J. Agric. Sci. Mansoura Univ., 29 (12): 7191 - 7199, 2004

STUDIES ON JOJOBA [*Simmondsia chinensis* (LINK) SCHNEIDER] I- IBA-INDUCED ROOTING POTENTIALS.

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ABSTRACT

Two types of cuttings were prepared from the current year's growth of jojoba plants; terminal and sub-terminal. Bases of the cuttings were quickly dipped for 15 seconds in different IBA (indol-3-butyric acid) solutions; zero, 2000, 4000, 6000, 8000 and 10000 ppm. Data showed that all IBA concentrations increased the rooting percentage of the treated jojoba cuttings except the 2000 ppm. The highest values of rooting percentage were obtained when cuttings were treated with 8000 ppm. Rooting percentage was found to increase steadily as IBA concentrations increased from zero to 8000 ppm. Rooting percentage of the terminal cuttings of jojoba were significantly higher than that of sub-terminal cuttings.

All IBA concentrations increased the average root length except the 2000 ppm. The maximum root lengths were obtained at 6000 ppm. in both seasons. Sub-terminal cuttings were found superior to terminal ones although they were not statistically different..

All IBA treatments increased the number of roots of the treated jojoba cuttings. The number of roots per cutting increased steadily as IBA concentrations increased from 4000 to 10000 ppm. The type of cutting have had no remarkable effect on the number of roots produced.

INTRODUCTION

Jojoba [*Simmondsia chinensis* (Link) Schneider. Family Simmondsiaceae] is an evergreen shrub that has attracted a great attention in recent years either for ornamental purposes or as a new oil producing industerial crop. Several asexual methods of propagation other than the use of stem cuttings can be successfully used to propagate jojoba. Among these methods are air layering (Melendez and Rocha, 1982), grafting (Palzkill, 1988) and tissue culture (Wang and Janick, 1986 and Apostolo *et al.*, 2001). Each of these asexual methods share the major advantage over seed propagation in that they allow propagation of unique genotypes which have been identified as being desirable. They allow growers to propagate plants of known sex, or of known high-yield potential, or of other desirable characteristics (Palzkill, 1988). An additional advantage of cutting propagated plants over seedling is that they mature reproductively sooner than those rown from seed (Low and Hackett, 1981a and b). Hogan *et al.* (1978) produced jojoba plants from stem cuttings by using different IBA concentrations. Maximum rooting percentage was achieved at 8000 ppm. They found tremendous differences in rooting percentages from one plant to another (from zero to 100 %). Abramovich *et al.*, (1978) found that rooting

percentages and root qualities of jojoba increased steadily as IBA concentration increased. Root length was little affected by the treatment but root number increased dramatically at the higher concentrations. In some cases, reduction of rooting percentage occurred when higher doses were applied suggesting a kind of toxicity which proved to depend on the source of cutting material. Abramovich and Forti (1985) used IBA to activate the rooting of jojoba cuttings. They found that the higher doses of IBA increased rooting percentage as well as the number of roots per cutting. Palzkill (1988) and Ayerza (1996) found that the best cutting material of jojoba is the current years growth that is semi-hardened. They also found that the genotype being used has a major influence on rooting success. Rooting success can vary from zero to almost 100 % depending on the clone being used. Most clones have intermediate to high rooting percentages (50-90 %). El-Hadeedy (1991) found that untreated jojoba cuttings failed to root along the whole months of the year. IBA generally enhanced root formation and increased rooting percentage. The highest rooting percentage as well as root number and length could be achieved by dipping terminal cuttings for 10 seconds in 8000 ppm. IBA or dipping sub-terminal cuttings for 10 seconds in 10000 ppm. IBA. Such treatments enhanced rooting to 95% and 90%; respectively.

