Effect of plant growth regulators on the development of *ex vitro* date palm (*Phoenix dactylifera* L.) Barhi cv. plantlets

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ABSTRACT

This work studied the effect of some growth regulators on date palm plantlets Barhi cv. during acclimatization stage to have healthy and vigorous plants. The plantlets were fertilized by nutrient solution contained 5.0 g/l complete fertilizer and different concentrations of growth regulators twice a week The seedlings were treated by different auxins (NAA and IBA), cytokinins (BA and Kin) and GA_3 with different combinations among them under greenhouse conditions. The results indicated that, the treatment of date palm cv. Barhi plants with IBA at 10.0 mg/l for 18 months was more effective than other treatments during the ex vitro development. Although Kin treatments produced strong plants compared to BA, differences were not significant between them and also1.0 mg/l Kin was more effective concentration on growth of date palm plants. The increasing of GA_3 concentrations from 0.0 to 1.0 mg/l was more effective on leaves number, pinnate leaf number, leaf length, roots number and root length. On the other hand, GA_3 has no effect on diameter of bulb of date palm plants cv. Barhi. Concerning, the interactions among growth regulators (IBA, Kin and GA_3) data showed that, the treatments of ex vitro date palm plants by 10.0 mg/l IBA + 1.0 mg/l KIN + 1.0 mg/l GA_3 for 18 months positively affected on the adaptation and development.

Key words: *date palm, acclimatization, nutrition, fertilization, auxin, cytokinin, gibberellins, ex vitro.*

INTRODUCTION

Barhi is one of the most commercial and popular date cultivars in the world (Hajian, 2007). Acclimatization of plantlets derived from tissue culture confirmed the efficiency and importance of this method. The subculture of rooted shoots into MS salts solution and increasing light intensity enhanced the plantlet photosynthesis and then changing it from heterotrophic to autotrophic status (Khieralla and Bader, 2007). The development of a good root system on the *in vitro* plantlets of date palm is considered one of the most important factors affecting acclimatization to *ex vitro* environment (El-Bahr *et al.*, 2004). In order to stimulate *in vitro* rooting and acclimatization of micrografted citrus plants, they were studied the effect of media substrate and auxin treatments on *in vitro* rooting and define techniques for suitable establishment in soil (Abo-El-Soaud *et al.*, 1999). Dipping the plantlets into a concentrated solution of IBA (10 g/l) for few seconds, just before putting them into culture tubes, stimulated the development of lateral roots in 68% of the plants and favored the formation of good secondary root system in 25% of the plants. Much better results were obtained when the plants were dipped, just

before their planting, in the concentrated solution of IBA 10 g/l. One hundred percent of these plants were well established in the soil and developed a rich secondary root system (Plastira and Karetsos, 2007). It was observed that *ex vitro* rooting was strongly influenced by auxin type and concentration, of the various treatments, *ex vitro* rooting after dipping the basal end of *in vitro* derived shoots in 1 g/l (IBA) facilitated the best rooting with a mean of 5 roots in 85% shoots and the highest survival percentage (Goncalves and Romano, 2007). This study was carried out to produce maximum number and good plants of date palm cv. Barhi during acclimatization stage in order to transfer them to the open field.

MATERIALS AND METHODS

The present study was conducted in 2006 and 2007 at the Central Laboratory for Date Palm Research and Development, ARC, Egypt. This work studied the effect of some growth regulators on date palm plantlets Barhi cv. during acclimatization stage. Plantlets (20 – 25 cm) produced for acclimatization stage were planted in plastic pots 5x18 cm containing vermiculite + peat moss + sand (1:1:1v/v/v) for 6 months. These plantlets were transferred to plastic pots 40x30 cm containing peat moss + sand (1:2 v/v) and incubated under 8000 – 10000 lux light intensity at plastic greenhouse under high humidity and 30±2°C (El-Sharabasy *et al.*, 2001). The plantlets were treated by nutrient solution contained 5.0 mg/l complete fertilizer (19: 19: 19 NPK plus micro nutrients) and different concentrations of growth regulators twice a week as follows:

1. Auxins: two types of auxin were studied(NAA and IBA at 0.0, 0.1, 1.0 and 10.0 mg/l).
2. Cytokinins: two types of cytokinins were studied (BA and Kin at 0.0, 0.01, 0.1 and 1.0 mg/l).
3. GA_3 at 0.0, 0.01, 0.1 and 1.0 mg/l.
4. Different combinations of IBA, Kin and GA_3.

