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IN VITRO PROPAGATION OF *CORDYLINE TERMINALS*

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ABSTRACT

Shoot tips of *Cordyline terminalis* were subjected to different cold periods, medium types, anti-oxidant treatments, adenine sulphate concentrations, and natural additives during establishment stage. Also, cytokinin types and concentrations were evaluated during proliferation stage. In addition, medium strength and GA_3 concentrations were studied at shoot elongation phase. In the meantime, auxin types were taken in consideration during root formation phase. It appears that subjecting shoot tips to cold pretreatment for four days in the refrigerator (5°C) and culturing on modified Murashige and Skoog medium after immersing the explants in an anti-oxidant solution and addition of 40 mg/L cystin as well as 40 mg/L adenine sulphate and 5.0 of banana fruit juice to the culture medium enhanced establishment stage. Meanwhile, supplementation of the culture medium with 2.0 mg/L BAP was effective on increasing proliferation, while 4.0 mg/L BAP encouraged the highest callus production. Moreover, using half strength medium supplemented with 0.5 mg/L GA_3 and 1.0 mg/L IBA_3 maximized shoot elongation and root formation phases.

INTRODUCTION

Cordyline terminalis is an attractive ornamental plant used for indoor decoration. *In vitro* propagation produce large number of healthy, homogenous, and identical plants in short and exact time. Also, reduce expenses and losses in plant materials which resulted in maximizing producers profitability.

Murashige (1974) indicated that soaking tobacco explants in ascorbic acid and citric acid or adding them to the culture medium succeeded in reducing the harmful effect of phenolic compounds.

Kunisaki (1975) reported that modified Murashige and Skoog medium supplemented with 0.5 ppm 6-benzylaminopurine was preferred for *in vitro* propagation of *Cordyline terminalis*. However, Beruto *et al.* (1983), Welander (1988); and Tui-Ray *et al.* (2006) recommended using of Murashige and Skoog for *in vitro* propagation of *Cordyline terminalis*. Proliferation of *Cordyline terminalis* was enhanced when 2.0 mg/L BA was added to the culture medium (Evaldsson and Welander, 1985).

Stoehr and Zsuffa (1990) found that cold pretreatment (4°C) for 4 days encouraged callus production and development of *populous maximowiczii*. Also, Atta-Alla *et al.* (1996) stated that large numbers of shoots and leaves were obtained when 0.5-40 mg/L BA was used instead of both kinetin or 2-ip at the same concentrations. Rooting was improved by adding 2.0 mg/L IBA to the culture medium (Beruto *et al.*, 1983). Moreover, Tui-Rag *et al.* (2006) pointed out that the best elongation of shoots was found on half MS basal medium. Also, rooting was achieved on half strength medium supplemented with IBA.

MATERIALS AND METHODS

This study was carried out in the Tissue Culture Laboratory, Horticulture Department, Faculty of Agriculture Moshtohor, from 2003 to 2004.

New growing shoots from cordyline were taken and washed with a running water for 30 minutes then sterilized by using 15% Clorox solution (0.5 NaOCl commercial bleach) with two drops of Tween-20 for 7 minutes and immersed in a sterilized distilled water three times for 5 minutes each.

Shoot tips of cordyline were excised and cultured on different medium types containing 100 mg/L Myoinstol, 0.5 mg/L BAP (6-benzylamino-purine), 0.1 mg/L IBA (indole-3-butyric acid), 30 g/L sucrose and 7 g/L agar agar. The pH of these media was adjusted to 5.7 and autoclaved at 121°C and 15 lb/in^2 for 15 minutes. The cultured explants were incubated under complete darkness for 3 days then transferred to 16 hours of fluorescent light and 8 hours of dark with average temperature of 27-30°C. Sub-culturing was done regularly every 4 weeks interval in all stages and experiments.

This investigation was carried as follows:

3.1. Establishment stage.

3.1.a. Effect of cold treatment.

Sterilized explants of cordyline were placed in sterilized small white plastic bags and kept either in refrigerator at 5±1°C for 1, 2 and 4 days or directly cultured without refrigerating (control) then cultured on MS medium to verify the best cold treatment to reduce accumulation of phenolic compounds and enhance explant development.

3.1.b. Effect of medium type.

Different medium types i.e. Murashige and Skoog (MS, 1962). Modified Murashige and Skoog, Gomborge *et al.* (B_5, 1968) and Nitsch & Nitsch (NN, 1969) were studied to select the most suitable medium type to induce the best results.

3.1.c. Effect of anti-oxidant treatment:

Explants of cordyline were treated with different anti-oxidant to testify the most effective anti-oxidant treatment for minimizing phenolic compounds and inturn improve explant development.

The following anti-oxidant treatments were done:

1- Control: explants were immersed in a sterilized distilled water for 30 minutes.
2- Cystin: cystin was added to the medium at the rate of 40 mg/L.
3- Anti-oxidant solution: the explants were dipped in a mixture of 100 mg ascorbic acid and 150 mg citric acid dissolved in 1000 ml as used as a pre-treatment for 30 minutes.
4- Cystin + Anti-oxidant: the explants were dipped in an anti-oxidant solution then cultured on the medium supplemented with 40 mg/L cystin.

3.1.d. Effect of adenine sulphate concentration:

Different adenin sulphate concentrations i.e. 0.0, 20, 40 and 80 mg/L were added to the medium to select the best concentration to induce the highest explant development.

3.1.e. Effect of natural additives:

Banana juice was prepared by adding 5 g of fruit juice then added to the medium. Also, both tomato juice, and orange juice were added at the rate of 50 ml while 40 mg/L adenine as used as control. These additives were supplemented to the culture medium added to study their effect on explant development.

3.2. Proliferation stage:

3.2.a. Effect of cytokinin type:

Kinetin, 6-benzylaminopurine (BAP) and 2-isopentenyladenine (2ip) were tested at the rate of 1.0 mg/L to point out the optimum cytokinin type to. induce the highest proliferation.

