

Improving Root Development on Ground and Aerial Date Palm Offshoots

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ABSTRACT

This investigation was carried out to study the effect of different rooting media and naphthalene acetic acid (NAA) and/or catechol on root development of small size ground and aerial offshoots of two date palm cultivars namely Sheshi and Shahl in order to improve their survival.

Results showed that rooting medium was an important factor in determining the extent of root formation of offshoots. The highest rooting percentages were obtained using the following media, perlite : peat moss (3:1) medium followed by the woodshavings : peat moss (1:1) and perlite : peat moss (1:1) media. Sand medium was inferior to the other media.

It was also found that neither rooting percentage nor root weight of ground offshoots were increased by NAA and/or catechol treatments. On the other hand, NAA and/or catechol treatments appeared to be essential for good root formation and development on aerial offshoots.

INTRODUCTION

Date Palm (*Phoenix dactylifera*, L) represents the most important fruit tree in Saudi Arabia for fruit production, ornamental and landscape purposes. During the last several years, there has been a great demand for date palm offshoots. The survival of the small-size and aerial offshoots is very low and they require special nursery conditions. The propagation of date palm trees through offshoots has been the main method up till now. Ground offshoots of large sizes are usually used for this purpose. The use of small sized and aerial (high and unrooted) offshoots is not practical due to their low survival (Raz, 1959; Vij *et al.*, 1977; Al-Ghamdi, 1988). Therefore, they are usually discarded during the separation process of large sized ones (Reuveni *et al.*, 1972; Mohammed, 1978). However, these offshoots could regenerate roots and be used successfully if an inverted intermittent mist system is used (El-Hamady *et al.*, 1992).

Auxins have been implicated in the adventitious root initiation of several plant species (Gasper and Hodinger, 1989). However, there was no agreement on the effect of auxins application on root formation of date palm offshoots. Auxin treatment was found to increase rooting effectively on the aerial offshoots (Gupta and Godara, 1984). No such effect was found in other reports (Reuveni *et al.*, 1972). It has been reported that beside the suitable auxin content of the plant material, there are several other rooting co-factors which occur naturally in the cuttings of several plant species. These co-factors appear to act synergistically with auxins in the root initiation process of hard-to-root cuttings (Hess, 1968; James *et al.*, 1980; James and Thurbon, 1981; Jones and Hopgood, 1979). The action of these co-factors in root promotion could be, at least partly, in protecting the indole acetic acid (IAA), the naturally occurring hormone thought to be the most responsible root initiation from destruction by the enzyme, IAA-oxidase (Donoho *et al.*, 1962; Reuveni and Adato, 1974; Fadl *et al.*, 1979). These co-factors are thought to be phenolic compounds (Hess, 1968).

Limited information concerning the effect of phenolic compounds treatments on rooting of detached date palm offshoots are available in the literature. Thus, this study was carried out for the following purposes :

1- Evaluation of different rooting media on root development on small size ground and aerial offshoots of Sheshi date palm cultivar.

2- Effect of NAA and/or catechol on root formation and regeneration on small size ground and aerial offshoots of Shahl date palm cultivar.

Materials and Methods

This study was carried out during 1992 and 1993 in the lathhouse at the Agricultural Research Station of Deirab, College of Agriculture, King Saud University. Ground offshoots of weights ranging from 2 - 6 Kg and aerial offshoots of various weights were separated from both Sheshi and Shahl date palm cultivars in late spring. After separation, all offshoots were sterilized by soaking the entire offshoots in Bavastin solution (fungicide material containing 50% Carbendazim {2-methocarbonyl amino-benzimidazol}) for 30 minutes. These offshoots were used for the following two experiments :

Experiment No. 1 :

Evaluation of different rooting media :

The sterilized offshoots were planted in plastic containers (8 gallons) filled with six various rooting media. Thirty ground offshoots and 25 aerial offshoots of the cultivar Sheshi were used in this experiment. Media used were as follows:

- 1 - Woodshavings.
- 2 - Mixture of woodshavings : peat moss (3 : 1 v/v).
- 3 - Mixture of woodshaving : peat moss (1 : 1 v/v).
- 4 - Mixture of perlite : peat moss (3 : 1 v/v)
- 5 - Mixture of perlite : peat moss (1 : 1 v/v).
- 6 - Sand.

