ا ملكة العربية السعودية
وزارة التعليم العا
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عمادة البحث العلمي

Kingdom of Saudi Arabia
Ministry of Higher Education
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تقرير متابعة مشروع بحث ممول

التقرير:

الأول ☐ الثاني ☐ الثالث ☐ الرابع ☐ النهائي ☐

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القسم: -

٢. عنوان المشروع: تجذير فسائل النخيل الهوائية صنف خلاص بواحة الاحساء

- **٣. رقم المشروع : ٢٠٤٣**
- **ميزانية المشروع : ١٢٢٣٠٠ ريال**
- **المنصرف حتى تاريخ التقرير:**
- **تاريخ البدء في المشروع : ١ / ١ / ١٤٢٢ هـ**
- **التاريخ المتوقع للأنتهاء: ٣١ /٣ / ١٤٢٣ هـ**

٤. النسبة التقريبية لما تم انجازة من المشروع:

اقل من ١٠% ☐ بين ١٠% و٣٠% ☐ بين ٣٠ % و ٦٠ % ☐ أكثر من ٦٠ % ☐

٥. صعوبات تواجه المشروع:

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٦. معد التقرير: د. حسن مزهل على دينار

التوقيع: .... **التاريخ: ٢٧ / ٨ / ١٤٢٤ هـ**

البريد الألكتروني: ....

تقرير عن ما تم انجازه فى المشروع

Introduction

Date palm (*Phoenix dactylifera* L.) is the major fruit crops in Kingdom of Saudi Arabia. Its utilization is quite variable ranging from food security to ornamental and landscape purposes. Offshoots are normally used in propagation due to their ability of root regeneration (REUVENI et. al., 1972; MOHAMMED, 1978; El-HAMADY et. al, 1992; IBRAHIM and KHALIF, 1998). This ability is highly cultivar dependant with certain high quality ones difficult to root. However, with the increasing demands for date palm offshoots in recent years, farmers tendency to use offshoots of low quality has tremendously increased. Offshoots of certain high quality commercial cultivars have been always difficult to root and their survival ability is low (VIJ et. al, 1977; AL-GHAMDI, 1988, AL-MANA et. al., 1996).

Isoprothiolane (diisopropyl-1, 3-dithiolan-2-ylidenemalonate, IPT) is a fungicide (12% hormone, 126 IPT) mainly used for control of rice blast. Recently, IPT has been proven to demonstrate a hormonal action in rice (OHTSUKA and SAKA, 1988). Improvement of development of seminal root, promotion of root formation in kidney bean (*Phaseolus vulgaris* L.) and azuki bean (*Phaseolus angularis* L.) by using IPT was also reported (OHTSUKA et. al., 1990). Recently, OKAWARA et al. (2003) were able to dramatically enhance top and root growth of young date palm plants with application of IPT. Other hormones as well showed their substantial ability to initiate rooting of several plant species (GASPER and HODINGER,1989, ISMAIL and EGAILI, 1993). Auxins in general, have been intensively used in adventitious root initiation of many hardwood crops (GUPTA and GODARA, 1984, GASPER and HODINGER,1989). Next to the obligatory presence of endo- or exogenously applied auxin (HAISSIG, 1972), rooting initiation seems to involve the mobilization or redistribution of certain minerals. Several authors revealed that N had great effects on root initiation of cuttings with a low or medium N supply resulting in the highest rooting (HAUN and CORNELL, 1951). The significant role of N in root growth and development was also noticed and explained by its need for nucleic acid and protein synthesis in addition to carbohydrate metabolism. The high C/N ratio was noticed to always favour rooting of several plant species (PEARSE, 1943). However, other reports revealed negative correlations between N and root number and weight in cuttings of certain plant species (JUNGR, 1970, KURVITS and KIRKBY, 1980). The negative correlations have led the authors to demonstrate that N composition or source was more important in mineral uptake and carbohydrate and organic acid content of shoots during rooting. It was also found that other rooting co-factors could possibly play a partial role in root initiation (HESS, 1968, JONES and HOPGOOD, 1979, JAMES and THUMBON, 1981). The cofactors may partially prevent the oxidation of the naturally occurring rooting hormone IAA by the enzyme IAA-oxidase (DONOHO et. al., 1962, HESS, 1968, FADL et. al., 1979).

