnormalities include distortions of carpels and stigmas. The

abnormalities in most cases one is alleviated in older trees, with approx equal to 50% of trees reverting to normal within 10 years from transplanting. Many flowers on the abnormal trees have impaired pollen tube elongation, with growth being limited to the stigma or to regions near its point of attachment to the carpel. Directional growth of pollen tubes ceases and tubes grow in different directions or stop growing completely (Cohen *et al.*, 2004). This phenomenon is locally known as 'sheiss' has been lately noticed on tissue culture 'Barhi' date palm at 'Alqassim' area. Although the phenomenon has also been noticed in other date palm cultivars, its occurrence in 'Barhi' is more serious often reaching 59-86% (Ali-Dinar and Alkhateeb, 2005). Over the past few years, several researchers investigated the phenomenon to identify the nature and possible causes of the problem reported that the failure of normal fruiting in young tissue culture of date palm trees cv. Barhi was probably due to many interrelated events that lead to a slow growth of pollen tube at early stages of fruit growth and which may be accentuated by the relatively high abscisic acid (ABA) contents during this period. In conclusion, most of these abnormalities mentioned previously recover in most cases as the plants get old (10-year-old). Furthermore, all these abnormalities were also observed in date palm propagated by offshoots which is the normal method of propagation for date palms (Alkhateeb *et al.*, 2006). This was supported by the finding of Ali-Dinar and Alkhateeb (2005) and Djerbi (2000). They indicated that the plant showed a substantial improvement in vegetative growth and set normal fruit as the plant get older. They concluded that this may probably be to the relatively longer juvenile period of these plants induced by unstable interrelated factors and seemed that tree age plays a central vital role in these events. Ali-Dinar and Alkhateeb (2005) studied microscopically the reproductive process from a thesis too early stages of seed development in collected samples of pistils, ovaries, and young fruit at 2-day intervals during the first 3 weeks after anthesis and pollination and at weekly intervals thereafter for normal and abnormal (sheiss) in Barhi date palm cultivar. They indicated that events of the reproductive process showed that pollens grew normally on the stigmatic surface and the pollen tubes were progressing within the style 2-4 days after pollination in tissue culture and vegetative offshoots Barhi date palm. Six to 10 days after pollination, pollen tubes of vegetative offshoots and tissue culture trees (with few incidences of abnormal fruiting) had already entered the ovary while those of young tissue culture trees (with a high percentage of abnormal fruiting) were slowly progressing within the style. Ovule fertilization as estimated by the initial endosperm division was observed 2 weeks after pollination in vegetative offshoots and old tissue culture trees. However, inner and outer integument in the ovary of young tissue culture trees became less intact and separated from each other reflecting a possible subsequent failure of normal fruit setting due to failure of the fertilization process. Fruit development was quite normal in offshoots and old tissue culture trees 6 weeks after pollination. Differences in pollen tube growth and the fertilization process between Barhi date palm trees may reflect possible physical or hormonal related factors that prevent normal progress of the reproductive process in young tissue culture trees. Multiple carpels Normally date palm female flower has 3 carpels. After successful pollination and fertilization, only one carpel develops to fruit while the other two shrink and die (Alkhateeb and Ali-Dinar, 2002). Often,

in some micro propagated date palm cultivars, female flowers possess more than 3 carpels.

### Field level

Somaclonal variations in date palm plants can be permanent (genetic stable variations) or temporary (epigenetic variation). While the genetic variations in plants are fixed and difficult to be changed, epigenetic variations are unstable and mostly result from physiological changes. Plants with epigenetic variation normally recover with time once the causes of these physiological changes are removed (Skirvin *et al.* 1994). Several factors may contribute to the occurrence of somaclonal variations in tissue cultured date palm, namely: growth regulators, type of explants used in micropropagation process, genome typical nature of plants, length of duration cultured tissues are kept and frequency of subculturing and proliferation rate of cultured tissues (Alkhateeb *et al.* 2006). Types of somaclonal variations in date palm are following: On the other hand, parthenocarpic fruits were observed on date palm trees propagated by tissue culture almost in all experimental trees (Damankeshan and Panahi, 2013). El-Jarrah, and Al-Ani (1981). The pollinated and fertilized carpel grow and enlarge in size shortly after pollination. Al-Bakr (1972) reported that date palm embryo starts to develop one week following pollination, occupying one-third of the ovule cavity and reaching its full length six to seven months later as the fruit matures. The development of a single carpel towards the stage of fruit maturity may be a result of unsuccessful pollination and/ or fertilization of the developmental stages of date palm carpel to become mature fruit, on the expense of the other two carpels, have been studied in details by Long (1943), Osman *et al.* (1974) remaining two carpels; domination of the fertilized carpel to become fruit over the remaining two carpels due to a competition on space and nutrition; embryo abortion of the other two carpels shortly after fertilization. perianth around the carpels which affected their progress of growth. Observations on abnormal behavior of tissue culture-derived date palm have been reported by McCubbin *et al.*, (2000). Such abnormality includes slow growth rate with deformed leaves and wide leaflets, variegated leaves, non-flowering and low fruit setting. Similar findings were also found in tissue culture-derived populations of date palms, such as abnormal multi carpel flowers and fruits with six to seven carpels (Djerbi, 2000; Al-Wasel, 2000; Cohen *et al.*, 2004; Al-Kaabi *et al.*, 2007; Al-Khalifah *et al.*, 2007).