Each of the six media were represented by five ground offshoots, where each offshoot was considered as a replicate. The same media were used for the aerial offshoots, except media number 5 (mixture of perlite : peat moss {3:1 v/v}) was eliminated for lack of offshoots. The planted offshoots were randomly arranged in the lathhouse. The offshoots were irrigated using a simple drip irrigation system, and each offshoot received the same amounts of water.

Six months later, the offshoots were dug out and the rooting percentage and the length of the longest roots were determined. Then, all the newly formed roots were removed and their total fresh weight for each offshoot was recorded. The small diameter roots (less than 0.5 cm) were separated and their weight was determined and the percentage that this weight represented from the total root weight was calculated.

Experiment No.2 :

Effect of NAA and /or catechol treatments :

Thirty six of ground offshoots and a similar number of aerial offshoots from Shahl cultivar were prepared as described before. The bases of these offshoots were treated with one of the following treatments:

- 1- Dusting offshoot bases with rooting powder containing 8 % NAA.
- 2- Soaking offshoot bases in solution containing 25 ppm of catechol.
- 3- Soaking offshoot bases in solution containing 50 ppm of catechol.
- 4- Treatment No. 2 + treatment No. 1 .
- 5- Treatment No. 3 + treatment No. 1 .
- 6- Control(untreated).

The offshoots were planted in plastic containers (8 gallons) filled with a mixture of perlite : peat moss (1:1 v/v). Six offshoots from each type were used for each treatment. Each offshoot was considered a replicate. The experiment was arranged randomly in the lathhouse, and

offshoots were dug out for examination 6 months later. The same procedure and data taken in the first experiment were followed.

All data were subjected to analysis of variance and means were separated by the Duncan's multiple range test at 0.05 level of probability as described by Steel and Torrie (1980).

Results

Experiment No. 1:

Evaluation of different rooting media:

a - Ground offshoots :

Rooting percentages (100%) of Sheshi ground offshoots were achieved in all treatments (Table 1 and Fig.1). The greatest root length was obtained when a mixture of woodshavings : peat moss (3:1) was used, whereas the root length produced in woodshavings : peat moss (1:1) was significantly shorter than the other media (Table 1). It was also found that the greatest total fresh root weight was obtained in the perlite : peat moss (3:1) medium. On the other hand, the lowest total fresh root weight was obtained when sand medium was used (Fig.2). It was also found that the ratio of the weight of the small diameter roots to the weight of the total roots was greatest in both woodshavings : peat moss (1 :1) and perlite : peat moss (3:1) media . The other media gave statistically significant lower ratios (Fig. 3).

b- Aerial offshoots:

The highest rooting percentage was obtained when perlite : peat moss (3:1) medium was used, while the lowest value was obtained in the sand medium (Table 1 and Fig. 4). The longest roots were found in the woodshavings medium, while the sand medium had the shortest root (Table1).

Table (1). Effect of rooting media on rooting percentage and length of roots of Sheshi cultivar ground and aerial offshoots.

Chararcter	Ground offshoots		Aerial offshoots	
	rooting %	Root length (cm)	Rooting %	Root length (cm)
Woodshavings	100	35.6 a	40 b	47.6 a
woodshaving : peat moss (3:1)	100	42.6 a	40 b	35.0 b
woodshaving : peat moss (1:1)	100	25.8 b	40 b	29.0 b
perlite : peat moss (3:1)	100	38.0 a	60 a	36.7 b
perlite : peat moss (1:1)	100	41.2 a	—	—
Sand	100	40.4 a	20 c	15.0 c

Means not sharing the same letter(s) within each column are significantly different at 0.05, Duncan's multiple range test.