3.2.b. Effect of BAP concentration:

Different concentrations of BAP i.e. 0.0, 1.0, 2.0 and 4.0 mg/L were applied to investigate the most suitable concentration which give the highest proliferation.

3.3. Rooting stage:

3.3.1. Shoot elongation:

3.3.1.a. Effect of medium strength:

Full, one-half, one-quarter and one eight medium strength were tested to obtain the best medium strength which induced the longest shoots.

3.3.1.b. Effect of gibbrellic acid (GA_3) concentration:

GA_3 at different concentrations i.e. 0.1, 0.5 and 1.0 mg/L were added to the medium to select the best concentration which gave the longest shoot.

3.3.2. Root formation:

3.3.2.a. Effect of auxin type:

Indole-3-butyric acid (IBA) and naphthalene acetic acid (NAA) were studied to detect the best auxin type that enhanced the best root formation.

3.3.2.b. Effect of IBA concentration:

Different concentrations of indol3-butyric acid (IBA) i.e. 0, 0.1, 0.5 and 1.0 mg/L were used to obtained the best concentration which encouraged the highest root formation.

Data and calculations:

Scores were given for necrosis estimated as the degree of darkened or dead tissues or parts of the explant and plantlets. Also, browning which appeared as degrees of medium darkening the scores were given as follow: complete necrosis and browning = 5, most explants or plantlets dead and the most medium darkened = 4, medium = 3, less than medium = 2, while healthy and no browning = 1. However, explant development (measured as any change occurred in the explant), callus production (calculated as visual callus size), growth (estimated as vegetative growth development), greening (defined as the degree of keeping the original color of the explant and the degree of the green color of the leaves), proliferation (expressed as the quantity of shoots produced) shoot elongation (defined as shoot length), and rooting (estimated as quantity of roots produced were evaluated. Furthermore, survival percentage was estimated as the percentage of explants survived and still alive at the end of the experiment. The percentage of survival was calculated as follow:

$$\%\text{ofsurvival} = \frac{\text{Numberofsurvivalexplants}}{\text{Totalnumberofculturedexplants}} \times 10($$

These scores were given as follow:

Negative results = 1, below average = 2, average = 3, above average = 4, and excellent = 5 (according to Pottino, 1981).

Statistical analysis:

All treatments used in this study were arranged in a complete randomized block design and replicated 10 times for each treatment according to Snedecor and Cochran (1980). The obtained data were statistically analyzed and the means were compared according to Duncan's multiple range test at 5% level as described by Duncan, (1955).

RESULTS AND DISCUSSION

4.1. Establishment stage:

4.1.a. Effect of cold periods:

The data outlined in Table (1) reflect that cold treatments gave valuable and significant improvement of all explant parameters under study as compared with control (not refrigerated). Moreover, subjecting the explants to cold treatment for 4 days were significantly superior for increasing explant development and callus production while reduced necrosis and browning parameters in relation to other cold treatments under study.

The above results conclude that using cold treatments and increasing the period of subjecting these explants to cold condition (5°C) succeeded in reducing necrosis and browning while improved explant development and callus production. These results may be due to that cold conditions reduced free phenolic compounds accumulation which is harmful for explants and inturn improved all explants parameters. These results are in harmony with the findings of Stoehr and Zsuffa (1990). They stated that cold pre-treated *Populous axtmowiczii* explants (4°C) for 4 days encouraged callus production and development.

4.1.b. Effect of medium types:

Table (2) indicated that modified MS encouraged significant increase in explant

development, greening and survival percentage parameters as compared with the other media under study. However, MS medium significantly increased callus production in relation to the others media . On the other hand, NN medium showed the worst result in all parameters compared with the different used media. Those results summarized that modified Murashige and Skoog is best suitable medium for *in vitro* propagation of *Cordyline terminalis*. These results are in agreement with the findings of Kunisaki (1977) who reported that modified MS was preferred for *in vitro* propagation of *Cordyline terminals*.

4.1.c. Effect of different anti-oxidant treatments:

Data in Table (3) reflected that using anti-oxidant treatment combined with cystin in the medium resulted in significant decrease of both necrosis and browning parameters as compared with the other anti-oxidant treatments. Meanwhile, explant development, greening and survival percentage parameters were significantly increased when combined treatment was used followed by cystim treatment then antioxidant treatment while the control induced the lowest result in all parameters.

These results are in accordance with the findings of Murashige (1973) who indicated that soaking tobacco explants in ascorbic acid and citric acid or adding them to the medium succeeded in reducing the harmful effect of phenolic compounds.

4.1.d. Effect of adenine sulphate concentration:

The results in Table (4) and Photo (1) revealed that increasing adenine concentrations up to 40 mg/L encouraged significant increase in necorsis, explant development, and greening parameters in relation to the other adenine concentrations. However, the parameters under study showed the lowest level when adenine sulphate was excluded from the medium (control). The above results reflect the importance of adding adenine sulphate to the culture medium specifically at the rate of 40 mg/L. This may be due to that adenine sulphate has a simulative effect on shoot initiation. These results are completely agreed with the findings of Miller and Skoog (1953). They stated that adenine sulphate has a promotive effect on shoot initiation of tobacco explants.

4.1.e. Effect of natural additives:

Table (5) and Photo (2) showed that supplementing the culture medium with 5 g/L banana fruit juice was significantly effective on reducing necrosis while significantly improved explant development and greening parameters in relation to either natural additives. Moreover, adding of tomato juice to the culture medium succeeded significantly in maximumizing number of shoots in comparison with the other natural additives. However, addition of either orange juice or adenine sulphate as control showed the lowest number of shoots and increased necrosis.

The aforementioned results recommended using of banana or tomato juice as natural additives for improving explant development or number of shoots, respectively. These may be due to the contents of the natural juices of both banana and tomato as they contained a lot of elements, vitamins and growth regulators.

