Comparative Studies on Some Factors Affecting Rooting Ability of Carob Stem Cuttings

Shereen, A. Shaheen and Aly A. A.

Olive & Semiarid Zone Fruits Res. Dept., Hort. Res. Institute, Agric. Res. Centre, Giza, Egypt
***Corresponding author**: Sheerenatef@yahoo.com*

Abstract: The present study was carried out during two successive seasons of 2007 and 2008 on 20 – years –old on a Carob (*Ceratonia Silique L.*), female tree which performed the best vegetative growth ,yield and pod quality, grown in the experimental orchard station of Horticulture Research Institute at Giza, Egypt .The aim was to find out the effect of some factors (type of cutting, date of cutting preparation and hormone treatment) on vegetative propagation of Carob plants by stem cuttings. To achieve this work, two types of Carob stem cuttings (terminal and sub-terminal) were prepared from one- year- old branches. Monthly, on each collection date, cuttings were subjected to the hetero auxin (IBA) treatments by dipping the base of them 10 sec. in 3000, 6000 and 9000 ppm IBA solution, with or without wounding and with or without NAA at two concentrations 100 & 200 ppm. Cuttings were divided into two groups; first group was planted under intermittent mist, and the second group under white plastic tunnel. Results showed that rooting ability of carob, root length and dry weight, survival after 2 months and average number of roots increased by increasing concentration of IBA from 3000 to 9000 ppm with wounding and with NAA at 100 and 200 ppm in both April and May in both terminal and sub terminal cuttings, but decreased to the little extent in August and September. While, fluctuated greatly exhibiting very low values to zero during the period from October to March. Terminal cuttings were the best in the rooting ability, root length and survival after 2 months. Sub-terminal cuttings were the best in the average number of roots and dry weight of roots under mist and tunnel. The untreated Carob stem cuttings of two types appeared to be difficult or impossible to root in collection dates and different concentrations of hormone. In conclusion, vegetative propagation of Carob by cuttings under mist or under tunnel affected by many factors such as: time of preparing cuttings, type of cuttings and treated with growth regulators. Moreover, mist propagation technique costly where as in areas characterized by poor facilities, propagation under white plastic tunnels is cheaper and save the cost of electricity and can be used commercially.
[Shereen, A. Shaheen and Aly A. A. **Comparative Studies on Some Factors Affecting Rooting Ability of CarobStem Cuttings**. Journal of American Science 2011;7(8):285-301] (ISSN: 1545-1003).
http://www.americanscience.org.

Key words: Carob tree,type of cutting, date of cutting preparation and hormone treatment, stem cutting types

1. Introduction

Carob is native to the eastern Mediterranean, probably the Middle East, where it has been in cultivation for at least 4000 years. Carob grows well in the Mediterranean basin, and some parts of Western Asia and the Middle East. The tree is well adapted to mild and dry areas with poor soils. Carob tree is an important part of Mediterranean vegetation and it is often interplant with olives, grapes, almonds, and barley in low intensive faming system. *(Hill Coat et al., 1980*).

Carob trees may be male, female and hermaphrodite or play gummous inflorescences, showing high plasticity in inflorescences and flowering characteristics. Female cultivars are the most important trees commercial groves of Mediterranean countries. *Laubscher and Ndakidemi,(2008*) .

The carob is cultivated primarily in Mediterranean countries; most of the world's carob production comes from Mediterranean countries. Portugal and Spain have approximately 100,000 has of carob trees and process approximately half of the world's commercial carob supply. World carob pod production is approximately 315,000 t per year and the main carob bean producers and exporters are Spain (42%), Italy (16%), Portugal (10%), Morocco (8%), Greece (6.5%), Cyprus (5.5%) and Turkey (4.8%) (*Haselberg 2000*).

Carob is drought-resistant, requires little maintenance and produces a range of products from the seed and the pod. The endosperm is extracted from the seeds to produce a galactomannan, which forms locust bean gum .It is a valuable natural food additive used also in textile and cosmetic industries. The pod is useful for high-energy stock feed and the human food industry as a cocoa substitute and in syrups. Carob pod is also an anti-diarrheic product because of its high tannin content. (Loeb *et al.*, 1989).