### Materials and Methods

This study was conducted on the palm trees of Barhi cv. during 2018 and 2019 seasons respectively which is characterized by the failure of fertilization 15 years old Growing in sandy soil In the Agricultural Research Station, Qassasin Egypt. To find out the reasons why pollination and fertilization are not successful. Feminine floral samples were taken on the first day of opening the flower pod. Specimens were killed and fixed for at least 48 hrs. in F.A.A (10ml formalin, 5ml glacial acetic acid, 35 ml distilled water, and 50 ml ethyl alcohol 95%). The selected materials were washed in 50% ethyl alcohol, dehydrated in a normal butyl alcohol series, embedded in paraffin wax of melting point 56 °C, sectioned to a thickness of 20 microns, double-stained With Erythrosin and Crystal Violet, cleared in xylene and mounted in Canada balsam (Nassar and El-Sahhar, 1998). Were analyzed microscopically and photo micro graphed.

Anatomical sections of the internal structure of normal and abnormal flowers and setting showed the development of flower in normal behavior, but in, it was found that no zygote and embryo sac was detected in the ovary during the developmental stages of abnormal flower.

There is the apparent failure of fertilization in the orchards of date palms barhi c.v thought that the reason for this phenomenon is the impossibility of flower for fertilization prospect absence and atrophy of ovule, deformity of stigma and absence embryo sac of failure of fertilization in barhi date palm or production fruit undeveloped. So conducted study the abnormal flowers which caused the failure of fertilization in date palms cv. To improve fruit set., where there is pure fertilization failure of the success of the set of the carpel which has an egg dissection of the female flower that was carried out from the palm tree which is fertilized failure. Absence and atrophy of ovule, deformity of

stigma and absence embryo sac leads to failure of fertilization in barhi date palm or production fruit undeveloped most of the Parthenocarpic fruits on bunches and have significant influence on the economic value of fruits in this physiological type.

The objective of this study is to increase the fruit set and productivity and improve fruit quality of Barhi date palm.

**The shape of feminine flowers of Barhi date cultivar**

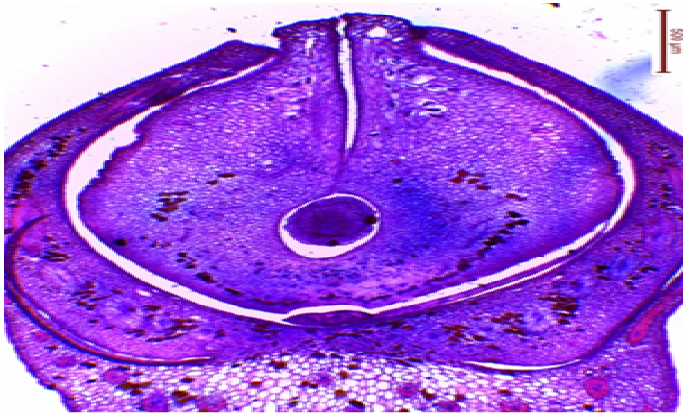
The yellow color is creamy, the ovary is three carpels with a short style on it. The stigma is surrounded by three petals and three sepals (Fig.1) After completion of the pollination, the tube of the vaccine passes through the stigma and then the style goes to the ovary fertilizes the egg and grows one of the carpels in size and Decays the other two carpels, including oocytes (Osman *et al.*, 1974).



