

Effect of cultivar and offshoots weight on survival rate and some vegetative parameters of date palm (*Phoenix dactylifera*) in Jordan Valley

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Abstract

Date palm, *Phoenix dactylifera* L. (Arecales: Arecaceae) is considered the cultural heritage of many nations worldwide. However, the current study was conducted at the Ghour Al-Mazrah Station, Faculty of Agriculture, Mutah University in October, 2018 to determine if the cultivar and offshoots weight have an effect on the survival rate and some vegetative parameters of *P. dactylifera* offshoots during their handling. Three date palm cultivars were selected; namely Medjool, Barhi and Dejlet Noor, each with 4 weight groups; 2-7.99, 8-13.99, 14-19.99 and 20-26 kg. Results showed a significant superiority of all investigated parameters of Barhi and Dejlet Noor cultivars (survival rate, plant height, trunk diameter, leaf length, leaf and pinnae number) in comparison with Medjool cultivar. The high performance of Barhi cultivar may be due to the genetic nature of the cultivar, while offshoots' weight (14-19.99 kg) showed a significant superiority in all studied parameters as compared with other weights; small offshoots have a weak or not formed root system, and the large weight (20-26 kg) reduced the survival rate because the difficulty of dealing with it.

Keywords: Date palm, *Phoenix dactylifera*, survival rate, Dejlet Noor, Medjool, Barhi, vegetative propagation, Jordan

1. Introduction:

The date palm, *Phoenix dactylifera* L. (Arecales: Arecaceae) cultivation has been commercially grown in Jordan especially in Jordan Valley (Abu-Qaoud, 2015). *P. dactylifera* plays an important social, environment and economic roles in arid and semi-arid regions (Sharma and Singh, 2013). In general, date palm propagated commercially by two main methods; offshoots from the mother plant or by tissue culture (Zaid and De Wet, 2002). The first date palm in vitro regeneration was reported by Tissrat (1979, 1982), and numerous researchers have described different techniques for *P. dactylifera* micropropagation, i.e. organogenesis (Jazinizadeh et al., 2015; Meziani et al., 2015, 2016), and somatic embryogenesis (Naik and Al-Khayri, 2016; Mazri et al., 2017; Roshanfekrrad et al., 2017), meanwhile offshoots planting is the dominant method of propagation in North Africa and Middle East (Hodel and Pittenge, 2003).

Nevertheless, each of these propagation methods have advantages and disadvantages; the tissue culture plant has high survival rate, easy handling because of the small size, free of pathogens and viruses, and it was used to propagate superior date palm trees that did not produce offshoots (Rokba et al., 1993; Bakr et al., 2003). In addition, for rapid clonal propagation of date palm trees (Khierallah and Bader, 2007), tissue culture can be used to produce synthetic seeds (Bekheet et al., 2002), cryopreservation (Fki et al., 2013), and somaclonal variation, giving hand to produce high fruit quality, stress tolerant, and disease resistant cultivars (El Hadrmi and El Hadrmi, 2009). In the contrary, some abnormal changes have been reported from tissue culture technique (Al-Mazroui et al., 2007) such as parthenocarpy fruits, curly inflorescence, bright white leaves, high vegetative growth and dwarfism. Furthermore, the tissue culture plant has a high price in comparison with other propagation methods, estimating at 70-75 US \$ for each tissue culture seedling.

In the offshoots propagation method, there is no pathway for genetic mutation, so offshoots will give true to type with identical quality and quantity of fruits for mother tree. In addition, the low price for off shoots enhances the growers to handle the off shoots with 30 - 40 US \$ for each one, in which the mother plant being ready to give off shoots with 3-4 years old (Zaid et al., 2011). It is worthy to mention that the survival rate in off shoots is low and chance of disease transmission is high (Abahmane, 2011), also it needs a professional workers to separate them from mother tree and more attention to get offshoots free of pests especially the larvae of red palm weevil, *Rhynchophorus ferrugineus* Olivier (Col., Curculionidae) which is among the world's most invasive pest species of palms. One of the most serious problems in the offshoots' propagation is the poor root or no root will be formed (Bitar et al., 2019). Furthermore, the low number of offshoots available during tree life span varies from 5 to 30 depending on the cultivar and the cultivation practices being used (Bouguedoura, 1983; Zaid et al., 2011).