Avallone et al., 1997 determined carob pod composition. High content of carbohydrates (45%), sucrose (30%), appreciable amounts of protein (3%) and low levels of fat (0.6%) were found. High tannin content is also present in carob pod composition, which limits the consumption by cattle because of reduced digestibility (*Priolo et al., 2000).*

Carob pods were also used in ancient Egypt, where the pulp of the pods was mixed in porridge, with a little

honey, and wax as a treatment for diarrhea and other. The trees are also useful as ornamentals and for landscaping, windbreaks and a forestation. Cattle can browse on leaves and the wood is suitable for fuel.

Carob has been neglected with respect to both cultural practices and research and development.

Carob grows well in a warm temperature and sub-tropical areas, tolerates hot and humid coastal areas. *(Roman et al., 2004)*

The art of propagation by cuttings is a very old technique popular in the field of horticulture. However, there are many species which are difficult to root. In recent years, many such difficults to root species are made to root easily by use of root inducing chemicals and

modifying the surrounding environment. Such attempts have been successful to get higher rooting percentage and early rooting. The rooting generally affected by internal and external factors i.e. type, date of taking and growth regulators application *(Hartman et al., 2002, Manan et al., 2002, Gerakakis and Ozkaya , 2005, Laubscher and Ndakidemi, 2008, Mohy 2009 and Sayed et al., 2010)* .

Plastic tunnels with water mist gave the best rooting and vegetative growth followed by the cutting under plastic tunnels without mist in Hamelia patens, (*Elgimabi, 2009).*

Carob may be propagated by seeds, budding, grafting or cutting *(Roman et al., 2002),* and has been described by *Lee et al. (1977)* and *Hartman and Kester (1983)* as a difficult to root. *Alorda er al.,(1987) and Cabrita et al., (1988)*

This investigation was carried out to study the effect of IBA & NAA concentration, wounding, time of cutting collection and the way of planting cuttings (mist or tunnels) on the rooting ability of two types (terminal or sub-terminal) of Carob cuttings.

2. Materials and Methods

This investigation was conducted through two seasons of 2007 and 2008 on 20 – years –old on a Carob *(Ceratonia Silique L.)* female tree which performed the best vegetative growth ,yield and pod quality , grown in the experimental orchard station of Horticulture Research Institute at Giza, Egypt was used as a source of cuttings.

This investigation included two experiments:

The first experiment studied the effect of some factors on vegetative propagation of Carob by using stem cuttings under mist.

The second experiment studied the effect of the same factors on vegetative propagation of Carob by using stem cuttings under tunnel.

Both experiments included three factors:

1- **Type of cuttings**

Two types of cuttings: terminal and sub terminal cuttings were prepared from one-year-old branches. Cuttings were about 15-20 cm in length, 1 – 1.5 cm in diameter and with 4 – 6 buds. A basal cut was made just below a nod and all leaves were removed except two leaves left at the apex.

2- **Growth regulators**

The basal end of cuttings to about 2 cm was quickly dipped for 10 seconds in different solutions of IBA concentration (3000, 6000 and 9000 ppm) with / or without wounding, and with / or without NAA in two concentrations 100 and 200 ppm.

The tested treatments were arranged as follow:

1- Control (water)
2- IBA at 3000 ppm
3- IBA at 3000 ppm + wounding
4- IBA at 3000 ppm + wounding + NAA at 100 ppm
5- IBA at 3000 ppm + wounding + NAA at 200 ppm
6- IBA at 6000 ppm
7- IBA at 6000 ppm + wounding
8- IBA at 6000 ppm + wounding + NAA at 100 ppm
9- IBA at 6000 ppm + wounding + NAA at 200 ppm
10- IBA at 9000 ppm
11- IBA at 9000 ppm + wounding
12- IBA at 9000 ppm + wounding + NAA at 100 ppm
13- IBA at 9000 ppm + wounding + NAA at 200 ppm

3-**Date of cutting preparation**

All cuttings were prepared at monthly intervals during the period from January till December.

Then each type of cuttings was divided into two groups:

First group (The first experiment) Carob cuttings were planted to depth of 5 – 6 in plastic flats containing a mixture of peat moss and sand (2: 1, V/V). Planted flats were directly kept under intermittent mist for 12 weeks. Misting was applied according to seasonal and daily weather conditions, within a range of 5-15 seconds ON and 2.5- 5 min OFF; bottom heat system was used during winter months.

The second group (The second experiment) cuttings were planted in one litre black plastic container (1 cutting / bag). The containers were filled with media of sand and peat moss (2 : 1, V/V) under white plastic tunnels 80 micron in diameter and placed in shaded net-house about 65 percentage porosity.