**Fig. 1 :** Morphological aspects of Barhi flower date palm cultivars.



**Fig. 2 :** Normal and abnormal developing fruit of Barhee date palm cultivar



**Fig. 3 :** Longitudinal section of normal flower



**Fig. 7 :** Cross-section in normal flower one of the three ovule eggs Atrophy



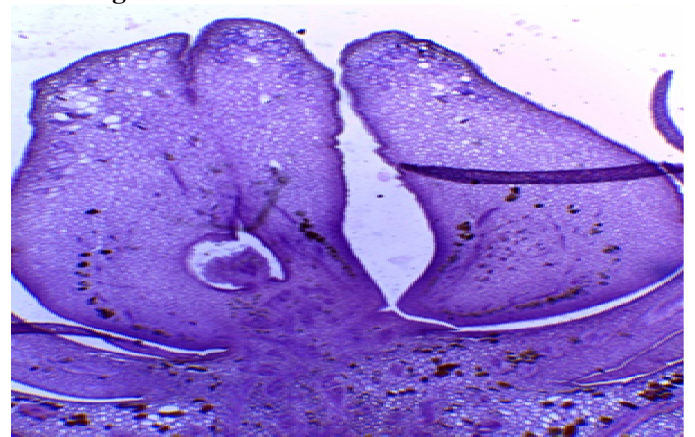
**Fig. 4 :** Cross-section in normal flower



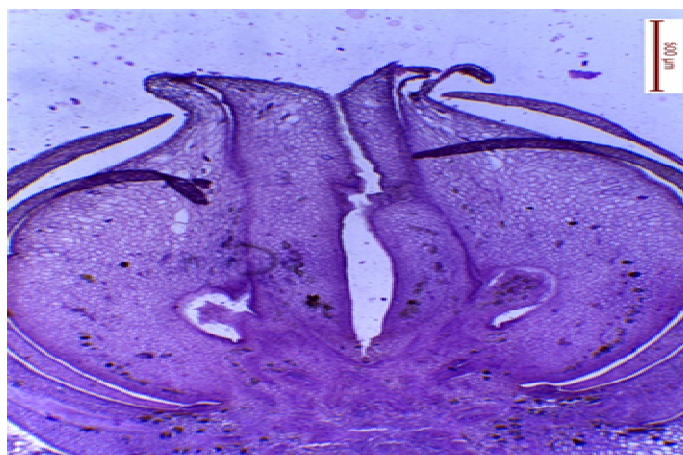
**Fig. 8 :** Cross-section in normal flower



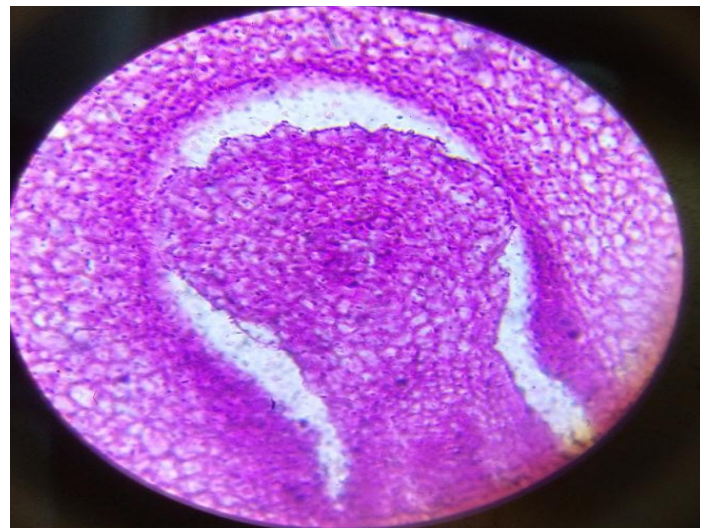
**Fig. 5 :** Longitudinal section in abnormal fruits



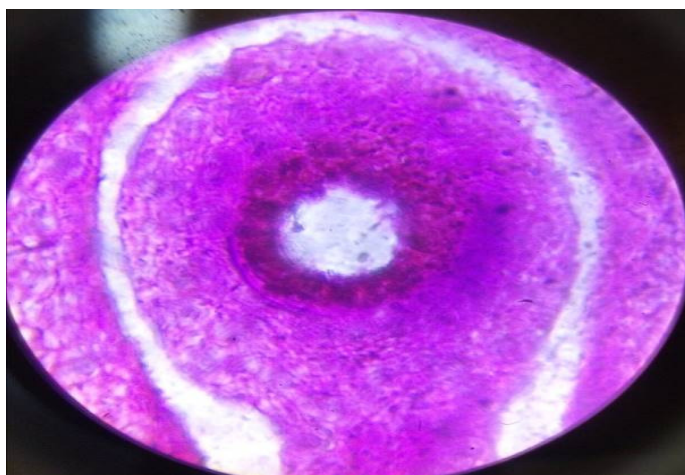
**Fig. 9 :** Longitudinal section in abnormal flower One of the two ovules in the Atrophy