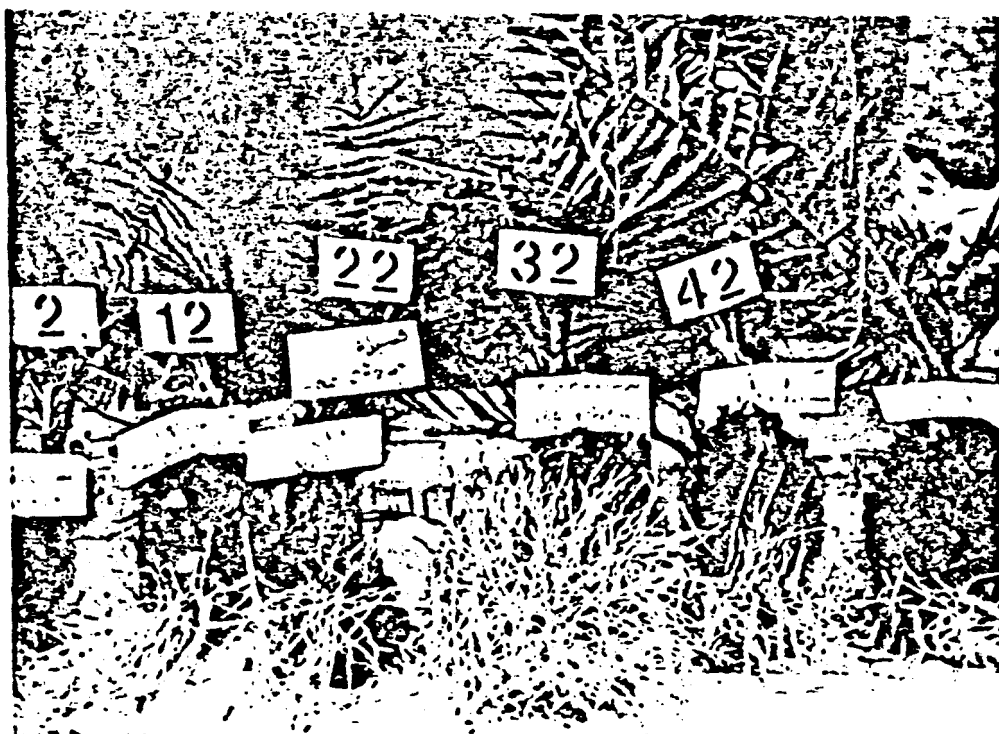


Fig. (1) The effect of different rooting media on root development of ground offshoots of Sheshi cultivar.

Used media left to right were : Woodshaving, Woodshaving : Peat Moss (3:1), Sand, Perlite : Peat Moss (3:1), Woodshavings : Peat Moss (1:1), and Perlite : Peat Moss (1:1).

It was also shown that the greatest total fresh weight of the formed roots were in the woodshavings : peat moss (1:1) medium, followed by the perlite: peat moss (3 :1). However, the fresh total root weight was drastically reduced in the sand medium (Fig.2). It was also evident that the highest ratio of the small diameter roots weight to the total fresh roots weight was obtained in the woodshavings : peat moss (1:1) followed by the perlite : peat moss (3:1) and woodshavings : peat moss (3:1) treatments , while the sand medium had the lowest ratio (Fig.3).

Experiment No.2 :

Effect of NAA and / or catechol treatments :

a - Ground offshoots:

Data of this study showed that all treatments gave a 100 % root generation on Shahl ground offshoots regardless of the treatment (Table 2). The longest roots were obtained in the 50 ppm catechol and the control treatments (Table 2). It was also found that the greatest fresh root weight was obtained in the control and the NAA + 50 ppm catechol treatments (Fig.5).

When the ratio of the weight of the small roots diameter/total roots weight is considered, it became evident that the NAA + 50 ppm catechol treatment was the best followed by the 50 ppm catechol treatment (Fig.6).

b- Aerial offshoots:

Data showed that the greatest rooting percentage of Shahl ground offshoots was achieved in the NAA hormone powder (8 %) treatment while the lowest was obtained in 50 ppm catechol treatment. Also, there were no significant differences among the NAA + 25 ppm catechol, NAA + 50 ppm catechol and the control treatment (Table 2).

The longest roots were obtained in the NAA, 25 ppm catechol and NAA + 50 ppm catechol treatments. On the other hand, the shortest roots were obtained in the NAA + 25 ppm catechol and the control treatment (Table 2).

