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Rooting of Aerial Offshoots of Four Date Palm (*Phoenix dactylifera* L.) Cultivars by Air Layering Method using Polyethylene Bags

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Abstract: Ten aerial (high and unrooted) offshoots of each of four date palm (*Phoenix dactylifera* L.) cultivars namely Succary, Seleg, Segie and Khalas were wrapped using polyethylene bags and treated with or without (treated or untreated) commercial Naphthalene Acetic Acid powder (Radicante, 0.8% NAA) . The results revealed that, after 6 months of treatment application in the first season, Segie and Khalas produced well developed root system, while Succary and Seleg produced poor roots. In the second season, the two cultivars Segie and Khalas rooted easily within four months and the other two cultivars Succary and Seleg did not root until left for longer period (within 8 months after treatment application). Data showed that the cultivars differ in number of small roots (diameter < 0.5 cm), number of large roots (diameter >0.5 cm), mean root length, weight of large and small roots, percentage of large and small roots and total root weight in the two seasons of study. Total root weight varied from 2.4 g in Seleg cultivar to 45.3 g in Succary within 6 months compared to 163.5 and 477.6 g for the two cultivars, respectively within 8 month after treatment application. The second year data showed significant higher mean root length in Succary compared to the two cultivars, Segie and Khalas. As for the NAA treatments, the untreated offshoots in the second season gave significant higher values of total root weight, small root weight and percentages of small and large root weights compared to the treated ones, while a different trend (though not significant) was observed in the first season. This difference was thought to be due to the variation in the endogenous hormones of the two groups (easy and difficult-to root cultivars). Wrapping the offshoots bases with polyethylene bags proved to be suitable for aerial offshoot rooting since the polyethylene bags maintained the moisture around the offshoots bases all the duration of the study.

Key words: *Phoenix dactylifera*, aerial offshoot, air layering, Naphthalene acetic acid

INTRODUCTION

Date palm offshoots arising from the base of the mother stem have a high survival rate due to the well-developed root system. Aerial offshoots which arising from a high position on the mother stem, lack such root system and their survival is very low[1,2]. Aerial offshoots are usually discarded and rarely used for propagation[3]. However, they should be removed early when they are small in size, possibly to avoid causing a weak point in the mother stem.

Some conventional and laborious methods are practiced on the mother palm before the separation of offshoots; such methods accelerate root induction and improve the rooting ability, which maximize the survival rate of aerial offshoots. Metal or wood box containers have been used to hold the rooting media at the base of the offshoots and frequent irrigation is required[4]. Such technique is commonly used for propagation of date palm in Saudi Arabia, Sudan[5] and some other countries. Periodic watering is an essential need, however it is a tedious job and failure to fulfill this need may result in delay or lack of aerial offshoots rooting.

An improved method was described by Raz[1], who used polyethylene bags to wrap and hold a media of wet wood shavings at the base of the aerial offshoot. Both the media and the container were easy to handle and no periodic watering was required.

Reuveni *et al.*[3] tried dipping offshoots or spraying them with root promoting growth regulators (auxins) to improve offshoot rooting but they did not get good results and concluded that the substances either did not reach the site of action or were not taken by the offshoots. Other reports[6] revealed an effective increase in rooting of aerial offshoots when treated with auxins. Al-Mana *et al.*[7] showed that aerial offshoots treated with NAA and/or catechol (as a rooting co-factor) resulted in good root formation and development. Large offshoots size was found to contain greater qualities of endogenous root promoting substances or smaller quantities of rooting inhibitors[8].

The present investigation was designed to study the rooting ability of aerial date palm offshoots, locally known

as rakoup, of four cultivars (Succary, Seleg, Segie and Khalas) treated with or without dusting the offshoot base with a commercial rooting powder (Radicante) containing 0.8% Naphthalene Acetic Acid (NAA) and to determine the time required for root formation using the procedure described by Raz[1].