Measurements

- Rooting ability: root length, numbers of roots per cuttings and dry weight of roots (gm.) were recorded after 3 months of planting.
- Survival percentage: It was estimated on the number of rooted cuttings that remained alive two months latter from recording the rooting measurements.

The experiment was arranged in split plot design. Each treatment was replicated three times, and each replicate represented by 10 cuttings.

All collected data were subjected to statistical analysis for each year according to procedure out lined by *Gomez and Gomez (1984)* and the LSD was used to compare the treatment mean.

3. Results and discussion

3.1. The first experiment:

The effect of some factors [time of cutting preparation (dates), concentration of growth regulators and cutting position (type)] on vegetative propagation of Carob by using stem cuttings under intermittent mist.

3.1.1- Rooting ability (%)

Data in Tables (1&2) represented that treated Carob stem cuttings of two types along the whole year from January till December. It is evident from data that cutting preparation dates were very important factor for rooting ability. It can be noticed that, all treated cuttings were done from Oct. to March exhibited very low values to reach zero, April and May had fluctuated greatly. The highest rooting percentage was in April (40.90 & 40.44) followed by May (37.02, 37.26) in both seasons. Then decreasing in rooting percentage from June till September. As for treated cuttings with growth regulators, it is obvious that all treatments had increasing influence on rooting percent of cuttings compared with control the differences reach up to level significant, high concentration of IBA (9000 ppm) with wounding plus NAA at 100 ppm had the maximum rooting percentage in both seasons (30.4&30.27). Regarding the types of cutting (terminal and sub terminal) ;the treated terminal cuttings had the higher value than the treated sub terminal cuttings in April, May, and June (48.87,48.55, 43.35,43.21, & 34.90,34.68) in both seasons, respectively. Concerning interaction factors, it can be concluded that the terminal cuttings treated by IBA 9000 ppm with wounding plus NAA at 100 ppm through April was achieved the highest values in both seasons (62.47 & 63.13).

These results were in agreement with those obtained by *Mostafa et al., (1979), Mohamed (1980)* and *Al Tury et al., (1999)* on Carob. They reported that, date of preparing cuttings, different concentrations of IBA affected greatly on the rooting ability of Carob. Other investigators had reported results similar to ours [*El-Nabawy et al., (1983) and* El-*Said et al., (1990])* on olive .

3.1.2- Root length (mm):

Data in Tables (3&4) revealed that, the highest significant values of root length were obtained during April and May in the first season (9.55, 9.63) and during May in the second season (9.13). Then the root length decreased from June till Sept regarding the types of cuttings the terminal .Cuttings tended to have statistically significant higher root length than sub terminal ones from April to Sept. (11.22,11.38,11.14,9.15,6.96,6.74 cm and 10.82,11.07,10.70,8.96,6.37,6.14 cm) in both seasons. As for growth regulators treatments data presented in table (3&4) showed that all treatments significantly increased the root length as compared with control, best treatment was IBA at 9000 ppm with wounding (9.59, 10.25 cm) following by IBA at 9000 ppm with wounding plus NAA at 200 ppm (9.09 , 9.53 cm) treatment in both seasons, respectively.

Concerning the interaction the analysis of variance indicated that there was a significant respond to the interaction between date of preparation cutting, type of cutting, and concentration of growth regulators. It was clear from the current study that the highest length of root was achieved through April in terminal cutting treated with IBA at 9000 ppm with wounding (13.33,12.57) in both seasons .

These results are in line with *Alorda et al., (1987)* and *Cabrita et al., (1988)* on Carob; *El-Nabawy et al, 1983* and *Ibrahim et al., 2009* on Olive. They all reported that number of roots affected greatly by many factors such date, concentration of hormone, and planting date.

3.1.3- Number of roots:

It can be noticed in Tables (5&6) that number of roots increments were more pronounced in April in both seasons (10.38, 9.31) following in descending order by May, June, July, August and Sept.. As for type of cutting, it was quite evident that treated sub terminal cuttings had higher records during April, May and June in the first season , however the data in the second season did not take the same trend. The average number of
roots were positively affected by growth regulators, treatment with IBA at 9000 ppm
with wounding plus NAA at 200 ppm was superior applications followed by the
treatment with IBA at 9000 ppm with wounding plus NAA at 100 ppm (10.25, 10.11& 9.69, 9.67) in both seasons, respectively . Regarding the interaction between factors it can be concluded that the sub terminal cuttings treated by IBA at 9000 ppm with wounding plus NAA at 200 ppm or IBA at 9000 ppm with wounding plus NAA at 100 ppm through April recorded the highest number of roots (16.00,14.00 & 16.00,14.00) in both seasons.