Date palm cultivation in Jordan have many constrains, one of these constrains is the offshoots availability, relatively high price of the offshoots, lacking the professional workers, and low survival rate. So that, the present study is aiming to determine some parameters such as cultivar and offshoots weight that may increase the survival rate of date palm offshoots during their handling.

2. Material and methods:

The study was conducted in Ghour Almazrah Station, Faculty of Agriculture, Mutah University, Jordan in October 2018. Three date palm cultivars (Medjool, Barhi and Dejlet Noor) were selected from a farm in the South Jordan Valley (Ghour Al-Safi), Karak District, Jordan, where the farm was established in 2005, so all mother plants are 13-year-old. The offshoots were separated from their mother plants at 3year-old and weighted to divide them into four weight groups; 2-7.99, 8-13.99, 14-19.99 and 20-26 kg. Eight offshoots were chosen for each weight, so that there were 32 offshoots for each cultivar. The offshoots' bases were treated with both fungicides and insecticides to protect them pest attack. All the offshoots (96, 32 for each cultivar) were translocated and planted in the permanent site and they had the same agricultural practices and irrigation regime. Some parameters, i.e. survival rate percentage, plant height (cm), plant diameter (cm), leaf number, leaf length (cm), and pinnae number were recorded. For leaf length and pinnae number, 3 leaves were randomly selected per each offshoot. The data were recorded for two times throughout the study; directly after planting and after 12 months from planting.

The experimental treatments were a factorial experiment arranged in a Randomized Complete Block Design (RCBD) with 3 replications. The statistical analysis was performed using the Proc General Linear Model (GLM) (SPSS 19.0, SPSS Inc. Chicago, IL, USA) (SPSS, 1997). The data were analyzed using one-way analysis of variance (ANOVA) to detect the differences among the tested parameters (Zar, 1999). When significant differences were detected, means were separated using Least Significant Differences (LSD) test at probability level of 5% (0.05) (Abacus Concepts, 1991).

3. Results

3.1 Effect of cultivar

Results indicated that cultivar has no significant effect on the survival rate between Barhi and Dejlet Noor (65% and 62.5%, respectively), while there were significant differences between these two cultivars and Medjool, which had the lowest percentage of survival rate with only 32.5% (Table 1). There was a significant superiority for all parameters tested of Barhi and Dejlet Noor in comparison with Medjool, however, the superiority was in favor of Barhi more than of Dejlet Noor.

Plant height was not significantly different between Barhi and Dejlet Noor, with favorable height of Barhi than Dejlet Noor (2.71 cm vs. 2.29 cm, respectively), and 0.22 cm for Medjool. As for the difference between the trunk diameters, the results proved that there were no significant differences between Barhi and Dejlet Noor, but there was a significant difference between them and Medjool. Trunk diameter of Barhi and Dejlet Noor cultivars were 0.63 cm and 0.62 cm, respectively, while it was only 0.06 cm for Medjool. The differences between leaf length, leaf number and pinnae number were not significant between Barhi and Dejlet Noor, with a preference for Barhi, but they had significant differences when compared with Medjool (Table 1).

Table 1. Effect of date palm cultivar on survival rate and some vegetative parameters.

Cultivar	Plant height (cm)	Trunk diameter (cm)	Leaf length(cm)	Pinnae number	Leaf number	Survival rate (%)
Medjool	0.22 b	0.06 b	0.38 b	0.22 b	0.13 b	32.50 b
Dejlet Noor	2.29 a	0.62 a	1.88 a	1.94 a	0.91 a	62.50 a
Barhi	2.71 a	0.63 a	2.57 a	2.28 a	1.13 a	65.00 a

Means within the same column followed by different small letters are significantly different at $p \leq 0.5$.

3.2 Effect of offshoot weight

Regarding the offshoot weight, the results showed significant differences among the different 4 weights tested in the survival rate (Table 2). The highest percentage of survival rate was at 14-19.99 kg (86.67%), whereas for 20-29.99 kg and 8-13.99 kg the survival rate decreased to 66.67% and 60%, respectively. The lowest survival rate was recorded in the offshoot weight (2-7.99 kg) with only 10%. In all studied parameters, the offshoot weight 14-19.99 kg showed a significant superiority in plant height, trunk diameter, leaf length, leaf number and pinnae number compared with other offshoot weights. The weight of the offshoot of 20-26

kg came in the 2nd place in the outperformance, followed by 8-13.99 kg and the lowest was significantly recorded to the weight 2-7.99 kg (Table 2).

Table (2). Effect of offshoots weight on survival rate and some vegetative parameters.