Table (2). Effect of NAA and/or Catechol treatments on rooting percentage and length of roots of Shahl cultivar ground and aerial offshoots.

Character	Ground offshoots		Aerial offshoots	
	Rooting %	Length of root (cm)	Rooting %	Length of root (cm)
NAA*	100	34.3 b	83.4 a	23.7 a
25 ppm catechol	100	29.3 b	50.0 c	23.8 a
50 ppm catechol	100	54.8 a	33.3 d	22.9 a
NAA + 25 ppm catechol	100	32.8 b	66.6 b	13.6 b
NAA + 50 ppm catechol	100	35.0 b	66.6 b	23.7 a
Control	100	49.0 a	66.6 b	9.8 b

Means not sharing the same letter(s) within each column are significantly different at 0.05, Duncan's multiple range test.

* Rooting hormone powder containing 8% NAA.

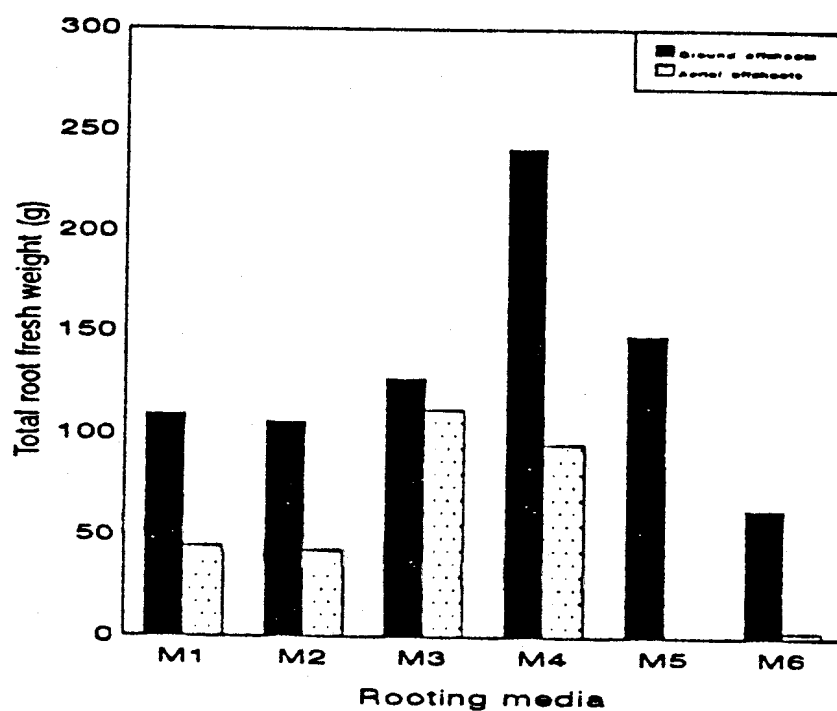


Fig. (2) The effect of rooting media on total root fresh weight of Sheshi date palm cultivar ground and aerial offshoots.

(M1= Woodshavings; M2= Woodshaving : Peat Moss (3:1); M3= Woodshavings : Peat Moss (1:1); M4= Perlite : Peat Moss (3:1) M5= Perlite : Peat Moss (1:1); M6= Sand)