ISMAIL and EGAILI (1993) have used 1000, 2000 and 3000 ppm concentrations of IBA to root different date palm offshoots of different cultivars and sizes. After one year, he found that 'Barnsee' and 'Ahmed Sayed' cultivars were the best to root while 'Elhora' cultivar did not produce any roots under all IBA concentrations. Normally young date palm offshoots have to withstand severe drought conditions until the root system is sufficiently developed for sustainable water absorption. The use of rooting hormones to enhance root formation, considerably shorten the period during which the offshoots may be subjected to adverse drought conditions.

Objectives of the study

The purpose of this study was to stimulate and improve rooting of date palm cv. 'Khalas' offshoots by using auxin rooting hormones (IAA, IBA, NAA) and the hormonal fungicide Isoprothiolane (12% hormone, 126 IPT). 'Khalas' date palm is a major high quality commercial cultivar in Kingdom of Saudi Arabia.

Materials and methods

Plant materials

Two experiments were conducted at Alhassa National Date Palm Center for 15 months (Fig. 1, 2). Uniform offshoots weighing between 25 – 30 kg were separated from mother trees and used for the experiments. Aerial offshoots were used for auxin rooting hormones (IAA, IBA, NAA) while ground offshoots were treated with IPT.

Auxins and IPT application

Aerial offshoots after separation from mother trees were dipped for 10 seconds in IAA, IBA and NAA solutions with the following concentrations: 0 (control/ distilled water), 1000, 2000 and 4000 ppm. IPT, in a granule form (12% effective hormonal dose) at rates of 0 (control/ without IPT), 25, 50, 75, 100, 200 and 500 hole $^{-1}$ was applied to bottom of holes and thoroughly mixed with soil before planting of ground offshoots. All offshoots were planted in March 2001 until April 2002. Proper management practices were given during offshoots growth.

Experimental parameters

After 12 months from planting, offshoots were dug and separated into top (shoot and leaves) and roots (solid rhizome and adventitious roots). Data were obtained for offshoot ability of rooting as indicated in the following scale:

1 represents below 25% rooting of offshoot basal area
2 represents between 25-50% rooting of offshoot basal area
3 represents above 50% rooting of offshoot basal area

Average length and fresh weight of roots in addition to offshoots survival rate were also obtained. Dry weight of roots was determined after oven drying the samples at 80 °C to a constant weight. Offshoot leaf chlorophyll content was determined at the termination of the experiment using a Minolta Chlorophyll Meter SPAD-502.

K^+ and Ca^{2+} contents in roots were determined from dry, powdered root tissue after extraction in HCl, using an atomic absorption spectrophotometer (905AA, GBC, Australia). Total N was determined using an automated semi-macro Kjeldahl apparatus (430l322, Buchi, Swizerland).

Statistical analysis

Treatments were set in a randomized complete block design. Results were expressed as means of 10 replications and statistically separated by Duncan Multiple Test (GOMEZ and GOMEZ 1984). Least significant differences for the 5% probability level are indicated in the figures by bars.

Results and discussion

This study has quantified in details the rooting behavior of aerial and ground offshoots of date palm cv. 'Khalas' in response to IPT and auxin rooting hormones (IAA, NAA and IBA).

IPT and ground offshoots

Rooting percentage and root length of offshoots are shown in Table 1. Data on rooting ability of offshoots have reflected considerable variation between IPT treatments. Substantial rooting was observed on offshoots treated with 75 and 100 g IPT (Fig. 3). Rooting on untreated offshoots (control) and on 25 and 500 g IPT was drastically reduced (Fig. 3). Length of offshoot roots followed almost the same rooting percentage pattern. Both 75 and 100 g IPT applications seemed to be quite optimal and promotive for maximum and efficient rooting of ground offshoots. Offshoots rooting under both applications was approximately 8 to 16 folds better than rootig ability of offshoots under control, 25 and 500 g applications. Root fresh and dry weights were relatively higher in offshoots treated with 75 and 100 g IPT (Table 2). Both root fresh and dry weights were drastically reduced on untreated (control) and 25 and 500 g treated offshoots. This is not surprising, since the rooting ability of offshoots under those treatments was shown to be low (Table 1). The efficiency of rooting under all treatments could probably be explained by the data on offshoot leaf chlorophyll content (Table 3) and root mineral content (Table 4). Leaf chlorophyll content and root mineral content (N, K^{2+}, Ca^{2+}) were significantly higher under offshoots treated with 75 and 100 g IPT. It is quite reasonable to postulate that leaves with higher chlorophyll content had much better photosynthetic ability to support root growth and development. Furthermore, the provision of optimum photosynthates to offshoots might have stimulated the roots of the same offshoots to accumulate higher N, K^{2+} and Ca^{2+} contents. The stimulation and development of roots in plants have been related to hormonal (HAISSIG, 1972; GASPER and HODINGER, 1989), nutritional (HAUN and CORNELL , 1951; SCHMUTZ, 1998) and cofactors (HESS 1968, FADL et al., 1979) mechanisms. Auxins, in particular, have been reported to exert the primary control over root formation (GUPTA and GODARA