Data were recorded after 9, 12 and 18 months from culturing the plantlets in greenhouse as follows:

1. Growth of plantlets (leaves number – pinnate leaves number and diameter of bulb).
2. Growth of roots (root number and root length).

Layout of the experiment

The completely randomized design was used and data were subjected to factorial analysis of variance, using L.S.D test at 5% according to Snedecor and Cochran (1972).

RESULTS AND DISCUSSION

1 -Effect of auxins on *ex vitro* date palm plants

Data in Tables (1 and 2) showed the effect of different auxins and its concentrations on growth and development of shoots and roots after 9, 12 and 18 month.

Leaves number

Data clearled that different auxin types (NAA and IBA) added to culturing media had no significant effect on leaves numbers while; addition of 10.0 mg/l auxin recorded the best concentration on leaves numbers (4.7). After 18 months from culturing, the data revealed the highest significant value of leaves number (5.4). The interaction among different factors affected on leaves number was not significant.

Pinnate leaves number

Results in Table (1) showed the effect of auxins (NAA and BA) on pinnate leaves number developed at greenhouse. Pinnate leaves number increased significantly when treated with IBA compared with NAA. The date palm plants produced the highest number of leaves when treated with 10 mg/l auxin. Also, data recorded high significant number of pinnate leaves after 18 months compared with 9 and 12 months. Therefore, the interactions among auxin types, concentrations and culture period, revealed that the plants which treated with 10mg/l IBA for 18 month gave the highest number of pinnate leaves (2.3).

Table (1): Effect of auxins on growth of shoot of ex vitro date palm Barhi cv.

(A) Auxin	(B) Conc.	(C) Culture period (months) Leaves No. 9	12	18	M.	Pinnate leaves No. 9	12	18	M.	Leaf length(cm) 9	12	18	M.
0.0 (control)		2.3	3.7	4.7	3.5	0.0	0.0	0.7	0.2	29	40.7	48.7	39.4
	0.1	2.7	4.0	4.7	3.8	0.0	0.0	0.7	0.2	31.0	42.0	49.0	40.7
NAA	1.0	3.0	4.3	5.0	4.1	0.0	0.0	1.0	0.3	32.5	47.0	52.0	43.8
	10.0	3.0	4.7	6.0	4.6	0.0	0.7	1.3	0.7	34.3	47.7	53.3	45.1
Mean		2.9	4.3	5.2	4.1	0.0	0.22	1.0	0.4	32.6	45.6	51.4	43.2
	0.1	2.3	4.0	5.3	3.9	0.0	0.0	1.0	0.33	29.3	41.3	48.7	39.8
IBA	1.0	3.0	4.7	6.0	4.6	0.0	0.7	1.7	0.77	33.3	48.3	54.7	45.4
	10.0	3.0	5.0	6.3	4.8	0.0	1.3	2.3	1.2	37.7	52.0	55.3	48.3
Mean(A)		2.8	4.6	5.9	4.4	0.0	0.7	1.7	0.77	33.4	47.2	52.9	44.5
Mean(B)		3.9	4.4	4.7		0.27	0.49	0.75		40.3	44.6	46.2	
Mean©		2.8	4.3	5.4		0.0	0.39	1.24		32.4	45.6	50.2	
L.S.D at 0.05%		A	N.S			0.18				N.S			
		B	0.24			0.26				0.27			
		C	0.24			0.23				0.26			
		AB	N.S			0.46				N.S			
		AC	N.S			N.S				N.S			
		BC	N.S			N.S				N.S			
		ABC	N.S			N.S				N.S			

Leaf length

There was no significant difference between NAA and IBA for their effects on leaf length (Table 1) while, the date palm plants which treated with 10 mg/l auxin recorded the highest value of leaf length (46.2cm). Culturing for 18 months with treatment of the plants with auxin was more effective on leaf length compared with 9 and 12 month periods. The results revealed that, the fertilization with NPK one time every week of date palm plantlets during acclimatization stage for 18 month in addition IBA, Kin and GA_3 treatments achieved good leaves.