MATERIALS AND METHODS

This experiment was carried out during two successive seasons of 2000 and 2001 at the Research Stations of the Desert Development Center, The American University in Cairo. The aim of this study was developing a good technique for the production of known-sex rooted cuttings. Two types of cuttings were prepared from the current year's growth of jojoba plants; terminal and sub-terminal as described by Palzkill, (1988).Cuttings were taken from the clone named SF3 on May 15, 2000 and May 18, 2001 for the first and second seasons, respectively. Both types of cuttings were about 10 cm long with about 4-6 leaves. Bases of the cuttings were quickly dipped for 15 seconds in different IBA (indol-3-butyric acid) solutions; zero, 2000, 4000, 6000, 8000 and 10000 ppm (Hogan *et al.*, 1978). Cuttings were stuck in plastic flats containing a mixture of equal parts (by volume) of peat moss, sand and vermiculite and were arranged in the greenhouse and sprinkled three times a day. The rooting experiment was carried out in the form of Factorial in Completely Randomized Block Design of three replications (Snedecor and Cochran, 1990). Factors used were : IBA concentrations (six levels), type of cutting (two levels) and the rooting season (two levels). Fifty -cuttings were used for each experimental unit. After four months, the rooting percentage, average length of roots and the number of roots per cutting were recorded.

RESULTS AND DISCUSSION

1-Rooting percentage

Data presented in Table 1 showed that all IBA concentrations increased the rooting percentage of the treated jojoba cuttings except the

2000 ppm. The highest values of rooting percentage were obtained when cuttings were treated with 8000 ppm. IBA . Rooting percentage was found to decline as IBA concentrations increased from 2000 to 8000 ppm. increase steadily as the concentration increased from 2000 to 8000 ppm. These results are probably due to the active role of IBA in increasing the cambial activity as well as in stimulating root primordia and callus formation as reported by Hartmann and Kester (1983) and Griffin *et al.* (1999). Similar results on the vegetative propagation of jojoba using IBA applications were obtained and reported by Hogan *et al.* (1978), Low and Hackett (1981 a), Abramovich and Forti (1985), Ayerza (1996) as well as Keeley *et al.* (2003) on grapes.

Table 1 : Effect of various concentrations of IBA on the rooting percentage of jojoba cuttings either terminal or subterminal during the two seasons of 2000 and 2001. Cuttings were taken from the clone SF3.

IBA (ppm.)	Rooting Season	Rooting Percentage		
		Cutting Type		Mean Treatments
		Terminal	Sub-terminal	
0	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean zero		0.00	0.00	0.00
2000	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean 2000		0.00	0.00	0.00
4000	2000	21.33	38.00	29.67
	2001	22.00	39.00	30.50
mean 4000		21.67	38.5	30.09
6000	2000	30.67	40.67	35.67
	2001	32.00	43.67	37.84
mean 6000		31.94	42.17	36.67
8000	2000	36.00	46.00	41.00
	2001	38.67	48.33	43.50
mean 8000		37.34	47.17	42.26
10000	2000	20.67	24.67	22.67
	2001	22.33	25.33	23.83
mean 10000		21.50	25.00	23.25
mean season	2000	18.11	24.89	21.5
	2001	19.17	26.06	22.62
mean type		18.64	25.47	22.06

L.S.D. 0.05 for :	
A- IBA concentrations	**: 8.17**
B- Cutting type	**: 4.40**
C- Rooting season	**: N.S.**
A x B	**: N.S.**
A x C	**: N.S.**
B x C	**: N.S.**
A x B x C	**: N.S.**

On the other hand, using 10000 ppm. IBA sharply reduced the

high dose of IBA solution as explained by Abramovich *et al.* (1978) and Abramovich and Forti (1985).The significant low values of rooting percentage recorded for the terminal cuttings of jojoba compared to sub-terminal cuttings may be attributed to the fact that terminal cuttings of jojoba are more susceptible to drying out, drooping and wilting (Reddy, 1980). The tips of such cuttings frequently die before rooting occurs as reported by Palzkill (1988).

The relatively poorer rooting percentages resulted from the application of IBA in the first season compared to the second one (Table 1), although the difference was not significant , may be attributed to the seasonal changes in carbohydrate status of cuttings. Reddy (1980) found that the seasonal changes in carbohydrate status of jojoba cuttings could explain the differences in rooting occurred in different seasons. He found carbohydrates to be highest when he obtained best rooting, and lowest when rooting was least. Hartmann and Kester (1983) came also to the same conclusion.

2- Root length

Data presented in Table 2 as well as Figures 1 and 2 showed that all IBA concentrations significantly increased the average root length of the jojoba treated cuttings except the 2000 ppm. The maximum root lengths were obtained at 6000 ppm. in both seasons . In the second season, 6000 ppm. was statistically different from all other treatments and produced the longest roots. Sub-terminal cuttings had relatively longer roots than the terminal ones, but there was no significant difference between them.