4.2. Proliferation stage:

4.2.a. Effect of cytokinin types:

Data in Table (6) and Photo (3) indicate that both 2ip (2-isopentenyladenine) and BAP (6-benzylamino purine) significantly increased necrosis and callus production as compared with kinetin, However, the reverse was true when growth and greening parameters were considered as kinetin significantly increased both parameters. On the other hand, Proliferation was significantly maximized as BAP was added to the medium as compared with the other cytokinin types.

Those results are in general agreement with the findings of Atta-Alla *et al.* (1996). They stated that large number of shoots and leaves was obtained when 0.5-4.0 mg/L BA was used instead of kinetin and 2-ip growth regulators.

Table (1): Effect of cold treatment on explant development and callus production parameters of cordalin.

Cold treatment	Parameters (scores)					Survival %
	Necrosis	Browning	Explant development	Callus production	Greening	
Control	3.87±0.07^a	3.71±0.26^a	1.83±0.07^c	1.18±0.04^d	1.35±0.14^b	2.23±0.49^d
One day	3.16±0.14^b	3.33±0.04^b	1.88±0.34^c	1.94±0.02^c	1.51±0.28^b	3.43±0.40^c
Two days	2.61±0.12^c	2.84±0.08^c	3.23±0.25^b	2.40±0.10^b	2.36±0.32^a	5.74±0.49^b
Four days	1.21±0.01^d	1.16±0.01^d	3.85±0.10^a	3.39±0.13^a	1.77±0.14^b	12.22±0.67^a
LSD at 0.05	0.19	0.26	0.41	0.16	0.44	0.98

Table (2): Effect of different medium types on explant development and callus production parameters of cordalin.

Medium type	Parameters (scores)					
	Necrosis	Browning	Explant develop-ment	Callus production	Greening	Survival %
Murashige of skoog	3.17±0.15^c	3.55±0.09^b	2.63±0.24^b	1.85±0.13^a	2.55±0.48^b	2.81±0.20^b
Modified MS	2.34±0.14^d	2.62±0.17^c	3.28±0.12^a	1.32±0.11^b	3.55±0.08^a	4.37±0.11^a
Gamborg (B5)	3.79±0.09^b	3.81±0.11^a	1.93±0.06^c	1.07±0.12^c	1.93±0.12^c	1.36±0.10^b
White medium	4.79±0.12^a	4.91±0.08^a	1.10±0.10^d	1.03±0.06^c	1.00±0.00^d	0.03±0.05^b
LSD at 0.05	0.24	0.23	0.28	0.20	0.47	0.23

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

Table (3): Effect of antioxidant treatments on explant development parameters of cordalin.

Treatment	Parameters (scores)				Survival %
	Necrosis	Browning	Explant development	Greening	
Control	3.80±0.20^a	3.95±0.18^a	2.28±0.10^d	1.99±0.01^c	2.43±0.40^c
Cystem	3.67±0.21^a	3.23±0.15^a	3.27±0.25^b	2.27±0.31^b	2.77±0.25^c
Antioxidant	3.27±0.31^b	2.96±0.04^a	2.92±0.10^c	2.51±0.14^b	4.37±0.32^b
PVP	3.70±0.18^a	3.61±0.19^a	2.23±0.25^d	2.47±0.17^b	2.50±0.30^c
Anti + PVP	3.24±0.24^a	3.02±0.17^a	2.79±0.13^c	2.30±0.26^b	4.40±0.40^b
Cystem + Anti.	1.85±0.13^c	2.03±0.15^b	3.89±0.10^a	3.27±0.25^a	7.70±0.26^a
LSD at 0.05	0.38	0.28	0.30	0.38	0.59

Table (4): Effect of adinin sulphat concentration on explant development parameters of cordalin.

Treatment	Parameters (scores)			
	Necrosis	Browning	Explant development	Greening
0.0	1.44±0.00^a	2.13±0.12^a	1.92±0.14^d	1.91±0.18^c
20 mg/L	1.78±0.00^a	1.32±0.01^b	3.51±0.02^b	3.02±0.02^b
40 mg/L	2.32±0.00^a	1.23±0.02^b	4.32±0.03^a	3.40±0.18^a
80 mg/L	2.27±0.00^a	1.31±0.01^b	3.72±0.02^b	3.14±0.04^b
LSD at 0.05	0.13	0.11	0.14	0.24

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

Table (5): Effect of different rateral additivies concentration on explant development parameters of cordalin.

Additive	Parameters (scores)			
	Necrosis	Explant development	Proliferation	Greening
Control	2.83±0.16^{a}	3.20±0.20^{c}	1.11±0.19^{c}	2.33±0.34^{ab}
Tomato juice	1.97±0.21^{b}	3.63±0.15^{b}	2.33±0.34^{a}	2.56±0.51^{ab}
banana juice	1.40±0.10^{c}	4.27±0.25^{a}	1.67±0.34^{b}	3.11±0.96^{a}
Orange juice	2.90±0.10^{a}	2.67±0.15^{d}	1.00±0.00^{c}	1.78±0.39^{b}
LSD at 0.05	0.28	0.36	0.48	1.13

Table (6): Effect of cytokinin type on growth and proliferation parameters of cordalin.