Diameter of shoot

Data in Table (2) showed that, there was a high significant difference between NAA and IBA on diameter of shoot of date palm plants. Treatment with 10 mg/l IBA recorded the highest value of shoot diameter (2.3cm). Regarding the effect of culture period on diameter of shoot, data revealed that increasing the culture period form 9 to 12 and to 18 increased the diameter of shoots. A good value of shoot diameter (2.4 cm) was obtained after 18 month from culturing. The interaction among types of auxins, concentration and culture period was highly significant, where diameter of shoot gave the highest significant value when the plants were irrigated with

10mg/l IBA mixed with the complete fertilizer for 18 month.

Root number

Results, in Table (2) revealed that the highest root number was obtained when the plants treated with IBA compared with NAA and the best concentration of IBA was 10.0 mg/l. There was a significant effect of different culture periods on root number. Data indicated good effect of 18 month (long treatment) compared with 9 or 12 months (Table 2).

Table (2): Effect of auxins on growth of root of ex vitro date palm Barhi cv.

(A) Auxin	(B) Conc.	(C) Culture period (months) Diameter of shoot (cm)				No. of roots				Root length(cm)			
		9	12	18	M.	9	12	18	M.	9	12	18	M.
0.0 (control)		1.2	1.5	2.1	1.6	5.3	10.7	15.3	10.4	11.0	19.	58.0	32.0
NAA	0.1	1.3	1.7	2.0	1.7	6.3	13.0	18.0	12.4	13.0	23.3	59.7	34.2
	1.0	1.3	2.1	2.4	1.9	9.3	14.7	22.3	15.4	16.7	25.3	60.7	47.3
	10.0	1.5	2.2	2.6	2.1	9.3	18.3	22.3	16.6	33.7	44.0	64.3	37.8
Mean		1.4	1.9	2.3	1.9	8.3	15.3	20.9	14.8	21.1	30.9	61.6	37.0
IBA	0.1	1.2	1.0	2.0	1.7	6.0	14.0	19.7	17.1	23.3	24.0	63.7	46.6
	1.0	1.4	2.4	2.7	2.1	10.0	16.3	23.7	16.7	42.3	29.7	67.7	55.0
	10.0	1.6	2.6	3.0	2.4	10.7	19.0	24.7	18.1	417	53.0	70.3	46.2
Mean(A)		1.4	2.3	2.6	2.1	8.9	16.4	22.7	17.3	35.8	35.6	67.2	49.26
Mean(B)		1.7	2.1	2.3		14.8	16.1	17.4		34.5	40.4	51.2	
Mean (C)		1.4	2.1	2.4		8.1	15.1	20.9		25.9	33.2	64.4	
L.S.D at 0.05%			A	0.09			0.94				2.37		
			B	0.13			1.33				3.35		
			C	0.11			1.15				2.90		
			AB	N.S			N.S				4.74		
			AC	N.S			N.S				4.11		
			BC	0.23			N.S				5.81		
			ABC	N.S			N.S				N.S		

Root length

Data in Table (2) exhibited high significant effect of different types of auxins, concentrations and culture periods on root length. The best results for root length were obtained when the date palm plants were treated with 10.0 mg/l IBA for 18 month (64.4 cm). The plantlets require IBA to enhance root system. It was observed that *ex vitro* rooting was strongly influenced by auxin type and its concentrations. Goncalves and Romano (2007) reported that, after dipping the basal end of *in vitro* derived shoots in 1 g/l indole butaric acid for 2 min facilitated the best rooting with a mean of 5 roots in 85% of shoots and the highest survival percentage. In general, it was clearly observed that the treatment of date palm cv. Barhi plantlets with IBA at 10.0 mg/l for 18 months was more effective than other treatments during the cultivation of the *ex vitro* plants.

2 -Effect of cytokinins on *ex vitro* date palm plants

Results in Tables (3 and 4) showed the effect of cytokinin type and its concentration on the growth of shoots and roots after 9, 12 and 18 months.

Leaves number

It was clear that the type and concentration of cytokinin affected the response of leaves number, pinnate leaves number and leaf length (Table 3). No different response was noticed on leaves number treated with Kin or BA. The plants which treated with 1.0 mg/l cytokinin gave a better result in terms of average number of leaves (4.8). Culturing

for 18 months gave the best response for leaves number (5.9) compared with 9 and 12 months (2.7 and 4.6, respectively).