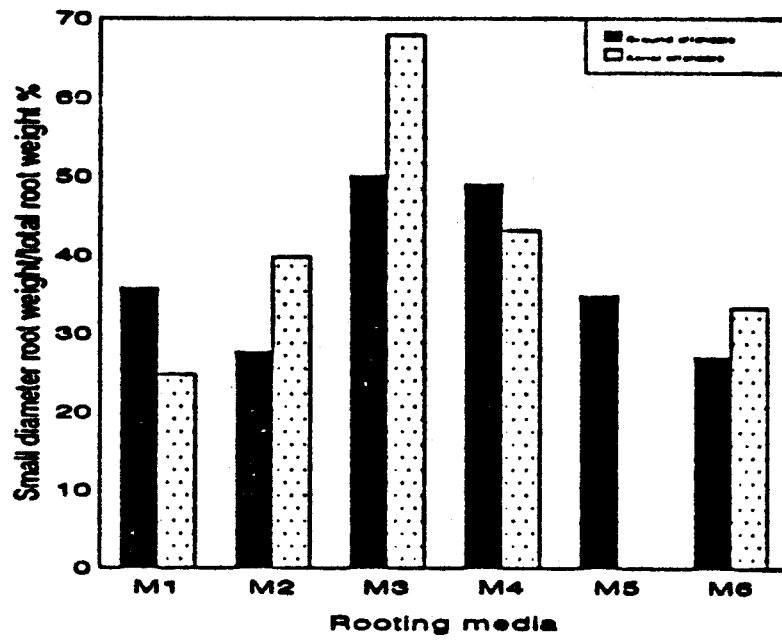


Fig. (3) The effect of rooting media on small diameter root weight/total root weight of Sheshi date palm cultivar ground and aerial offshoots. (M1= Woodshavings; M2= Woodshaving : Peat Moss (3:1); M3= Woodshavings : Peat Moss (1:1); M4= Perlite : Peat Moss (3:1); M5= Perlite : Peat Moss (1:1); M6= Sand)

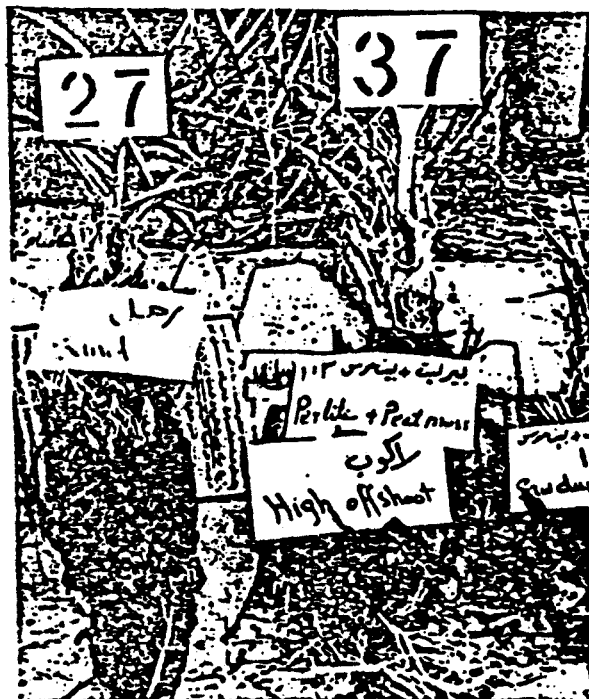


Fig. (4) A comparison between root development of Sheshi date palm aerial offshoots in sand or perlite : peat moss (3:1) media.

Total fresh weight of the formed adventitious roots of the shahl aerial offshoots was the greatest in the NAA treatment followed by the 50 ppm catechol and the NAA + 25 ppm catechol treatments in decreasing order. The lowest fresh root weight was obtained in the untreated offshoots (Fig.5).