Offshoot weight	Plant height(cm)	Trunk diameter(cm)	Leaf length(cm)	Pinnae number	Leaf number	Survival rate (%)
2 – 7.99 kg	78.00 d	43.50 c	10.30 d	62.00 c	7.00 d	10.00 c
8 – 13.99 kg	0.10 c	0.067 b	0.14 c	1.08 b	0.50 c	60.00 b
14 –19.99 kg	4.50 a	1.39 a	4.08 a	3.42 a	1.83 a	86.67 a
20 – 26 kg	2.35 b	0.28 b	2.22 b	1.42 b	1.04 b	66.67 b

Means within the same column followed by different small letters are significantly different at $p \leq 0.5$.

The Table (3) showed that there was no correlation between offshoot weight and cultivar, but there was a significant correlation between cultivar and the other studied parameters such as survival rate, plant height, trunk diameter, leaf length, leaf number and pinnae number. The offshoot weight also had a significant correlation with survival rate, plant height, trunk diameter, leaf length, leaf and pinnae number. The statistical analysis showed significant differences in the correlation among all parameters, leaf length, leaf number, plant height, stem diameter, number of leaves and survival rate (Table 3).

Table (3). Correlation analysis among date palm cultivars and offshoot weight with survival rate and some vegetative parameters.

	Cultivar	Offshoot weight	Plant height	Trunk diameter	Leaf length	Pinnae number	Leaf number	Survival rate
Cultivar	1.000	0.000	0.474**	0.479**	0.428**	0.476**	0.296**	0.436**
Offshoot weight		1.000	0.547**	0.528**	0.533**	0.479**	0.538**	0.658**
Plant height			1.000	0.984**	0.988**	0.974**	0.867**	0.903**
Trunk diameter				1.000	0.987**	0.981**	0.858**	0.903**
Leaf length					1.000	0.980**	0.862**	0.887**
Pinnae number						1.000	0.821**	0.894**
Leaf number							1.000	0.724**
Survival rate								1.000

** . Correlation is significant at the 0.01 level.

4. Discussion

The genotypes could have a significant influence on root initiation (Isaied et al., 2018), and Barhi cultivar is considered one of the most cultivars that is easy to propagate by offshoots, and this is mostly due to its genetic nature. The high performance of Barhi in survival rate may be due to high storage C: N ratio in the offshoot roots. El-Sharabasy (2004) and Hartmann et al. (2011) demonstrated that there were compound differentiations that stimulate rooting according to different cultivars. Isaied et al (2018) noticed that shoot growth and dry matter accumulation are higher in Barhi compared to Dejetlet Noor and Medjool. The response of the offshoots to form a callus that stimulates by cellular division refers to accumulation of natural auxin and carbohydrates, leading to increase transpiration rate and ethylene released, which plays an important role in formation the adventitious roots (Al-Obeid, 2005).

The variation in the vegetative parameters among the different date palm cultivars may be due to genotype differences; the best vegetative parameters may be referred to more availability of photosynthates (food materials) due to early fruit ripening of Barhi when it was compared with other investigated cultivar. These current are in agreement with the findings of many previous researchers (Qaddoury and Amssa, 2004; Rahmana and Rahkhodaei, 2013, Isaied et al., 2018). The low survival rate of Medjool could be due to sensitivity of the cultivar for many factors like environmental conditions, so it needs more care during transportation and cultivation.

The offshoot weight may have a significant role in the survival rate. In this regard, El-Hammady et al. (1992) stated that propagation by using small offshoots is not preferred because it has a weak rooting system or not formed root system at all. In addition, the large weight used in the current trial (20-29.99 kg) reduce the survival rate, and this may be due to difficulty of dealing with the shoots during the transfer and planting process, which is in line with the findings of Al-Ghamdi (1988), who reported that the offshoots to be survived, must be weighted 12-20 kg when transplanted in the field.

It could be concluded from present study that Barhi cultivar was significantly superior in almost all survival rate and vegetative parameters studied. Deglet Noor cultivar was come in the 2nd position in the superiority, while the last one was Medjool. This study is considered the first study in which offshoot weight and cultivar were studied with each other, and considers as a field study that helps the farmers to determine the appropriate conditions for handling the cultivar and selecting the appropriate weight for offshoot separation from mother plant and transplant them into the field. Further researches on physiological changes of cultivars during different environmental conditions and offshoot transportation of date palm cultivars are required.

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