The obtained results were in agreement with those obtained by *Mohamed (1980)* and *Ramon et al., (2002)* on Carob, as well as, *Mencuccin et al., (1988)* on Olive and Mohy Eldeen *(2009)* on Jojoba

3.1.4-Dry weight of roots (gm):

Tables (7&8) displayed that the treated cuttings which prepared in April had the significantly highest dry weight (6.16 & 6.16 gm.) in both seasons following in descending order by May, June, July, August and Sept.. As for type of cuttings, it is clear from available data that significant differences were observed in dry weight of roots, where the treated sub terminal cuttings recorded higher values than terminals ones during the months of April, May and June (6.94, 6.09, 5.60, 6.96, & 6.07,5.60 gm.) in both seasons, respectively. Concerning the effect of different treatments on dry weight of roots it is obvious that cuttings treated with IBA at 9000 ppm with wounding plus NAA at 200 ppm or IBA at 9000 ppm with wounding plus NAA at 100 ppm had the highest values in this respect (5.93, 5.84 & 5.93, 5.82) in both seasons, respectively. Meanwhile, the interaction between factors was significantly affected dry weight of roots. In this respect when sub terminal cuttings treated with IBA at 9000ppm + wounding plus NAA at 100ppm or IBA at 9000 ppm with wounding plus NAA at 200 ppm through April gave the maximum values (8.96, 8.83 & 9.01, 8.98) in both seasons, respectively .

Similar results were obtained by Lee and Hackett (1977), Hartman and Kester (1983), Alorda et al., (1987), Roman and Martins (2002) and Ibrahim et al., (2009).

Table (1): Effect of planting date, type of cutting and treating with hormone on the rooting ability (%) under mist in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	37.70	22.37	31.67	22.10	24.70	20.23	0.00	13.90	0.00	0.00	0.00	0.00	14.39
3	48.13	29.83	37.63	26.50	27.00	23.20	12.17	15.40	0.00	0.00	0.00	0.00	18.32
4	51.67	29.17	39.58	26.17	31.40	22.83	13.00	16.07	0.00	0.00	0.00	0.00	19.16
5	44.57	29.00	35.87	25.70	26.47	22.57	11.40	14.73	0.00	0.00	0.00	0.00	17.53
6	42.23	33.63	35.00	29.63	23.50	24.17	13.67	14.07	6.87	12.83	5.07	9.93	20.88
7	45.87	36.23	45.80	32.87	34.90	26.90	16.20	15.83	11.83	14.27	6.47	10.87	24.84
8	51.20	35.40	49.37	31.53	37.20	25.40	13.70	15.73	8.70	14.40	5.30	11.00	24.91
9	46.65	33.83	40.58	31.53	31.70	25.03	12.20	15.70	8.37	13.33	4.40	10.00	22.78
10	48.83	37.07	44.67	35.87	33.83	28.63	11.83	15.00	11.67	13.00	6.37	9.83	24.72
11	51.50	35.17	49.83	37.20	44.30	33.03	18.10	12.17	13.03	14.97	7.67	10.00	27.50
12	62.47	38.40	57.50	34.73	54.93	31.43	19.27	16.17	14.57	15.27	8.53	10.17	30.04
13	55.63	35.13	52.70	34.33	48.90	30.33	14.37	14.50	11.20	14.07	7.60	9.07	27.32
Mean(B)	40.90		37.02		30.53		13.97		8.27		5.51		
Mean(C)	48.87	32.94	43.35	30.68	34.90	26.15	12.99	14.94	7.19	9.34	4.28	6.74	

L.S.D.	A	B	C	ABC
	0.3400	0.2404	0.1388	1.178

T1= IBA 3000 ppm
T2= IBA 3000 ppm + Wounding
T3= IBA 3000 ppm + Wounding + NAA 100 ppm
T4= IBA 3000 ppm + Wounding + NAA 200 ppm
T5= IBA 6 000 ppm
T6= IBA 6000 ppm + Wounding
T7= IBA 6000 ppm + Wounding + NAA 100 ppm
T8= IBA 6000 ppm + Wounding + NAA 200 ppm
T9= IBA 9000 ppm
T10= IBA 9000 ppm + Wounding
T11= IBA 9000 ppm + Wounding + NAA 100 ppm
T12= IBA 9000 ppm + Wounding + NAA 200 ppm

* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: Interaction

Table (2): Effect of planting date, type of cutting and treating with hormone on rooting ability (%) under mist in 2008 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub	Ter.	Sub	Ter.	Sub	Ter.	Sub	Ter.	Sub	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	37.27	22.10	31.22	21.93	24.67	20.00	0.00	13.90	0.00	0.00	0.00	0.00	14.26
3	44.48	30.27	37.20	27.60	27.67	23.33	11.57	16.23	0.00	0.00	0.00	0.00	18.20
4	51.10	29.70	39.50	27.70	30.53	22.67	12.67	16.40	0.00	0.00	0.00	0.00	19.19
5	44.40	28.80	35.57	26.67	26.33	23.07	11.10	14.93	0.00	0.00	0.00	0.00	17.57
6	42.50	27.57	35.53	31.23	23.23	24.50	13.40	14.33	7.03	13.10	5.00	9.67	20.59
7	46.37	35.83	46.50	34.00	34.33	27.00	16.23	16.43	11.73	14.50	7.20	10.87	25.08
8	51.10	34.37	48.43	31.87	37.00	25.73	13.53	15.97	8.70	14.67	5.13	10.53	24.75
9	46.54	33.67	40.55	32.17	31.63	25.33	11.97	15.50	8.33	13.10	4.60	9.90	22.77
10	48.83	37.50	43.64	36.50	33.57	25.10	11.50	15.30	11.60	13.83	6.40	9.57	24.44
11	51.23	35.17	49.67	37.63	44.33	28.83	17.73	16.63	13.13	15.43	7.67	10.43	27.58
12	63.13	38.50	57.67	35.00	54.50	33.27	18.87	16.20	14.77	14.97	8.60	10.73	30.27
13	55.60	34.57	53.07	33.33	48.33	31.07	14.77	14.83	11.17	13.97	7.57	9.10	27.28
Mean(B)	40.44		37.26		30.25		14.17		8.33		5.54		
Mean(C)	48.55	32.34	43.21	31.30	34.68	25.83	12.78	15.56	7.21	9.46	4.35	6.73	

L.S.D.	A	B	C	ABC
	0.3909	0.2764	0.1596	1.354

T1= 3000 ppm
T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm
T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm
T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200ppm
* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: Interaction

Table (3): Effect of planting date, type of cutting and treating with hormone on length of roots under mist in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	10.40	6.67	10.57	6.67	10.17	6.63	0.00	6.17	0.00	0.00	0.00	0.00	4.77
3	11.50	8.00	11.67	7.83	11.17	7.47	10.60	7.10	0.00	0.00	0.00	0.00	6.28
4	10.50	7.40	10.50	7.57	10.17	7.20	9.40	6.30	0.00	0.00	0.00	0.00	5.75
5	10.27	7.33	10.33	7.30	10.17	6.83	8.97	6.23	0.00	0.00	0.00	0.00	5.62
6	10.90	7.50	11.17	7.47	11.00	7.60	10.17	6.67	10.17	6.10	10.17	6.07	8.75
7	12.00	8.50	12.33	8.40	12.33	8.47	10.50	7.07	11.17	6.30	10.83	6.40	8.63
8	10.83	8.00	10.73	7.80	11.67	8.10	9.33	6.53	10.17	6.10	9.00	6.00	8.69
9	10.07	7.67	10.40	8.00	10.50	7.67	9.17	6.20	9.83	6.00	9.07	5.67	8.35
10	11.83	8.30	12.73	8.30	12.17	7.50	10.83	7.00	11.00	6.63	10.67	6.17	9.04
11	13.33	8.83	14.00	8.80	13.00	8.40	11.67	7.50	11.83	7.17	11.67	6.83	10.25
12	11.76	8.20	11.33	8.50	11.00	8.10	9.83	7.00	9.83	6.83	10.00	6.17	9.45
13	11.33	8.10	10.83	8.00	10.40	7.83	9.33	6.37	9.50	6.37	9.50	6.00	9.53
Mean(B)	9.55		9.63		9.40		7.91		5.63		5.43		
Mean(C)	11.22	7.88	11.38	7.89	11.14	7.65	9.15	6.68	6.96	4.29	6.74	4.11	