These results are probably due to the role of rooting hormone in the elongation of root cells (Scott, 1972). Rooting hormones, also regulate root growth by inhibiting the duration of cell elongation. The metabolism of auxins in the root is complex and some of its many features may be related directly to cell growth and differentiation.

On the other hand, the effects of chemical cofactors produced in leaves and buds which are required for rooting may be involved (Carpenter and Cornell, 1992). These cofactors act synergistically with auxins in promoting rooting. The reduction of root length at higher IBA concentrations (8000 and 10000 ppm., especially in the second season) could be attributed either to an inhibition in the growth of the root primordia or a reduction in the number of root primordia formed. Similar results were obtained on jojoba by Palzkill (1988) and El-Hadeedy (1991).

3- Number of roots per cutting

Data presented in Table 3 as well as Figures 1 and 2 showed definitly that all IBA treatments, except 2000 ppm., increased the number of roots of the treated jojoba cuttings. The number of roots per cutting increased steadily as IBA concentrations increased from 4000 to 10000 ppm. It's clear also that neither the season nor the type of cutting have had any significant effect on the number of roots produced.

These results could be attributed to the active role of IBA in

promoting cell division of the root cells as well as the concomitant increase in RNA content in the new roots. The determining influence of RNA, while implicated in determining the final number and size of roots, occurs at the time of cell division rather than during elongation as extensively explained by Scott (1972).

Similar results were obtained on jojoba by Abramovich *et al.* (1978), Abramovich and Forti (1985) as well as El-Hadeedy (1991), where they found that the number of roots increased significantly at the higher IBA concentrations.

Table 2 : Effect of various concentrations of IBA on the root length (cm.) of jojoba cuttings either terminal or sub-terminal during the two seasons of 2000 and 2001. Cuttings were taken from the clone SF3.

IBA (ppm.)	Rooting Season	Root Length (cm.)		
		Cutting Type		Mean Treatments
		Terminal	Sub-terminal	
0	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean zero		0.00	0.00	0.00
2000	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean 2000		0.00	0.00	0.00
4000	2000	2.39	2.98	2.96
	2001	2.43	3.15	2.79
mean 4000		2.41	3.07	2.74
6000	2000	3.13	3.25	3.19
	2001	3.23	3.38	3.31
mean 6000		3.18	3.32	3.25
8000	2000	2.77	2.98	2.88
	2001	2.85	3.06	2.96
mean 8000		2.81	3.02	2.92
10000	2000	2.17	2.42	2.30
	2001	2.22	2.52	2.37
mean 10000		2.20	2.47	2.34
mean season	2000	1.74	1.94	1.84
	2001	1.79	2.02	1.91
mean type		1.77	1.98	1.88

L.S.D. 0.05 for :	
A- IBA concentrations	**: 0.46**
B- Cutting type	**: N.S.**
C- Rooting season	**: N.S.**
A x B	**: N.S.**
A x C	**: N.S.**
B x C	**: N.S.**
A x B x C	**: N.S.**

Table 3 : Effect of various concentrations of IBA on the number of roots of jojoba cuttings either terminal or sub-terminal during the two seasons of 2000 and 2001. Cuttings were taken from the clone SF3.

IBA (ppm.)	Rooting Season	Number of Roots per Cutting		
		Cutting Type		Mean Treatments
		Terminal	Sub-terminal	
0	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean zero		0.00	0.00	0.00
2000	2000	0.00	0.00	0.00
	2001	0.00	0.00	0.00
mean 2000		0.00	0.00	0.00
4000	2000	3.61	4.20	3.91
	2001	3.73	4.17	3.95
mean 4000		3.67	4.19	3.93
6000	2000	4.43	4.32	4.38
	2001	4.51	4.44	4.48
mean 6000		4.47	4.38	4.43
8000	2000	4.78	4.64	4.71
	2001	4.77	4.86	4.82
mean 8000		4.78	4.75	4.77
10000	2000	5.04	5.00	5.02
	2001	5.17	5.55	5.36
mean 10000		5.11	5.28	5.19
mean season	2000	2.98	3.03	3.00
	2001	3.03	3.17	3.10
mean type		3.00	3.10	3.05

L.S.D. 0.05 for :	
A- IBA concentrations	: 0.44
B- Cutting type	: N.S.
C- Rooting season	: N.S.
A x B	: N.S.
A x C	: N.S.
B x C	: N.S.
A x B x C	: N.S.