Cytokinin	Parameters (scores)				
	Necrosis	Callus production	Proliferation	Growth	Greening
Kinetin	1.50±0.08^{b}	1.11±0.12^{b}	1.27±0.20^{c}	4.12±0.20^{a}	4.12±0.10^{a}
2-isopenteryladenine	1.74±0.13^{a}	1.69±0.05^{a}	2.28±0.04^{b}	3.43±0.03^{b}	3.17±0.02^{b}
BAP 6-benzylaminopurine	1.83±0.08^{a}	1.75±0.06^{a}	4.14±0.12^{a}	3.17±0.02^{c}	3.13±0.12^{b}
LSD at 0.05	0.19	0.16	0.28	0.24	0.18

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

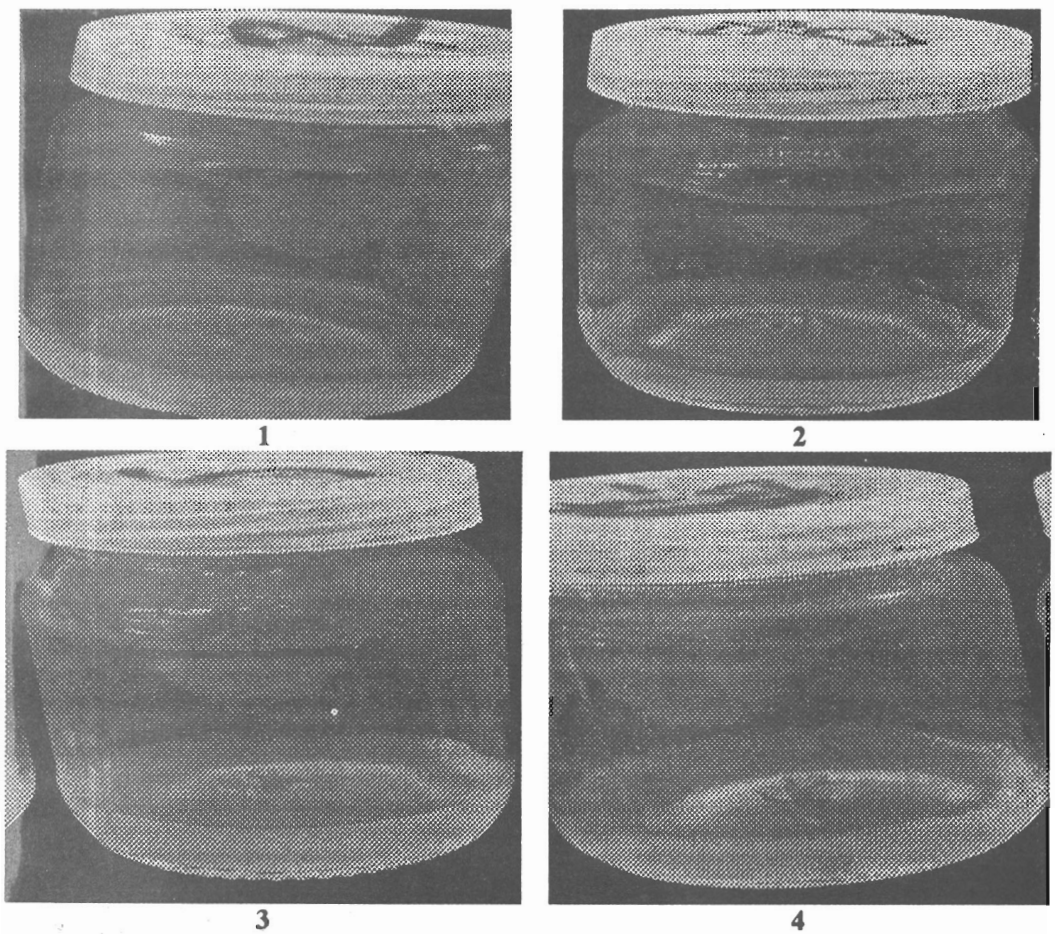


Photo (1): Effect of different adenine concentrations on explant development and greening of cordyline explant. 1: 0.0 mg adenine/L (control) 2: 20.0 mg adenine/L 3: 40.0 mg adenine/L 4: 80.0 mg adenine/L