L.S.D.	A	B	C	ABC
	0.1856	0.1312	0.07576	0.6428

T1= 3000 ppm
T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm
T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm
T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200ppm
* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: Interactio

Table (4): Effect of planting date, type of cutting and treating with hormone on the length of roots under mist in 2008 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	9.83	6.57	10.57	6.33	10.27	6.23	0.00	6.27	0.00	0.00	0.00	0.00	4.67
3	11.13	7.73	11.17	7.60	11.27	7.17	10.43	7.10	0.00	0.00	0.00	0.00	6.13
4	10.67	7.20	10.33	7.47	10.57	7.17	9.47	6.17	0.00	0.00	0.00	0.00	5.75
5	9.83	7.17	10.23	7.27	9.97	7.07	9.00	6.10	0.00	0.00	0.00	0.00	5.55
6	10.83	6.80	10.67	7.30	10.27	7.27	10.17	6.20	9.57	6.07	9.10	6.03	8.36
7	11.30	7.43	11.67	8.20	11.57	8.07	10.67	7.17	10.50	6.37	9.83	6.30	7.89
8	10.50	7.03	10.83	7.00	10.53	6.67	9.00	6.80	9.00	6.07	8.93	6.10	8.21
9	10.00	6.83	10.53	6.50	9.40	6.40	8.40	7.03	8.10	6.00	8.27	5.63	7.76
10	11.47	7.40	12.17	7.17	11.57	6.87	10.10	7.23	10.07	6.53	9.60	6.30	8.87
11	12.57	7.87	13.17	7.67	12.40	7.60	11.07	7.60	10.67	7.13	10.57	6.83	9.59
12	11.00	7.47	11.30	7.30	10.50	7.20	10.17	7.03	10.00	6.83	9.17	6.67	8.72
13	10.67	6.87	10.17	6.57	10.10	6.17	9.07	6.37	8.57	6.70	8.23	6.23	9.09
Mean(B)	9.01		9.13		8.84		7.86		5.34		5.16		
Mean(C)	10.82	7.20	11.07	7.20	10.70	6.99	8.96	6.76	6.37	4.31	6.14	4.18	

L.S.D	A	B	C	ABC
	0.1415	0.1000	0.05776	0.4901

T1= 3000 ppm
T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm
T4= 3000 ppm + Wounding + NAA 200 ppm
T5= 6000 ppm
T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200 ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200 ppm

* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: Interaction

Table (5): Effect of planting date, type of cutting and treating with hormone on number of roots of Carob under mist in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
2	*3.67*	*7.67*	*4.00*	*5.67*	*4.33*	*5.33*	*2.67*	*3.00*	*0.00*	*2.67*	*0.00*	*2.33*	*3.44*
3	*4.67*	*10.33*	*5.33*	*9.00*	*6.00*	*4.33*	*5.33*	*4.33*	*0.00*	*3.00*	*0.00*	*2.33*	*4.56*
4	*6.33*	*11.33*	*6.67*	*10.00*	*6.33*	*8.00*	*7.00*	*5.33*	*0.00*	*3.00*	*0.00*	*2.67*	*5.56*
5	*7.33*	*12.67*	*7.67*	*11.33*	*7.33*	*8.67*	*8.00*	*6.00*	*0.00*	*3.00*	*0.00*	*3.00*	*6.25*
6	*8.33*	*8.33*	*8.67*	*7.33*	*8.00*	*9.00*	*5.67*	*3.33*	*5.67*	*4.00*	*4.33*	*2.67*	*6.28*
7	*9.00*	*12.00*	*7.00*	*11.00*	*8.33*	*9.67*	*7.67*	*4.67*	*8.67*	*4.67*	*6.00*	*3.00*	*7.64*
8	*10.67*	*13.33*	*8.67*	*11.00*	*8.67*	*10.00*	*8.67*	*5.67*	*9.33*	*5.00*	*8.00*	*3.33*	*8.53*
9	*10.00*	*13.67*	*9.33*	*12.33*	*9.33*	*11.33*	*9.00*	*6.00*	*9.67*	*5.67*	*8.67*	*3.67*	*9.06*
10	*9.33*	*9.67*	*9.67*	*8.00*	*8.67*	*7.00*	*8.00*	*6.33*	*8.67*	*5.67*	*6.00*	*4.33*	*7.61*
11	*10.33*	*14.33*	*11.00*	*11.67*	*9.67*	*9.67*	*9.00*	*6.67*	*8.67*	*6.00*	*8.33*	*4.33*	*9.14*
12	*11.00*	*16.00*	*11.33*	*11.67*	*10.33*	*10.67*	*9.33*	*7.33*	*8.67*	*6.33*	*9.00*	*4.67*	*9.69*
13	*13.00*	*16.00*	*12.33*	*12.00*	*11.00*	*11.33*	*9.67*	*8.00*	*8.67*	*6.67*	*9.33*	*5.00*	*10.25*
Mean (B)	*10.38*		*9.28*		*8.46*		*6.53*		*5.15*		*4.21*		
Mean (c) C)	*8.64*	*12.11*	*8.47*	*10.08*	*8.17*	*8.75*	*7.50*	*5.56*	*5.67*	*4.64*	*4.97*	*3.44 I*	