1984). However, SKOOG et al. (1951) have demonstrated that meristematic differentiation either to root primordium or to callus and leaf primordium is dependent on the proportion of auxin to cytokinin or to other substances that may stimulate cell division. IPT is a fungicide that has recently been known for its growth- regulatory action in rice (OHTSUKA and SAKA 1988). Its application to soil has also been shown to promote initial root growth in date palm offshoots (OKAWARA et al. 2003). In our study, optimal levels of IPT have distinctly promoted rooting of ground offshoots. Since IPT is not known as an auxin related hormone, we can reasonably assume that its promotive action to root formation possibly reflects interactive indirect effects. Those effects might have been stimulated and favoured by a positive proportion of auxins to other hormones, particularly cytokinin, or/ and by stimulating an active translocation of cofactors with photosynthates from leaves to root zone to promote rooting (JAMES and DONOHO et al., 1962, THUMBON 1981).

IAA, IBA, NAA and aerial offshoots

Variations in rate of rooting, root length and fresh and dry weights of roots under all hormonal applications (IAA, IBA, NAA) reflected negligable differences (Tables 5-6). Despite the fact that almost all offshoots under all treatments rooted, the quality of roots was poor (Fig. 3). Application of IAA, IBA and NAA also exerted no significant differential responses between treatments with regard to leaf chlorophyll content, survival percentage of offshoots and root mineral contents (N, K^{2+}, Ca^{2+}) (Tables 7- 8). For all parameters, a clear trend was difficult to be established under all hormonal treatments. A possible explanation for this situation could possibly lie on the physiological status of offshoots or/ and the environmental conditions of the shade house (SAIDI et al., 1993). The physiological status of offshoots reflect their nutritional status, particularly , the C/N ratio (KRAUS and KRAYBILL 1918, PEARSE 1943), hormonal contents (ISMAIL and EGAILI 1993) and other related cofactors (HESS 1968, FADL et al., 1979). The physiological status of ground offshoots seems to be more stable compared to aerial offshoots which normally do not have roots of their own and completely depend on their mother trees. With this situation one can expect erratic responses of aerial offshoots in all aspects if the physiological status of the mother trees at the time of detachment is quite diverse. Consequently, clear trends and resposes of such offshoots may need longer periods to obtain meaningful results. Results of interactive effects between aerial offshoots rooting and hormones have always been controversial (AL-MANA, et al. 1996, GUPTA and GODARA, 1984, REUVENI et al. 1972).Induction of rooting in aerial offshoots was obtained by using IBA (GUPTA and GODARA, 1984), however, the attempts of REUVENI et al. (1972) were not successful to achieve similar results.

Conclusions

1- The IPT concentrations of 75 and 100 g/ offshoot hole seems to be quite optimal for improving rooting of date palm offshoots.

2- The chlorophyll content data supported the edge effect of 75 and 100 g IPT/ offshoot hole. This edge effect might have played a significant role in the photosynthetic ability of offshoots under those treatments. The photosynthetic ability of the offshoots under the mentioned treatments might have resulted in a relatively balanced nutrient content within the plants to support the photosynthetic ability and hence improve rooting of offshoots.

3- Differential responses of aerial offshoots to variable concentrations of IAA, IBA and NAA to induce rooting was not established. The physiological status of offshoots and shade house environment, were probable reasons speculated for the cause of negative results. Further investigation considering offshoot sizes and time of detachment may be needed to get meaningful results.