MATERIALS AND METHODS

This research was carried out twice during January of 2002 and 2003 at the Agricultural Experiment Station at Dierab, south of Riyadh (24°N, 46°E), College of Agriculture, King Saud University. Similar aerial (high and unrooted) offshoots were used in this study. Four cultivars were chosen; Succary, Seleg, Segie and Khalas, which are commonly grown in the mid- and eastern regions of the Kingdom of Saudi Arabia. Ten offshoots from each cultivar were chosen and randomly divided into two groups: the first group (five offshoots≡five replicates) was treated with a commercial auxin powder and the other group was not treated. Offshoots bases were cleaned by removing the old leaf bases and the fibers surrounding the stem.

The commercial auxin powder Radicante Polvere Talee Legnose (0.8 % Naphthalene Acetic Acid) a product from Biolchim S. P. A. Medicina Bologna, Italy was applied as dust on offshoots bases after wetting them. Every offshoot was wrapped using a transparent polyethylene bag, which was wrapped around the offshoot base and tied at the bottom and filled with an equal amount of wet peat moss. The polyethylene bag was then tightly tied to keep the peat moss wet until the end of experiment. Offshoots were prepared for treatments during the first week of January 2002, they were cut after 6 months (June 2002) and the root growth parameters were studied. The offshoots in the second year were prepared for the treatments at the same time, the transparent polyethylene bag was regularly checked to note the dates when rooting occurred. Rooting was evident in two cultivars, Khalas and Segie, by the second week of May 2003, at which time they were separated from the mother plants. The other two cultivars, Succary and Seleg, were separated by the end of August 2003.

Offshoots were separated from the mother plants by cutting the connection below the bases of the offshoots. The roots formed were cut after the removal of the polyethylene bag from the offshoot base. The roots were divided into two groups: large diameter (more than 0.5 cm) and small diameter (less than 0.5 cm). The roots of each size were then counted, weighed and the length of 10 main roots was measured.

Data obtained in this study were subjected to analysis of variance using SAS[9]. The least significant difference was given as a mean separation.

RESULTS AND DISCUSSION

Period required for root formation: The offshoots of the four cultivars were separated from their mother plants at the same time 6 months after the treatment application in the first season. A very poor root system developed after this period in Succary and Seleg cultivars compared with the well developed one in the other two cultivars, Segie and Khalas (Table 1 and 3). In the second season, the two cultivars Segie and Khalas developed their root system within four months from the on set of the treatment time (January 2003) and they were separated during the second week of May 2003. At this mentioned date no sign of rooting was noticed in the other two cultivars Succary and Seleg, which were left until rooting was noticed four months later (August, 2003). The time required for root formation differed for the different cultivars, Siegie and Khalas could be considered easy rooting, since the rooting occurred during the first four months. On the other hand, Succary and Seleg cultivars rooted within 8 months, so they could be considered as difficult rooting.

Table 1: Effects of cultivars and NAA commercial Powder on root number and root length of aerial offshoots of four date palm cultivars

	Root number					
	Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)		Mean root length (cm)	
	*Season 2002	#Season 2003	Season 2002	Season 2003	Season 2002	Season 2003
Cultivars						
Succary	12b	445a	4b	71a	2.51b	21.09a
Seleg	1b	193b	1b	27a	0.24b	17.81ab
Segie	208a	184b	166a	60a	9.06a	14.00b
Khalas	227a	120b	164a	50a	11.74a	11.66b
NAA treatments						
Treated	145a	218a	182a	41a	7a	13b
Untreated	22a	253a	42a	63a	5a	19a

Means not sharing the same letter(s) within columns are significantly different ($p<0.05$), Duncan's Multiple Range Test

*= Studied 6 month after treatment application

=Data collected 4 month after treatment application for Segie and Khalas and 8 Months for Succary and Seleg

Table 2: The interaction between cultivars and the NAA commercial powder on root number and root length of aerial offshoots of four date palm cultivars