Pinnate leaves number

No significant differences between Kin or BA regarding pinnate leaves number. Adding 0.1 or 1.0 mg/l cytokinin results in higher pinnate leaves number compared with 0.01 mg/l cytokinin. Meanwhile, the best results were recorded after 18 months of treatment.

Table (3): Effect of cytokinins on growth of shoot of ex vitro date palm Barhi cv.

(A) Auxin	(B) Conc..	(C) Culture period (months) Leaves No. 9	12	18	M.	Pinnate leaves No. 9	12	18	M.	Leaf length (cm) 9	12	18	M.
0.0 (control)		2.3	3.7	4.7	3.6	0.0	0.0	0.7	0.2	29.0	40.7	48.7	39.5
	0.01	2.3	4.0	5.3	3.9	0.0	0.0	0.3	0.1	23.7	42.7	48.0	38.1
KIN	0.1	3.0	4.7	6.0	4.6	0.0	0.0	1.3	0.4	27.3	45.0	50.3	40.9
	1.0	3.0	5.0	6.7	4.9	0.0	0.3	1.3	0.5	30.7	46.7	51.3	42.9
Mean		2.7	4.6	6.0	4.4	0.0	0.1	1.0	0.4	29.0	44.8	49.9	41.2
	0.01	2.3	4.0	5.3	3.9	0.0	0.0	0.3	0.1	24.7	41.3	47.7	37.9
BA	0.1	3.0	4.7	5.7	4.5	0.0	0.0	1.0	0.3	28.3	45.0	49.3	40.9
	1.0	3.0	5.0	6.3	4.8	0.0	0.3	1.3	0.5	32.3	48.0	50.3	43.5
Mean(A)		2.8	4.6	5.8	4.4	0.0	0.1	0.9	0.3	28.4	44.8	49.1	40.8
Mean(B)		3.9	4.5	4.8		0.1	0.3	0.3		38.0	40.9	43.1	
Mean(C)		2.7	4.6	5.9		0.0	0.08	0.88		28.0	44.2	49.2	
L.S.D at 0.05%			A N.S				N.S				N.S		
			B 0.30				0.29				1.69		
			C 0.26				0.10				1.47		
			AB N.S				N.S				N.S		
			AC N.S				N.S				N.S		
			BC N.S				N.S				N.S		
			ABC N.S				N.S				N.S		

Leaf length

Leaf length of date palm plants treated with 1.0 mg/l of cytokinin was significantly higher than that treated with 0.01 or 0.1 mg/l cytokinin. The plants which treated for 18 months gave the longest leaf compared with those treated for 9 or 12 months. Moreover, there were no significant interaction effects among treatments. Hegazy *et al.* (2006) pointed out that the growth and development of plants depends mainly on the number of healthy formed leaves.

Diameter of bulb

It was clearly noticed from Table (4) that, treatement with Kin was more effective than BA on shoot diameter (2.0 and 1.9 cm, respectively) while, the treatment of date palm plants with 1.0 mg/l of cytokinin significantly increased the diameter of bulb compared to the other treatments. Diameter of bulbs increased significantly by prolonging culture period from 9 to 12 and 18 months (1.5, 2.0 and 2.7 cm, respectively). The interaction between type of auxins and the concentration showed a significant effect on diameter of bulb. Plants treated with 1.0 mg/l Kin gave the largest shoot diameter.

Table (4): Effect of cytokinins on growth of root of ex vitro date palm Barhi cv.

(A) Auxin	(B) Conc.	(C) Culture period (months) Diameter of bulb (cm) 9	12	18	M.	No. of roots 9	12	18	M.	Root length(cm) 9	12	18	M.
0.0 (control)		1.2	1.5	2.1	1.6	4.3	10.7	15.3	13.4	11.0	17.5	58.0	28.8
	0.01	1.4	1.5	2.0	1.6	6.3	10.7	14.7	10.6	8.7	22.0	45.3	25.3
KIN	0.1	1.6	1.9	2.8	2.1	6.7	13.0	16.3	12.0	13.3	24.3	50.3	29.3
	1.0	1.8	2.8	3.8	2.8	8.7	16.0	18.0	14.2	13.7	31.3	56.7	33.9
Mean		1.5	1.9	2.7	2.0	6.5	12.6	16.1	11.7	11.7	23.8	52.6	29.4
	0.01	1.2	1.5	2.0	1.6	5.3	9.0	15.0	9.1	10.0	22.0	47.0	26.3
BA	0.1	1.4	1.9	2.5	1.9	6.0	12.0	17.0	11.7	13.0	29.7	51.0	31.2
	1.0	1.7	2.6	3.7	2.7	9.0	16.0	18.3	14.4	17.0	35.3	53.8	35.4
Mean(A)		1.4	1.8	2.6	1.9	6.2	11.9	16.4	11.5	13.0	26.1	52.5	30.5
Mean(B)		1.6	2.0	2.8		14.9	16.7	18.2		25.8	30.3	34.7	
Mean (C)		1.5	2.0	2.7		6.0	12.5	16.4		12.4	26.0	51.7	
L.S.D at 0.05%		A 0.08				N.S				N.S			
		B 0.11				8.54				1.42			
		C 0.10				1.11				1.24			
		AB 0.16				N.S				N.S			
		AC N.S				N.S				N.S			
		BC 0.20				N.S				N.S			
		ABC N.S				N.S				N.S			