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Table(1): Effect of IPT on rooting percentage and root length of date palm ‘Khalas’ cv. Offshoots

IPT concentration (g/ offshoot hole)	Index of rooting %	Average length of offshoot root (cm)
Control (0)	0.25 c	26.7 e
25	0.35 c	46.1 bc
50	1.42 b	46.3 bc
75	2.24 a	56.1 ab
100	2.89 a	63.3 a
200	1.67 b	39.8 c
500	0.18 c	23.2 e

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (2): Effect of IPT on fresh and dry weight of date palm ‘Khalas’ cv. offshoots

IPT concentration (g/ offshoot hole)	Fresh weight (g)	Dry weight (g)
Control (0)	193.6 de	36.8 cd
25	193.5 de	39.7 c
50	391.6 b	48.2 ab
75	356.4 bc	44.8 b
100	460.8 a	54.9 a
200	237.4 d	39.5 bc
500	145.9 e	34.5 d

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (3): Effect of IPT on chlorophyll content and offshoot survival of date palm ‘Khalas’ cv. offshoots

IPT concentration (g/ offshoot hole)	Chlorophyll content (mg 100cm^2) (SPAD value)	Survival percentage of offshoots (%)
Control (0)	18.2 bc	60
25	18.3 bc	60
50	19.2 b	100
75	21.3 a	100
100	21.1 a	100
200	18.6 b	40
500	17.5 c	20

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (4): Effect of IPT on root N, K^{2+} and Ca^{2+} content of date palm ‘Khalas’ cv. offshoots

IPT concentration	N	K^{2+}	Ca^{2+}

(g/ offshoot hole)	(% dry wt.)	(% dry wt.)	(% dry wt.)
Control (0)	1.37 c	0.46 c	1.51 b
25	1.35 c	0.48 c	1.51 b
50	1.43 b	0.56 bc	1.63 ab
75	1.59 a	0.76 a	1.74 a
100	1.58 a	0.74 a	1.69 a
200	1.41 b	0.61 b	1.48 b
500	1.31 d	0.45 c	1.40 c

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (5): Effect of IAA, IBA and NAA rooting hormones on rooting percentage and root length of date palm 'Khalas' cv. offshoots

Rooting hormone concentrations	Index of rooting (%)			Average length of offshoot root (cm)		
	IAA	IBA	NAA	IAA	IBA	NAA
0	1.11 a	1.21 a	1.13 a	35.0 a	36.1 a	34.5 a
1000	1.09 a	1.25 a	1.16 a	29.4 a	35.3 a	35.1 a
2000	1.13 a	1.19 a	1.13 a	36.7 a	31.7 a	35.2 a
4000	1.11 a	1.23 a	1.12 a	35.4 a	31.9 a	30.8 a

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (6): Effect of IAA, IBA and NAA rooting hormones on fresh and dry weight of date palm 'Khalas' cv. offshoots

Rooting hormone concentrations	Fresh weight (g)			Dry weight (g)		
	IAA	IBA	NAA	IAA	IBA	NAA
0	136.7a	132.9a	130.5a	23.6 a	21.7 a	24.7 a
1000	131.2a	119.7a	134.5a	20.9 a	25.6 a	21.2 a
2000	125.1a	135.9a	134.1a	20.1 a	22.5 a	19.7 a
4000	133.4a	131.2a	129.6a	21.8 a	20.5 a	19.3 a

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (7): Effect of IAA, IBA and NAA rooting hormones on chlorophyll content and survival of date palm 'Khalas' cv. offshoots

Rooting hormone concentrations	Chlorophyll content (mg 100 cm^2) (SPAD value)			Survival percentage of offshoots (%)		
	IAA	IBA	NAA	IAA	IBA	NAA
0	12.3 a	13.6 a	11.9 a	40 a	40 a	40 a
1000	10.9 a	13.4 a	13.1 a	40 a	60 a	40 a
2000	11.3 a	13.9 a	12.5 a	60 a	40 a	40 a
4000	10.3 a	13.1 a	12.3 a	40 a	40 a	40 a

Means followed by the same letters in the same column are not significantly different at P = 0.05

Table (8): Effect of IAA, IBA and NAA rooting hormones on root N, K and Ca 0content of date palm ‘Khalas’ cv. offshoots