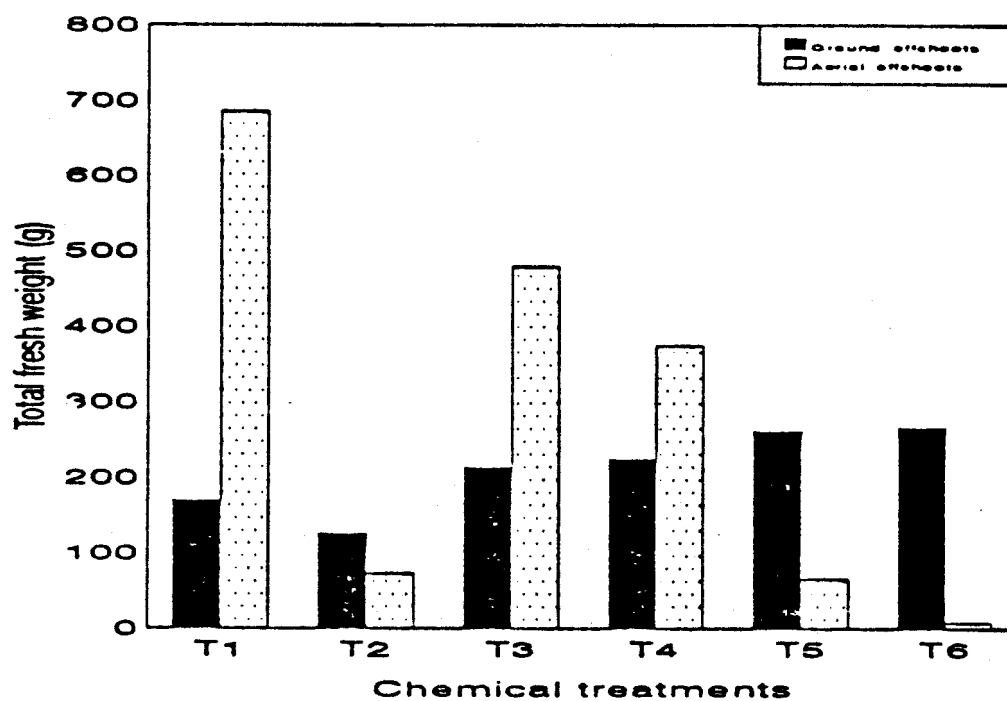


Fig. (5) The effect of NAA and /or catechol treatments on root total fresh weight of Shahl date palm cultivar ground and aerial offshoots.

(T1= NAA; T2= 25 ppm catechol; T3= 50 ppm catechol ;T4= NAA + 25 ppm catechol; T5= NAA + 50 ppm catechol; T6= control)

Highest values of small diameter root weight as percentages of total root weight were obtained in the NAA and NAA + 25 ppm catechol treatments. Lower values were obtained in the 25 ppm catechol and NAA + 50 ppm catechol treatments (Fig.6).

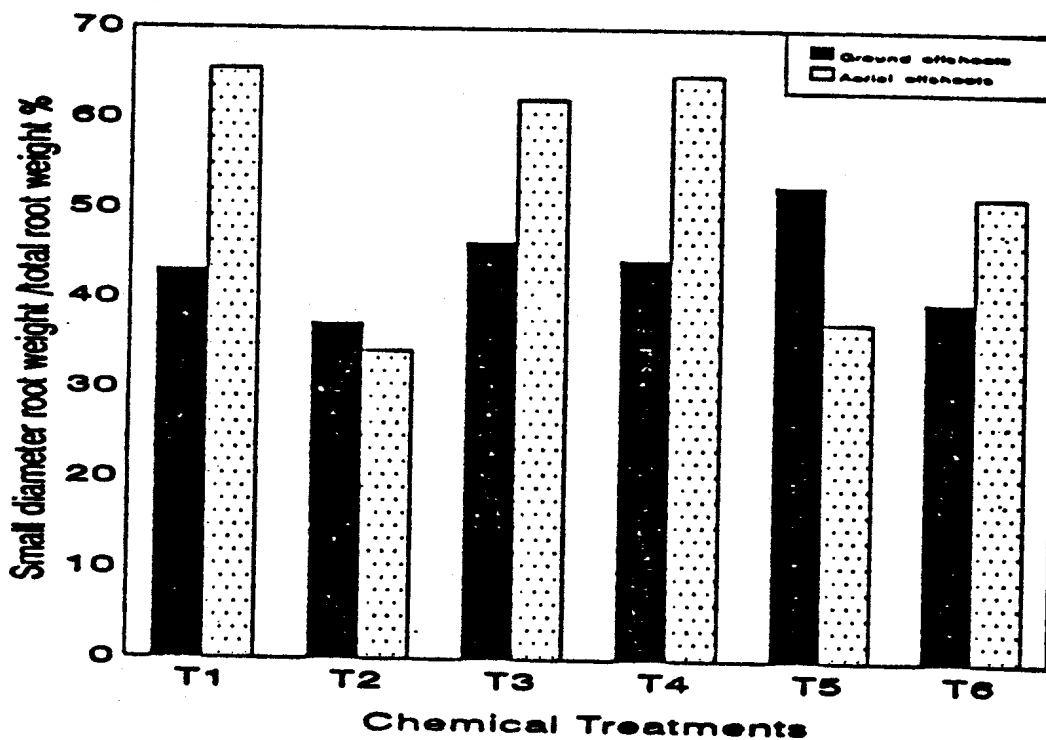


Fig. (6) The effect of NAA and /or catechol treatments on small root percentage of Shahi date palm cultivar ground and aerial offshoots.