Number of roots

Data in Table (4) showed that, number of roots increased by increasing cytokinin concentration from 0.01 to 0.1 and 1.0 mg/l (14.9, 16.7 and 18.2, respectively). Moreover, the date palm plantlets produced the best roots number after 18 months of treatment. On the other hand, all interactions had no significant effect.

Root length

Results in Table (4) showed no significant differences between Kin and BA in their effect on root length of date palm plantlets. Root of plants treated with 1.0 mg/l cytokinin was significantly longer than that of plants grown under 0.01 or 0.1 mg/l cytokinin treatments. The plants which treated for 18 months gave the longest root compared with those treated for 9 or 12 months. In conclusion, the data clearly showed that the treatment of date palm cv. Barhi plantlets with Kin at 1.0 mg/l for 18 months was more effective than other treatments during the *ex vitro* acclimatization of these plants.

3 -Effect of gibberellins on *ex vitro* date palm plants

Data in Tables (5 and 6) showed the effect of different gibberellin concentrations on growth of shoots and roots for 9, 12 and 18 month.

Leaves number

It is evident from the obtained data (Table 5) that leaves number increased by increasing GA_3 concentration from 0.0 to 1.0 mg/l. After 18 months from the planting the plants treated with GA_3 produced a large number of leaves. The interaction between GA_3 concentrations and culture period indicated that, treatment with 1.0 mg/l GA_3 for 18 months gave the highest number of leaves (5.7).

Table (5): Effect of gibberellins on growth of shoots of ex vitro date palm Barhi cv.

GA_3 mg/l(A)	(B) Culture period (months)											
	Leaves No.				Pinnate leaves No.				Leaf length(cm)			
	9	12	18	Mean	9	12	18	Mean	9	12	18	Mean
0.0	2.3	3.7	4.7	3.6	0.0	0.0	0.7	0.0	30.0	40.7	48.7	39.8
0.01	2.7	4.0	5.0	3.9	0.0	0.0	1.0	0.3	36.3	51.7	57.0	48.3
0.1	3.0	4.3	5.3	4.2	0.0	0.3	1.3	0.5	42.3	57.7	60.0	53.3
1.0	3.3	4.7	5.7	4.6	0.0	0.7	1.7	0.8	44.0	62.3	69.0	58.4
Mean(B)	2.8	4.2	5.2		0.0	0.3	1.2		38.2	53.1	58.7	
L.S.D at 0.05%		A	2.2			1.8				4.5		
		B	0.9			0.09				5.6		
		AB	1.5			1.00				11.2		

Pinnate leaves number

There were significant differences between effects of GA_3 concentrations on pinnate leaves number. Pinnate leaves started to develop after 9 months. After18 months, data recorded the highest number of pinnate leaves at 1.0 mg/l GA_3 (Table 5).

Leaf length

Data in Table (5) showed significant differences among GA_3 concentrations on leaf length. Concerning the interaction among GA_3 concentrations and culture period of date palm plants cv. Barhi data indicated that treatment with, 1.0 mg/l GA_3 after 18 months gave the largest leaf length (69.0 cm).

Table (6): Effect of gibberellins on growth of root of ex vitro date palm Barhi cv.