		Root number					
		Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)		Mean root length (cm)	
		Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003
Cultivars	NAA Treatment						
Succary	Treated	23b	544a	9b	96a	5ab	18.48a
	Untreated	0b	347a	0b	46b	0b	23.70a
Seleg	Treated	2b	284a	2b	32bc	0.47b	18.40a
	Untreated	0b	101a	0b	21c	0b	17.23ab
Segie	Treated	397a	41a	326a	31c	9.41a	11.28ab
	Untreated	20b	199a	6b	90a	8.71ab	16.73ab
Khalas	Treated	307ab	03a	244ab	5d	13.35a	4.75b
	Untreated	147ab	366a	83ab	96a	10.13a	18.58a

Means not sharing the same letter(s) within columns are significantly different ($p<0.05$), Duncan's Multiple Range Test

Table 3: Effects of cultivars and NAA commercial powder on root weight of aerial offshoots of four date palm cultivars

	Root weight (g)						%Root weight			
	Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)		Total root weight (g)		Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)	
	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003
Cultivars										
Succary	20.1b	224.8a	25.2b	252.8a	45.3bc	477.6a	49.1a	51.9a	50.9b	48.1a
Seleg	1.0b	87.5b	1.4b	76.1b	2.4c	163.5b	49.2a	46.7a	50.8b	53.3a
Segie	471.3a	158.4ab	513.2ab	261.9a	984.5ab	420.3a	44.6ab	33.1a	55.4ab	66.9a
Khalas	393.3ab	140.1b	909.2a	92.6b	1302.5a	232.7b	31.1b	45.9a	68.9a	54.1a
NAA treatments										
Treated	364.5a	113.3b	598.8a	157.8a	963.2a	271.0b	40.6a	36.6b	59.4a	63.4a
Untreated	78.4a	192.1a	125.8a	183.9a	204.2a	376.0a	46.4a	52.3a	53.6a	47.7b

Means not sharing the same letter(s) within columns are significantly different ($p<0.05$), Duncan's Multiple Range Test

Nevertheless, the offshoots of both the easy and difficult rooting cultivars developed their root system regardless of NAA treatment (Tables 1 and 3), the same trend was found by Reuveni and Adato[8].

Cultivars and root growth parameters:

Root number and length: The studied cultivars in the present experiment exhibited a wide range of differences in their ability of rooting. Regardless the effect of NAA treatments, data (Table 1) showed that Segie and Khalas cultivars produced significant greater root number of both large and small-diameter roots and root length compared with the two other cultivars within the 6 months in the first season, 2002. The Succary within 8 months in the second season 2003, significantly produced higher small-diameter root number compared with Seleg within the same period and significant higher small- diameter root number and root length when compared with Segie and Khalas cultivars. No significant differences were found among Seleg, Segie and Khalas in small-diameter root number and among all cultivars in large-diameter root number. The NAA treatment, regardless of the cultivars showed no significant difference between the treated and untreated offshoots in number of small and large- diameter roots for the two seasons (Table 1). The mean root length of the untreated offshoots was significantly higher in the second season (Table 1). The interaction between the cultivars and NAA treatments showed a significant increase in small and large-diameter root numbers of treated Segie offshoots compared with the untreated ones of the same cultivar and a non-significant increase in the number of both small and large-diameter roots and mean root length of the treated offshoots compared with the untreated ones for all cultivars in the first season, 2002 (Table 2). However, the easy rooting cultivars Segie and Khalas in the second season showed clearly that the untreated offshoots produced higher significant values of large-diameter roots number compared with the treated offshoots. The untreated Khalas offshoots produced also longer root mean length. The untreated offshoots of the difficult rooting cultivars, Succary and Seleg, showed an opposite response to the NAA treatment. A positive trend to the NAA treatment was clear for all parameters studied in the two seasons, it is not significant except for the number of large-diameter roots of Succary cultivar in the second season (Table 2).