(T1= NAA; T2= 25 ppm catechol; T3= 50 ppm catechol; T4= NAA + 25 ppm catechol; T5= NAA + 50 ppm catechol; T6= control)

Discussion

Rooting medium is an important factor in determining the extent of adventitious roots formation in many plant species (Hartmann *et al.*, 1990). This was shown to be also true for root formation and development in date palm offshoots. However, sand medium was found to be inferior to other media mixtures evaluated in this study.

It is expected that as the small diameter roots form a high percentage of the total formed roots, the absorption capacity of the root system will increase (El-Hamady *et al.*, 1992). Thus, higher ratio of smaller diameter roots percentage is expected to increase offshoot survival chances. The statistical analysis revealed that the highest percentages were obtained in both woodshaving : peat moss (1:1) and the perlite : peat moss (3 : 1) treatments, whereas the lowest ratio was with sand medium. On the other hand, the use of sand as a rooting medium was inferior to the studied media. The rooting percentage as well as the other studied root characters were inferior in sand medium. Therefore, the use of sand medium is not recommended for root development on offshoots. Also, total fresh root weight in sand medium was rather low so that the continuation survival in the permanent place might be doubted.

It was also found that neither rooting percentage nor total roots fresh weight of ground offshoots were increased by NAA and/or catechol treatments. However, small rooting percentage was increased in these treatments over the control, which might give some support to the application of such treatment.

On the other hand, NAA and/or catechol treatments appeared to be essential for good root development on aerial offshoots. However, no synergistic effect was evident in this respect as indicated for other plant species (Hess, 1968; James *et al.*, 1980; James and Thurbon, 1981; Jones and Hopgood, 1979). Auxin treatments were reported to be

effective in inducing root formation on aerial offshoots where indole butyric acid (IBA) treatment was found to be effective in increasing rooting of high offshoots (Gupta and Godara, 1984), which is in agreement with the results of this study . However, other workers did not find such effect (Reuveni et al., 1972).

The following points could be concluded from this study :

1- The use of rooting media other than sand is recommended since it improved the rooting percentage in aerial offshoots . Moreover, root quality in both ground and aerial offshoots was also better when media other than sand were used.

2- Treating aerial offshoots with NAA and/or catechol seems to be required for attaining good rooting. Thus, these treatments might be recommended.

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زيادة تكوين الجذور على فسائل ورواكيب نخيل البلح

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ملخص البحث

أجري هذا البحث لدراسة تأثير عدد من البيئات والأكسين (نفتالين حمض الخليك) و/أو الكاتيكول على تكوين الجذور وتقدمها في الفسائل والرواكيب الخاصة بأشجار نخيل البلح صنفى الشيشي والشهل.

وقد أوضحت نتائج هذا البحث أن البيئة المستخدمة في إكثار فسائل نخيل البلح تعتبر عاملاً مهماً في مدى تكوين الجذور وتقدمها. وقد أمكن الحصول على أعلى نسبة منوية من الجذور المتكونة عند استخدام بيئة مكونة من بيرليت : بيت موس (٣ : ١) يليها بيئة نشارة الخشب : بيت موس (١ : ١) ثم بيئة بيرليت : بيت موس (١ : ١)، أما بيئة الرمل فكانت أقل البيئات في تأثيرها على تكوين الجذور.

وقد وجد أيضاً أنه لم يكن لإستخدام كلا من حامض الخليك و/أو الكاتيكول تأثيراً واضحاً على النسبة المنوية لتكوين الجذور أو على وزن الجذور. في حين وجد أن هذه المعاملات تعتبر ضرورية لتكوين جذور جيدة في حالة استخدام الرواكيب في التكاثر.