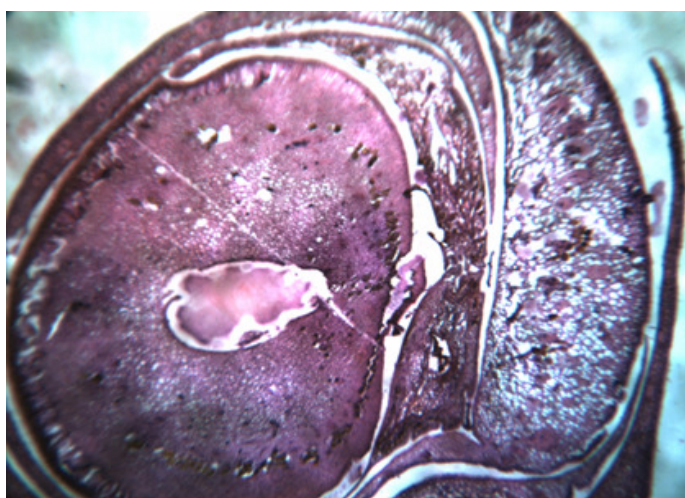
**Fig. 6 :** Longitudinal section in abnormal flower showed two carpals



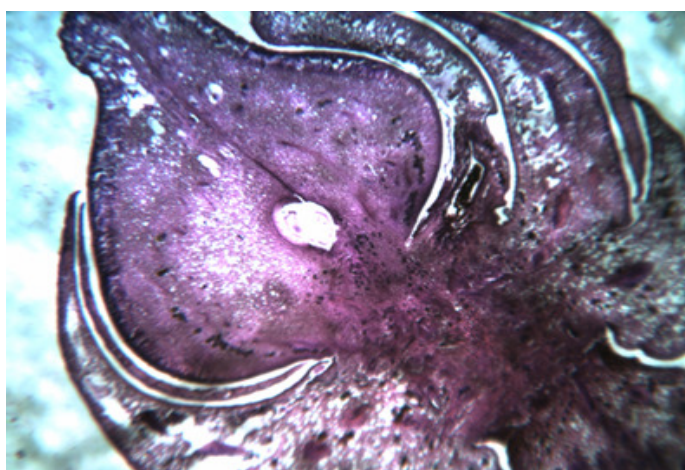
**Fig. 10 :** The cross-section of the egg is abnormal



**Fig. 11 :** Across section in a normal egg.



**Fig. 12 :** Cross-section in normal fruit after four-week fertilization



**Fig. 13 :** Longitudinal section in normal fruit after four-week fertilization Anatomy of flower development of Barhi date cultivar

started to enlarge in size at the end of the third week of pollination Osman *et al.* (1974). On the other hand, parthenocarpic fruits were observed on date palm trees propagated by tissue culture (Damankeshan and Panahi, 2013).

The anatomical forms show the internal of flowers and fruits normal are shown in Longitudinal section (Figure 3) showed flower in normal behavior, the Members of femininity it consists of the ovary, style and stigma around by the perianth. (Fig: 4) Cross-section in normal flower showed the presence of three eggs inside the ovaries contains embryo sack.

Figure 5 showed the abnormal behavior. Atrophy in the oocyte and lack of egg nucleus and embryo sac, which leads to fertilization failure and The passage of the vaccine tube is narrow, leading to the difficulty of penetration into the egg. (Fig: 6 )The longitudinal section of an abnormal flower shows two carpals one of which has an oocyte and the other has done embryo sack. (Fig: 7) One of three eggs by atrophy and the other two eggs in good condition. (Fai:8) showed The absence of ovule is a cause of fertilization failure (Ali and Sahar, 2015) can be concluded that the abnormal behavior of the developing fruit may be due to the absence of the embryo sac the damage that occurs in the embryo sac and endocarp layer; reduction in fetal tissue which has become a major cause of embryo development in the failure.

Figure 9 The longitudinal section of the abnormal one flower of two ovules in the dystrophy and the presence of malformations in the stigma and the size of the ovary, which leads to the failure of fertilization. (Fig.10) showed The Cross-section of the egg is abnormal before the fertilization process. The observed atrophy of the egg and the contents of the egg include the atrophy of the external and internal wall of the fetus and the atrophy of the fetal sac and the nucleus of the egg are unclear. (Fig.11) A cross-section in a normal egg showing the presence of the egg in its normal size and the presence of the components of the egg (inner wall and external, fetal sac and the nucleus of the egg). (Figs. 12,13) Cross-section and longitudinal section in normal fruit after four-week fertilization One of the carp appeared to form zygote grow and to be developed fruit but the two carbine miscarried.

### Conclusion

Definitively, from the acquired results, it can be concluded that „Absence and atrophy of ovule, deformity of stigma and absence embryo sac Leads to failure of fertilization in Barhi date palm or Production fruit undeveloped most of the parthenocarpic fruits on bunches and have significant influence on the economic value of fruits in this physiological type.

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