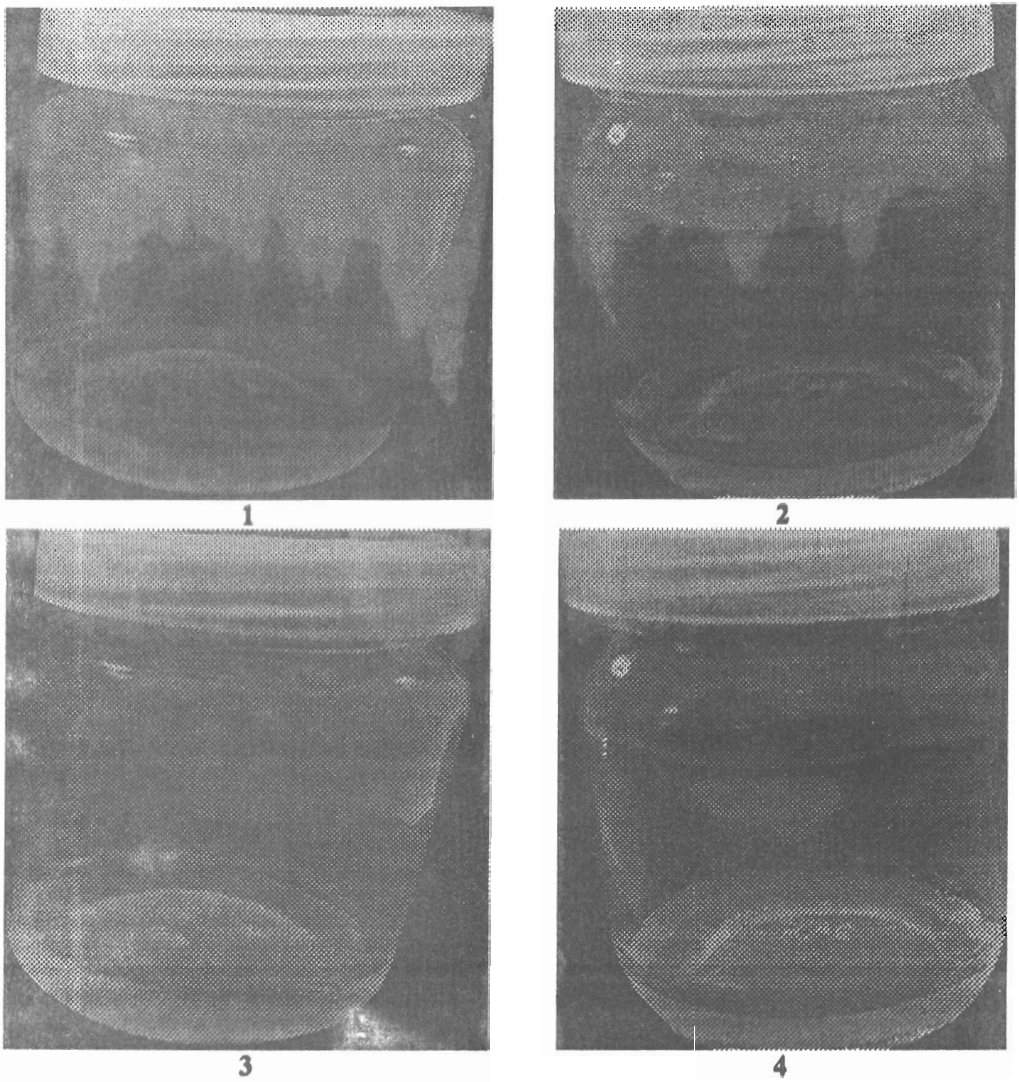


Photo (2): Effect of natural additives on explant development and greening of cordyline explants. 1: Control 2: Orange juice 3: Tomato juice 4: Banana juice

4.2.b. Effect of BAP concentration:

The outlined data in Table (7) declared that addition of 2.0 mg/L BAP was effective on significant increase proliferation in relation to the other concentrations. On contrary, using of low BAP concentration i.e. 1 mg/L significantly increased both growth and greening parameters in comparison with the others. Meanwhile, addition of 4.0 mg/L BAP significantly increased callus production and necrosis while it had harmful effects on the other parameters (growth, proliferation, and greening parameters).

Those results go in line with the findings of Evaldsson and Walender (1985). They declared that proliferation was enhanced as 2.0 mg/L BA was added to the culture medium.

4.3. Rooting stage:

4.3.1. Shoot elongation:

4.3.1.a. Effect of medium strength:

The results of Table (8) indicated that half strength medium resulted in significant increase of both shoot elongation and greening parameters as compared with the other medium strengths. However, continuous diluting of the medium caused a significant reduction in necrosis.

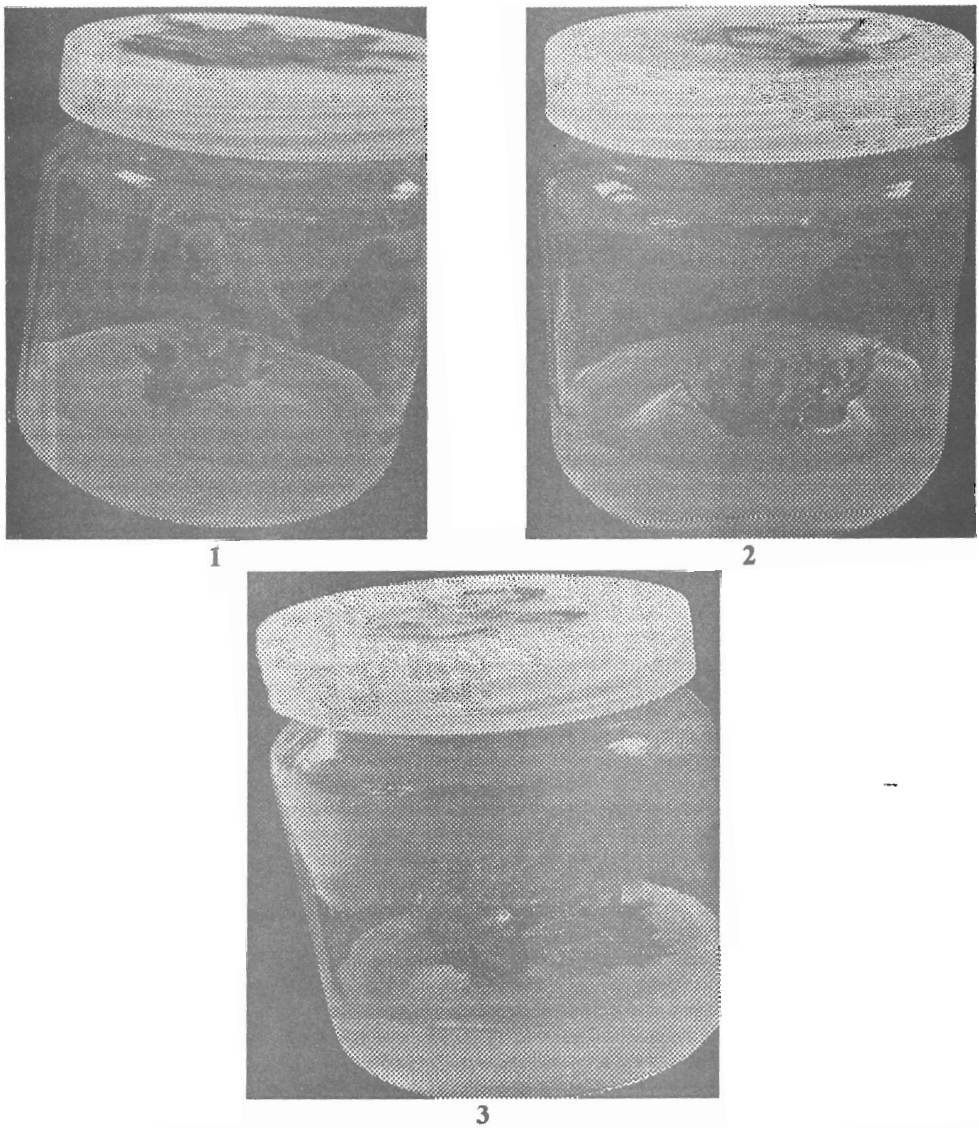


Photo (3): Effect of different cytokinin types on growth and proliferation of cordyline explants. 1: Kinetin 2: 2ip 3: BAP

These results were assured by the findings of Tui-Ray *et al.* (2006). They mentioned that half medium strength is the most suitable for the best shoot elongation of *Cordyline terminalis*.