GA_3 mg/l(A)	(B) Culture period (months)											
	Diameter of bulb(cm)				No. of roots				Root length(cm)			
	9	12	18	Mean	9	12	18	Mean	9	12	18	Mean
0.0	1.2	1.5	2.1	1.6	5.3	10.7	15.3	10.4	11.0	19.0	58.0	29.3
0.01	1.3	1.7	2.0	1.7	6.3	9.3	15.0	10.2	14.0	22.0	43.3	26.4
0.1	1.5	1.9	2.2	1.9	6.3	10.0	17.0	11.1	20.3	27.7	42.0	30.0
1.0	1.4	2.1	2.4	2.0	7.3	12.7	20.3	13.4	33.7	39.7	48.0	40.5
Mean(B)	1.4	1.8	2.2		6.3	10.7	16.9		19.8	27.1	47.8	
LSD at 0.05		A	0.6			1.5			5.4			
		B	0.2			4.5			1.7			
		AB	NS			3.2			12.6			

Diameter of bulb

Concerning the effect of GA_3 on diameter of bulb, data in Table (6) revealed that, no significant differences were observed among GA_3 concentrations. Moreover, treatment with GA_3 at 1.0 mg/l for 18 months gave the highest value of bulb diameter (2.4cm).

Number of roots

Data in Table (6) pointed out that, there were significant differences among GA_3 concentrations for their effects on roots number. Treatment with GA_3 for 18 months, produced a large average number of roots (16.9). Regarding the interaction between GA_3 concentrations and culture period data showed that the treatment of 1.0 mg/l GA_3 gave the best results of root number (20.3) with 18 month period.

Root length

Data in Table (6) showed the effect of GA_3 concentrations and culture periods on root length of plants. Data showed a similar trend for the previous measurement (number of roots). In general, it could be concluded that, the increasing GA_3 concentration from 0.0 to 1.0 mg/l was effective in increasing leaves number, pinnate leaves number, leaf length, root number and root length, whereas the same concentrations did not affect on diameter of bulb of date palm plants cv. Barhi

4 -Effect of different combinations among IBA, KIN and GA_3 on date palm plants *ex vitro*

Data in Tables (7 and 8) showed the effect of different combinations among IBA, Kin and GA_3 on growth of date palm plants cv. Barhi *ex vitro*. Table (7) recorded the results of leaf number, pinnate leaves number and leaf length during three culture periods. The results showed that the treatment with 10.0 IBA + 1.0 Kin + 1.0 GA_3 mg/l was statistically superior than others for the three culture periods of date palm plants cv.Barhi.

Table (7): Effect of different combinations among IBA, KIN and GA_3 on growth of shoots of ex vitro date palm Barhi cv.

Treatment mg/l (A)			(B) Culture period (months) Leaves No.				Pinnate leaves No.				Leaf length (cm)			
IBA	KIN	GA_3	9	12	18	M.	9	12	18	M.	9	12	18	M.
0.0	0.0	0.0	2.3	3.7	4.7	3.6	0.0	0.0	0.6	0.2	30.0	40.7	48.7	39.8
0.1	0.01	0.0	2.7	4.0	5.0	3.9	0.0	0.0	1.0	0.3	32.7	44.7	50.3	42.6
0.1	0.0	0.01	2.7	4.0	5.3	4.0	0.0	0.0	1.3	0.4	33.3	45.3	53.0	43.9
0.1	0.01	0.01	3.0	4.3	6.0	4.4	0.0	0.3	1.7	0.7	33.7	48.3	60.7	47.6
0.0	0.01	0.01	2.7	3.7	4.7	3.7	0.0	0.0	0.7	0.2	29.7	39.3	51.0	40.0
1.0	0.1	0.0	2.7	5.0	6.0	4.6	0.0	0.7	1.7	0.8	35.3	50.3	62.3	49.3
1.0	0.0	0.1	3.0	5.0	6.0	4.7	0.0	0.7	2.0	0.9	33.7	50.3	61.0	48.3
1.0	0.1	0.1	3.3	5.0	6.3	4.9	0.0	1.0	2.3	1.1	37.3	48.7	67.0	51.0
0.0	0.1	0.1	3.0	4.3	5.3	4.2	0.0	0.3	1.3	0.5	32.3	46.0	56.0	44.8
10.0	1.0	0.0	3.0	5.0	6.7	4.9	0.0	0.7	2.3	1.0	37.3	53.7	68.7	53.2
10.0	0.0	1.0	3.3	5.3	6.7	5.1	0.0	1.3	2.3	1.2	39.0	57.0	72.0	56.0
10.0	1.0	1.0	3.7	6.0	7.0	5.6	0.0	1.7	3.0	1.6	45.7	62.7	72.3	60.2
0.0	1.0	1.0	3.3	4.7	6.0	4.7	0.0	0.7	1.7	0.8	39.3	52.3	69.3	53.6
Mean (B)			2.98	4.6	5.8		0.0	0.6	1.7		35.2	49.2	60.9	
L.S.D at 0.05%			A				0.43			0.30			3.70	
			B				1.20			0.51			5.62	
			AB				0.93			0.18			1.20	