Root weight: The weight of small and large-diameter roots and total root weight for Siegie and Khalas cultivars, irrespective to NAA treatments, showed higher values in the first season since they rooted within the first 6 months of the experiment, while the other two cultivars; Succary and Seleg produced little or no roots and the root growth parameters hence were very poor (Table 3). Succary in the

Table 4: The interaction between cultivars and the NAA commercial powder on root number and root length of aerial offshoots of four date palm cultivars

		Root weight (g)						%Root weight			
		Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)		Total root weight (g)		Small diameter (< 0.5 cm)		Large diameter (> 0.5 cm)	
Cultivars	NAA Treatment	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003	Season 2002	Season 2003
Succary	Treated	40.2b	279.3a	50.4b	387.2a	90.6bc	666.5a	48.2a	42.0a	51.8b	58.0a
	Untreated	0b	170.3a	0b	118.4a	0c	288.7a	0c	61.8a	0c	38.2a
Seleg	Treated	2.0b	129.9a	2.8b	98.3a	4.8c	228.2a	48.5a	53.1a	51.5b	46.9a
	Untreated	0b	45.1a	0b	53.9a	0 c	98.9a	0c	40.3a	0c	59.7a
Segie	Treated	899.6a	41.0a	1006.0ab	137.2a	1905.6a	178.2a	39.3ab	23.5a	60.7ab	76.5a
	Untreated	43.0b	275.9a	20.4b	386.6a	63.4 c	662.4a	49.9a	42.8a	50.1b	57.3a
Khalas	Treated	516.0ab	2.9a	1335.8a	8.4a	1851.8ab	11.4a	26.3b	27.7a	73.7a	72.3a
	Untreated	270.6ab	277.3a	482.6ab	176.8a	753.2abc	454.0a	35.8b	64.2a	64.2ab	35.8a

Means not sharing the same letter(s) within columns are significantly different ($p<0.05$), Duncan's Multiple Range Test

second season when allowed to grow for 8 months gave significant top highest values of total root weight.

The data of the second season showed that the Segie cultivar was significantly higher in large-diameter root weight and total root weight (Table 3 and 4). Although Segie and Succary were comparable and showed similar values for all the studied root growth parameters, Segie could be considered as more vigorous and had the best rooting ability since the values of all its root growth parameters were obtained during a four months period, while the Succary cultivar rooted after eight months.

The Seleg and Khalas cultivars irrespective to the NAA treatments, had lower means in most of the studied root growth parameters compared with the other cultivars (Table 1 and 3), however, Seleg was lower in all of them compared with Khalas except the number of small- diameter roots, mean root length and the percentage of small-diameter roots. The advantage of Khalas over Seleg in the rooting ability could be more appreciated and valued to consider Khalas as an easy-rooting cultivar, since the means given for the above root growth parameters were obtained in a period of four months compared with eight months for Seleg.

Auxin and root growth parameters: The data of NAA treatments in the second season (Table 1 and 3) revealed significant higher values of total root weight, small-diameter root weight, percentage of small-diameter roots and root length for the untreated offshoots compared with the treated ones, which meant that NAA possibly acted as a growth inhibitor, while the results of the first season showed the opposite for the mentioned parameters though it is not significant. This inhibiting action of NAA was in agreement with the findings of Reuveni *et al.*[3] but other researchers did not find such effect. This conflict concerning the effect of NAA may be explained through the different response of the easy- rooting and difficult- rooting cultivars to the applied NAA. Succary and Seleg which were categorized as difficult- rooting cultivars showed similar positive response in the two season while the Segie and Khalas cultivars which are considered as easy- rooting cultivars showed different (positive and negative) response in the two seasons. The offshoot rooting is a result of the endogenous growth promoters and growth inhibitors[8]. This balance may be shifted differently in the two groups of cultivars when treated with NAA. The interaction of the NAA treatment and the cultivars, clearly explains the above conclusion when we examine the two groups of cultivars separately (Table 2 and 4).

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