4.3.1.b. Effect of GA_3 concentration:

Data of Table (9) and Photo (4) reflected that increasing GA_3 concentration caused a significant increase in shoot elongation and greening parameters up to 0.5 mg/L which showed the greatest significant increase of shoot elongation and greening. However, necrosis was significantly reduced as the low concentrations of GA_3 were used.

4.3.2. Root formation:

4.3.2.a. Effect of auxin type:

Data in Table (10) and Photos (5 & 6) indicate that indole-3 butyric acid (IBA) significantly suprassed naphthalene acetic acid in increasing necrosis parameter. However, statistical differences were nil between the two auxins as callus production, growth, greening and rooting parameters were concerned.

These results are in harmony with the findings of Tui-Ray *et al.* (2006). They stated that rooting was achieved as half MS basal medium was supplemented with IBA.

Table (7): Effect of BAP concentration on growth and proliferation parameters of cordalin.

BAP Concentration mg/L	Parameters (scores)				
	Necrosis	Callus production	Prolifer	Growth	Greening
0	1.29±0.03^{d}	1.12±0.01^{c}	1.22±0.02^{d}	2.68±0.04^{c}	2.07±0.06^{d}
1	1.51±0.02^{c}	1.26±0.01^{b}	3.12±0.10^{b}	3.66±0.01^{a}	3.42±0.03^{a}
2	1.69±0.05^{b}	1.28±0.02^{b}	3.85±0.07^{a}	3.15±0.05^{b}	3.15±0.02^{b}
4	2.16±0.01^{a}	2.32±0.03^{a}	2.16±0.01^{c}	2.42±0.10^{d}	2.65±0.10^{c}
LSD at 0.05	0.06	0.03	0.12	0.11	0.11

Table (8): Effect of medium strength on shoot elongation parameters of cordalin.

Additive medium strength	Parameters (scores)		
	Necrosis	Shoot elongation	Greening
Full	1.79±0.03^{d}	2.71±0.04^{a}	2.62±0.11^{a}
One-half	1.65±0.03^{c}	3.72±0.03^{b}	3.61±0.01^{b}
One-Quarter	1.52±0.01^{b}	1.93±0.04^{b}	2.35±0.04^{a}
One-eighth	1.22±0.02^{a}	1.23±0.02^{a}	1.31±0.05^{c}
LSD at 0.05	0.04	0.06	0.12

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

Table (9): Effect of GA_3 concentration on shoot elongation parameters of cordalin.

GA concentration (mg/L)	Parameters (scores)		
	Necrosis	Shoot elongation	Greening
0	1.20±0.02^{d}	1.22±0.01^{d}	1.42±0.02^{c}
0.1	1.36±0.01^{c}	2.01±0.01^{b}	2.36±0.01^{b}
0.5	2.63±0.02^{b}	3.72±0.03^{a}	3.63±0.02^{a}
1.0	3.45±0.09^{a}	1.28±0.03^{c}	1.17±0.02^{d}
LSD at 0.05	0.09	0.04	0.03

Table (10): Effect of auxin type on growth and rooting parameters of cordalin.

Auxin type	Parameters (scores)				
	Necrosis	Callus production	Growth	Greening	Rooting
NAA	2.29±0.03^{b}	1.48±0.06^{a}	3.21±0.04^{a}	3.18±0.02^{a}	1.77±0.05^{a}
IBA	2.79±0.03^{a}	2.15±0.13^{a}	2.45±0.05^{a}	2.38±0.02^{a}	3.46±0.01^{a}
LSD at 0.05	1.39	1.85	2.10	2.22	4.69

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

4.3.2.b. Effect of IBA concentration:

It is clear from Table (11) and Photo (7) that addition of 1.0 mg/L IBA to the culture medium enhanced a significant improv-ement as it increased rooting. More-over, increasing IBA concentration resulted in a significant increase in both necrosis and callus production. Also supplementation of the culture medium with low IBA concentrations i.e. 0.0 and 1.0 mg/L induced a significant increase in greening parameter in comparison with the other IBA concentrations.

These results disagreed with the findings of Tui-Ray *et al.* (2006). They reported that addition 2.0 mg/L IBA to the culture medium improved rooting of *Cordyline terminals*.