Concerning, the specific effect of combinations with IBA, Kin and GA_3 on diameter of bulbs, root number and root length, data in Table (8) showed that the treatment with 10.0 IBA + 1.0 Kin + 1.0 GA_3 mg/l increased significantly the diameter of bulbs, roots number and root length of date palm plants cv. Barhi (3.4 cm, 28.0 and 53.8 cm, respectively) compared to the control (growth regulator free) during three culture periods (Figures 1 and 2). In general, the fertilization of date palm plants with N P K and micro-nutrients during the acclimatization and developing stages is very important to obtain vigorous and healthy plants (Fig. 3). The treatment with any type of growth regulator under investigation (auxin, cytokinin and gibberellins) alone had no effect while, the combinations of auxin (IBA), cytokinin (Kin) and GA_3 were more effective to produce very good adapted plants that can be transferred to open field. On the other hand, gibberellins increased the elongation of plantlets. Abo-El-Soaud *et al.* (1999) found that GA_3 may

promote bulb and crown formation. Moreover, GA_3 treatment may enhance rooting ability of shoot, block shoot elongation and ease acclimatization ability (George, 1993). Unfortunately, there is no satisfactorily information available about the fertilization and growth regulator treatments for date palm plantlets inside green house during acclimatization stage, therefore this approach needs more detailed studies to enhance acclimatization process.

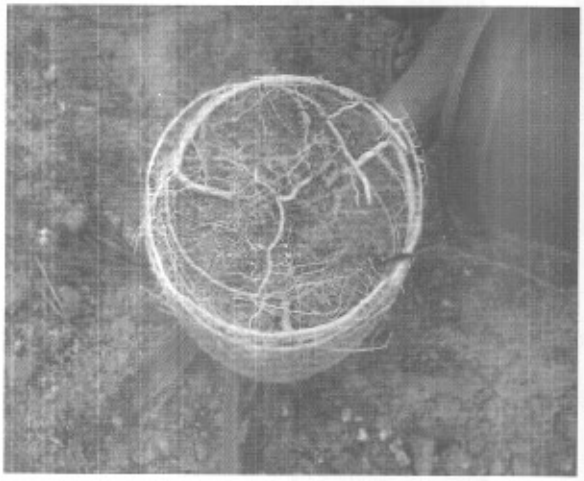

Fig. (1): The effect of IBA, KIN and GA_3 on root formation.

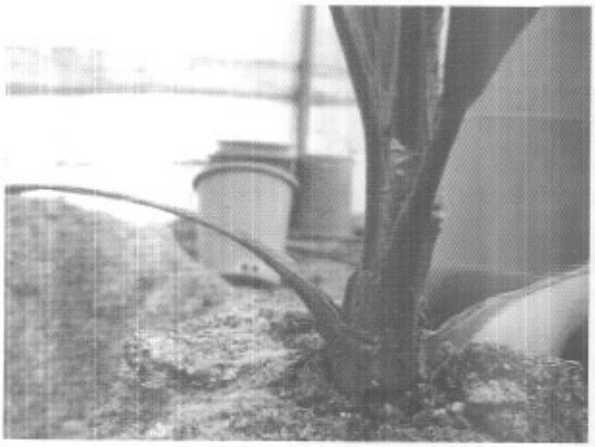

Fig. (2): The effect of IBA, KIN and GA_3 on diameter of bulb.

Fig. (3): The effect of IBA, KIN and GA_3 on growth and development of date palm plantlets during acclimatization stage.

Table (8): Effect of different combinations among IBA, KIN and GA_3 on growth of roots of ex vitro date palm Barhi cv.