Hor. conc.	N (% dry wt.)			K^{2+} (% dry wt.)			Ca^{2+} (% dry wt.)		
	IAA	IBA	NAA	IAA	IBA	NAA	IAA	IBA	NAA
0	1.01 a	1.08 a	1.12 a	0.462a	0.453a	0.446a	1.16 a	1.12 a	1.18 a
1000	1.03 a	1.11 a	1.10 a	0.454a	0.461a	0.449a	1.14 a	1.18 a	1.19 a
2000	1.08 a	1.13 a	1.17 a	0.465a	0.463a	0.451a	1.19 a	1.11 a	1.16 a
4000	0.93 a	1.13 a	1.10 a	0.464a	0.457a	0.449a	1.14 a	1.18 a	1.11 a

Means followed by the same letters in the same column are not significantly different at P = 0.05

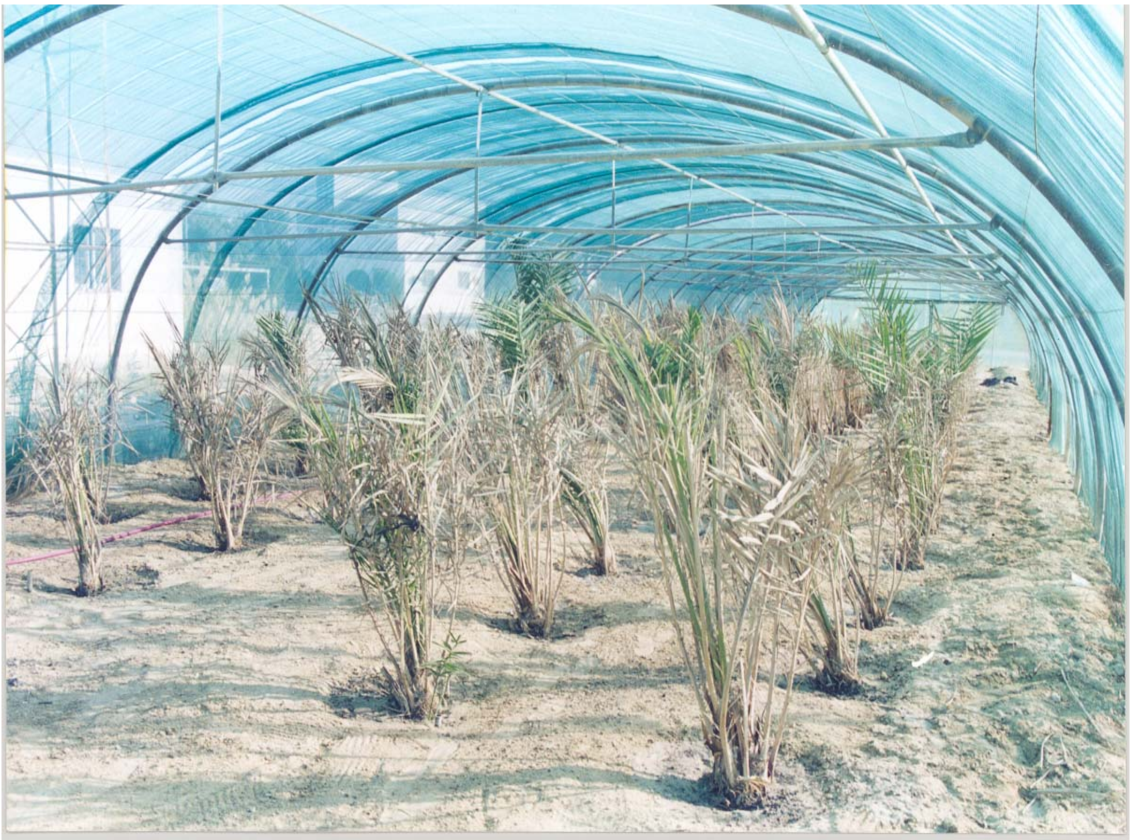

Fig. 1: IAA, IBA and NAA rooting hormones experiment in shade house at Alhassa National Date Palm Research Center

Fig. (2): IPT offshoots experiment at Alhassa National Date Palm Research Center

Fig. (3): Effect of IPT on rooting of date palm cv. 'Khalas' offshoots

Control (0 IPT)

25 g / offshoot hole

50 g / offshoot hole

75 g / offshoot hole

100 g / offshoot hole

200 g / offshoot hole

500 g / offshoot hole