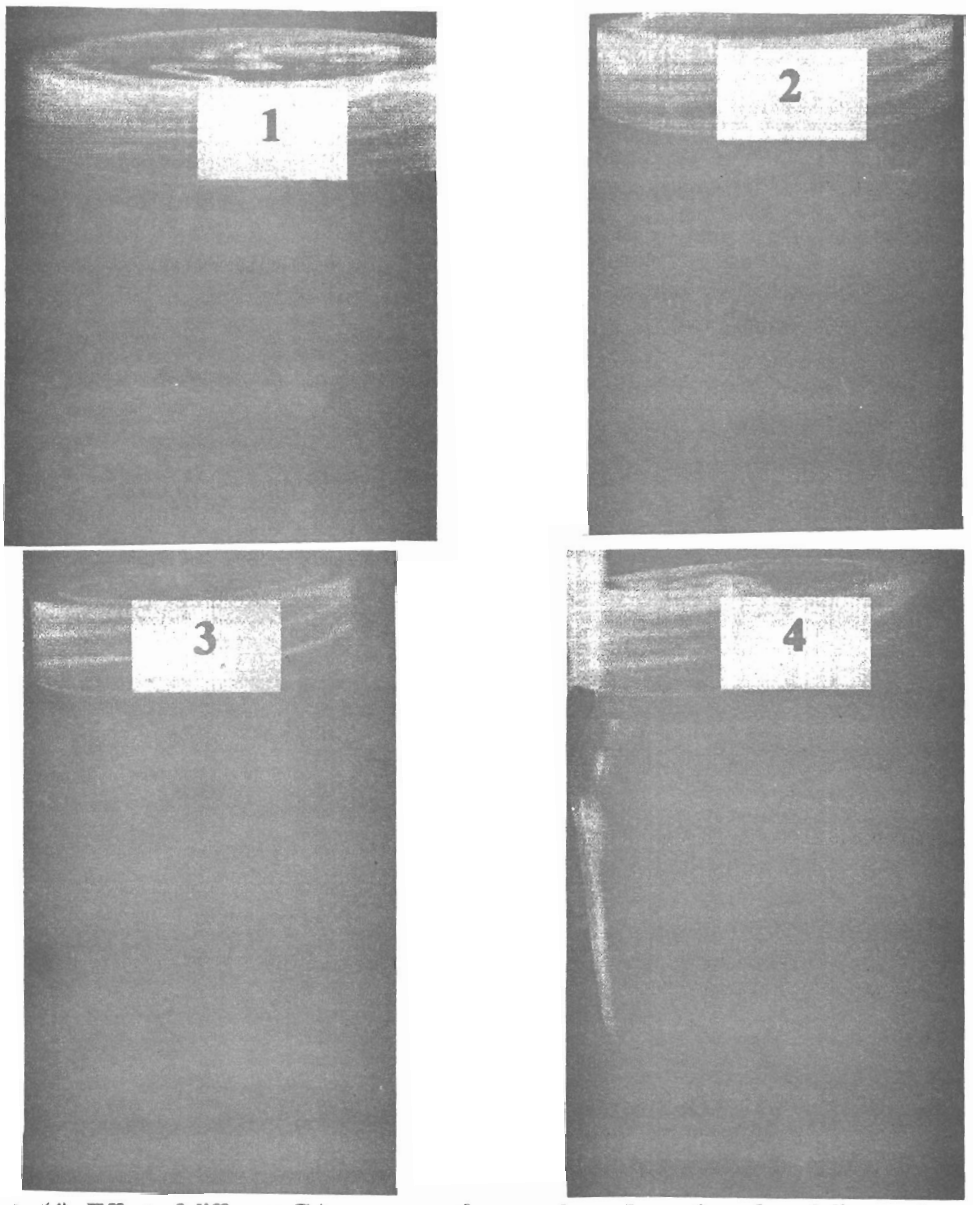


Photo (4): Effect of different GA_3 concentrations on shoot elongation of cordyline explants.
1: 0.0 mg GA_3/L 2: 0.1 mg GA_3/L 3: 0.5 mg GA/L 4: 1.0 mg GA_3/L

Table (11): Effect of IBA concentration on growth and rooting parameters of cordalin.

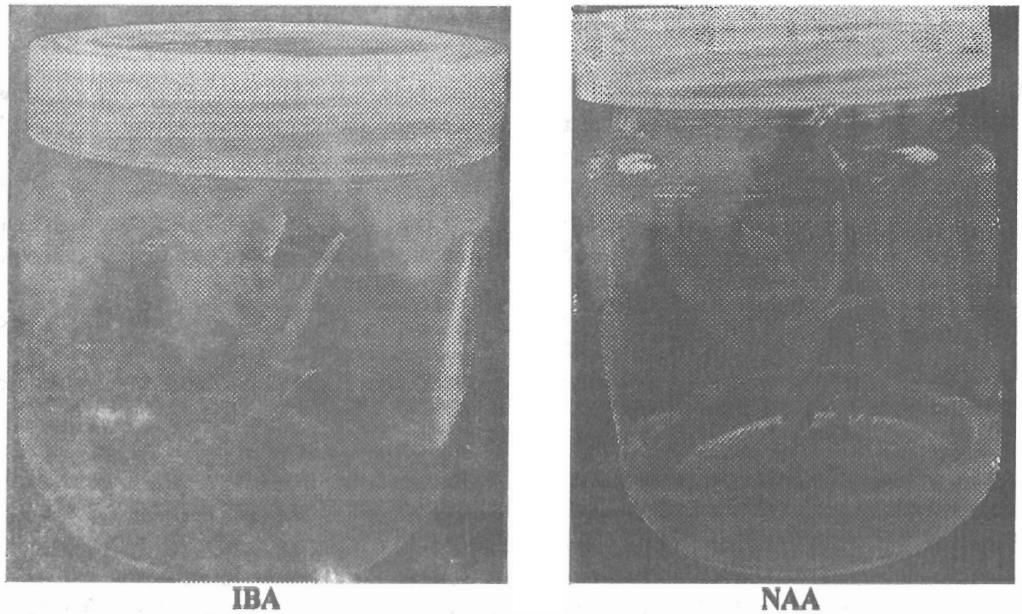
IBA concentration (mg/L)	Parameters (scores)				
	Necrosis	Callus production	Growth	Greening	Rooting
0	1.20±0.03^{d}	1.19±0.05^{d}	3.47±0.09^{a}	3.26±0.04^{a}	1.17±0.03^{c}
0.1	1.47±0.02^{c}	1.42±0.03^{c}	2.44±0.03^{b}	3.20±0.03^{a}	2.21±0.04^{b}
0.5	2.38±0.03^{b}	1.63±0.02^{b}	2.11±0.11^{c}	2.42±0.03^{b}	3.52±0.02^{a}
1.0	2.75±0.05^{a}	2.81±0.04^{a}	2.02±0.02^{c}	2.09±0.16^{c}	2.12±0.11^{b}
LSD at 0.05	0.06	0.07	0.13	0.15	0.11

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01).

Table (12): Effect of different agricultural medium on survival percentage and growth parameters of cordalin.