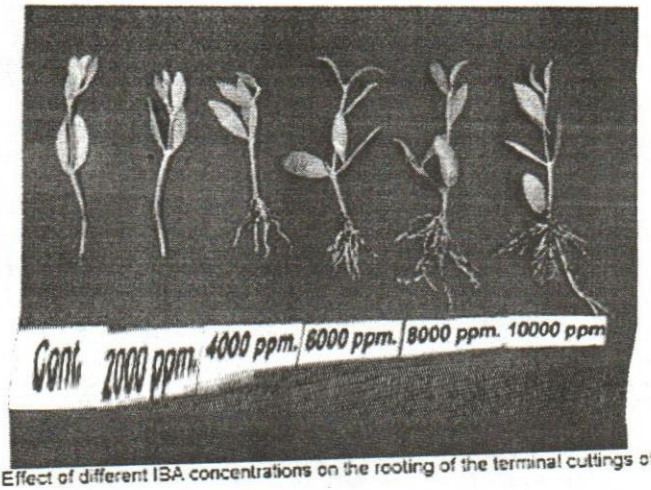

Figure 1. Effect of different IBA concentrations on the rooting of the terminal cuttings of jojoba.

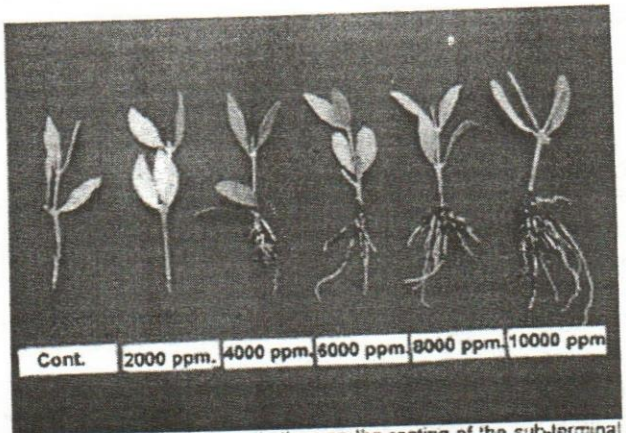

Figure 2 Effect of different IBA concentrations on the rooting of the sub-terminal cuttings of jojoba.

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دراسات على نبات الجوجوبا ١ _ استخدام اندول حمض البيوترك في تجذير العقل

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تم إجراء هذه التجارب خلال موسمي ٢٠٠٠ و ٢٠٠١ بمحطات بحوث مركز تنمية الصحراء التابع للجامعة الأمريكية بالقاهرة.

أظهرت النتائج زيادة النسبة المئوية للعقل المكونة لجذور والتي تم معاملة قواعدها بإندول حمض البيوتريك لمدة ١٥ ثانية وذلك بتركيز الإندول من ٢٠٠٠ إلى ٨٠٠٠ جزء في المليون – كما أن النسبة المئوية للعقل المكونة لجذور كانت أقل معنويا في العقل الطرفية مقارنة بمثيلتها في العقل تحت الطرفية

وقد أثبتت الدراسة أيضا أن متوسط طول الجذور الناتجة على العقل المعاملة بتركيزات مختلفة من اندول حمض البيوترك أعلى معنويا مما هو في الجذور المتكونة على عقل الكنترول أو تلك المعاملة بتركيز ٢٠٠٠جزء في المليون وكان أعلى متوسط لطول الجذور هو ما ظهر كنتيجة للمعاملة بتركيز ٦٠٠٠ جزء في المليون في كلا الموسمين. كما أن نتائج العقل تحت الطرفية كانت أفضل نسبيا من العقل الطرفية. كما.أظهرت النتائج أن كل تركيزات هرمون التجذير قد أدت إلى زيادة عدد الجذور المتكونة على كل عقلة. وكانت هذه الزيادة متناسبة طرديا مع زيادة تركيزات الهرمون من ٤٠٠٠ وحتى ١٠٠٠٠ جزء في المليون. ولم يكن لأي من موسم الزراعة أو نوع العقلة أي تأثير ملحوظ على عدد الجذور.