Conc. mg/l (A)			(B) Culture period (Months)											
			Diameter of bulb(cm)				Roots number				Root length(cm)			
IBA	KIN	GA_3	9	12	18	M.	9	12	18	M.	9	12	18	M.
0.0	0.0	0.0	1.2	1.5	2.1	1.6	5.3	10.7	15.3	10.4	11.0	19.0	58.0	29.3
0.1	0.01	0.0	1.5	1.6	2.5	1.9	7.0	14.3	25.7	15.7	15.0	19.7	59.3	31.3
0.1	0.0	0.01	1.3	1.3	2.2	1.6	7.7	14.3	25.0	15.7	15.0	22.3	62.0	33.1
0.1	0.01	0.01	1.5	1.7	2.6	1.9	8.0	16.5	28.3	17.6	19.7	26.7	65.3	37.2
0.0	0.01	0.01	1.2	1.6	2.6	1.8	7.3	14.3	21.3	14.3	15.0	21.0	58.7	31.6
1.0	0.1	0.0	1.4	2.0	2.9	2.1	8.7	21.7	28.7	19.7	18.3	22.7	65.0	35.3
1.0	0.0	0.1	1.5	1.5	2.7	1.9	9.7	21.0	34.3	21.7	19.3	29.3	64.0	37.5
1.0	0.1	0.1	1.7	2.2	3.4	2.4	10.7	24.0	37.7	24.1	23.3	35.3	70.7	43.1
0.0	0.1	0.1	1.6	2.3	3.3	2.4	8.3	18.7	31.7	19.6	20.7	27.7	60.0	36.1
10.0	1.0	0.0	1.6	3.0	4.3	3.0	11.0	24.7	40.7	25.5	25.0	49.0	73.7	49.2
10.0	0.0	1.0	1.6	2.7	4.0	2.8	10.0	26.3	40.0	25.4	28.7	51.3	73.3	51.1
10.0	1.0	1.0	1.9	3.5	4.7	3.4	13.0	28.3	42.7	28.0	36.0	48.0	77.3	53.8
0.0	1.0	1.0	1.5	2.8	4.2	2.8	10.7	22.7	37.7	23.6	25.7	31.4	68.7	41.9
Mean (B)			1.5	2.1	3.2		9.0	19.8	31.5		21.0	31.0	65.8	
L.S.D at 0.05%			A			2.50				3.1		2.9		
			B			0.90				7.33		5.74		
			AB			1.54				5.21		5.40		

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الملخص العربي

تأثير التغذية بمنظمات النمو على نمو وتطور شتلات نخيل البلح صنف البارحى المؤقلمة

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أجرى هذا العمل لدراسة تأثير بعض منظمات النمو النباتية على شتلات نخيل البلح صنف البارحى خلال مرحلة الأقلمة وذلك للحصول على نباتات مؤقلمة وقوية. تمت تغذية الشتلات ب 5جم/لتر سماد متكامل وأضافة تركيزات مختلفة من منظمات النمو النباتية مرتين فى الأسبوع. تمت معاملة الشتلات بتركيزات مختلفة من الأوكسينات (أندول بيوتريك اسيد و نفثالين اسيتك اسيد) و السيتوكينينات (الكينتين و البنزيل ادينين) و الجبرالين بالأضافة إلى توليفات بينهم. أشارت النتائج إلى أن التسميد لشتلات نخيل البلح صنف البارحى و المعاملة ب10 ملجم/لتر أندول بيوتريك اسيد لمدة 18 شهر أعطت أعلى تأثير عن باقى المعاملات للنباتات المؤقلمة. أضافة الكينيتين أعطى نباتات قوية بالمقارنة بالبنزيل ادينين ولم يكن بينهم فرق معنوى وأيضا إضافة 1 ملجم/ليتر كينيتين كان أكثر تأثيرا على نمو شتلات نخيل البلح. زيادة تركيز الجبرالين من صفر إلى 1 ملجم/لتر كان أكثر فاعلية لعدد الأوراق والأوراق المفصصة وطول الورقة وعدد الجذور وطول الجذور لكن تأثيره كان أقل على قطر قاعدة نباتات نخيل البلح صنف البارحى . فى نفس الدراسة أشارت النتائج ان التوليفة بين10 ملحم/لتر أندول بيوتريك اسيد و1 ملجم/لتر الكينيتين و 1 ملجم/لتر جبرالين لمدة 18 شهر أعطت نباتات قوية النمو صالحة للزراعة فى الأرض مباشرة .