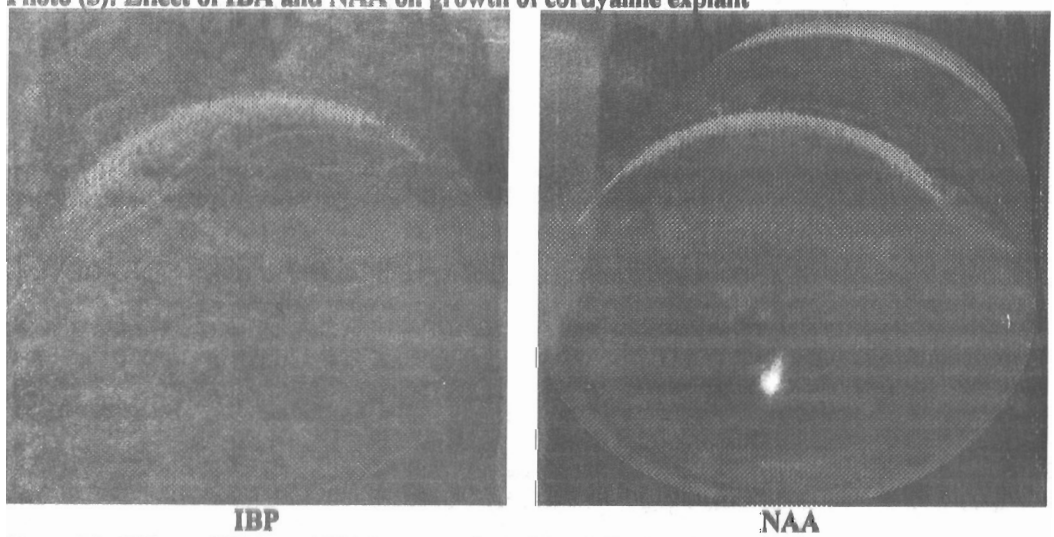
IBA concentration	Parameters (scores)				
	Necrosis	Callus production	Growth	Greening	Rooting
Peatmoss (1)	4.95±0.23	3.14±0.12	1.81±0.05	1.02±0.02	1.11±0.09
Perlite (2)	14.80±0.51	3.75±0.03	1.93±0.02	4.34±0.03	1.10±0.10
Vermiculite (3)	5.33±0.58	4.52±0.22	1.53±0.02	1.74±0.02	1.00±0.00
1 + 2	21.00±1.00	9.33±0.03	1.93±0.05	5.47±0.06	2.69±0.07
1 + 3	32.00±2.65	11.65±0.12	2.12±0.10	7.36±0.15	1.76±0.01
2 + 3	42.67±3.79	11.31±0.17	2.24±0.09	4.76±0.05	2.72±0.01
1 + 2 + 3	65.33±4.73	14.66±0.13	3.33±0.03	7.14±0.11	3.30±0.17
LSD at 0.05	4.46	0.24	0.11	0.13	0.15

a, b, c & d: There is no significant difference between any two mean, within the same column have the same subscript letter (LSD at 0.01)



IBA NAA

Photo (5): Effect of IBA and NAA on growth of cordyaline explant



IBP NAA

Photo (6): Effect of IBA and NAA on rooting of cordyline explants

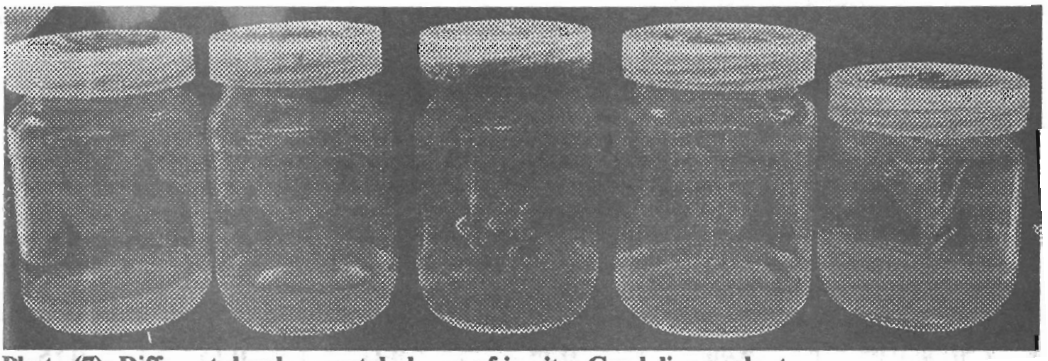


Photo (7): Different developmental phases of *in vitro* Cordyline explants
1 & 2: Extablishment stage 3: Proliferation stage
4 & 5: Shoot elongation and root formation

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إكثار الكوردالين داخل الأنابيب

جمال الدين إبراهيم عطوه
قسم البساتين – كلية الزراعة بمشتهر – جامعة بنها – مصر

تم أخذ القمة النامية كجزء نباتى حيث تم تعريضه لمعاملات البرودة ثم تمت دراسة كل من تأثير أنواع البيئات – مضادات الأكسدة – تركيزات مختلفة من سلفات الأدينين – إضافات لعصائر عضوية طبيعية وذلك خلال مرحلة بداية الزراعة. ثم تمت دراسة كل من تركيزات مختلفة من البيئة وتركيزات من الجبريلين وأنواع أكسينات وتركيزات مختلفة من أندول حمض البيوتريك وذلك خلال مرحلة التجذير.

وقد وجد أن تعريض الجزء النباتى قبل الزراعة لمعاملة البرودة لمدة ٤ أيام وعمر الجزء النباتى فى محلول مضادات الأكسدة وزراعة الجزء النباتى على بيئة موراشيج وسكوج المعدلة التى تحتوى على السيستين و ٤٠ ملجم من سلفات الأدينين و ٥ جرام من عصير الموز الطبيعى ساعد على نجاح مرحلة بداية الزراعة وكذا أدي إضافة ٢ ملجم/لتر من الـ ٦-بنزايل أمينو بيورين إلى زيادة أعداد النموات الخضرية بينما أدى استخدام بيئة نصف قوة (تركيز) مضافا إليها ٠,٥ ملجم/لتر جبريلين إلى زيادة استطالة النموات و كما أدى استخدام ١,٠ ملجم/لتر من أندول حمض البيوتريك إلى زيادة طول الجذور وأعدادها .