L.S.D.	*A*	*B*	*C*	*ABC*
	0.4126	*0.2918*	*0.1684*	*1.429*

T1= 3000 ppm
T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm
T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm
T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200ppm

*** (A):** Growth regulators ***(B):** Cutting type ***(C):** Planting date **ABC:** Interac

Table (6): Effect of planting date, type of cutting and treating with hormone on number of roots of Carob under mist in 2008

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.67	6.67	5.00	5.33	4.67	3.00	0.00	3.00	0.00	2.33	0.00	2.33	3.08
3	5.67	9.00	6.00	8.00	5.67	5.33	5.00	4.67	0.00	2.67	0.00	2.67	4.56
4	6.33	9.67	6.67	9.00	6.67	6.00	6.67	5.33	0.00	2.67	0.00	2.67	5.14
5	7.33	10.67	7.33	10.00	7.33	6.67	7.33	5.67	0.00	2.67	0.00	2.67	5.64
6	5.33	6.33	5.67	5.33	6.00	7.33	6.33	3.33	5.33	3.00	4.00	3.00	5.08
7	6.67	10.00	7.00	9.00	7.00	8.00	8.00	5.00	7.67	3.67	5.33	3.33	6.72
8	8.33	11.33	8.00	9.00	8.00	8.00	9.00	5.00	8.33	4.33	7.00	3.33	7.47
9	9.00	11.67	9.00	10.33	9.00	9.33	10.00	6.00	9.00	5.00	8.00	3.67	8.33
10	8.33	8.33	9.00	6.00	6.00	5.00	8.33	6.67	7.33	5.33	6.00	3.33	6.64
11	11.67	12.33	12.00	9.67	9.33	8.33	9.33	5.00	8.67	6.00	8.00	4.00	8.69
12	12.67	14.00	13.00	9.67	10.67	8.67	10.33	7.33	9.67	6.67	9.00	4.33	9.67
13	13.67	14.00	13.33	10.00	11.67	9.33	10.33	7.67	10.00	7.00	9.67	4.67	10.11
Mean (B)	9.31		8.49		7.38		6.47		4.89		4.04		
Mean C)	8.28	10.33	8.53	8.44	7.67	7.08	7.56	5.39	5.50	4.28	4.75	3.33	

L.S.D	A	B	C	ABC
	0.4443	0.3141	0.1814	1.539

T1= 3000 ppm T2= 3000 ppm + Wounding T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm

T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm T9= 9000 ppm T10= 9000 ppm + Wounding

T5= 6000 ppm T6= 6000 ppm + Wounding T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm

* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: Interac

Table (7): Effect of planting date, type of cutting and treating with hormone on the dry weight of roots (gm.) under mist in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2.88	5.48	3.15	3.34	3.25	3.95	0.00	2.65	0.00	0.00	0.00	0.00	2.06
3	3.24	6.31	3.38	5.79	4.17	4.97	3.82	3.00	0.00	0.00	0.00	0.00	2.89
4	4.52	6.79	4.58	6.29	4.41	5.17	5.00	3.80	0.00	0.00	0.00	0.00	3.38
5	5.06	6.90	5.19	6.73	5.12	5.30	5.21	4.37	0.00	0.00	0.00	0.00	3.66
6	5.16	5.23	5.23	5.38	5.07	5.36	4.13	2.58	4.33	3.15	3.88	2.08	4.02
7	5.69	6.58	5.02	6.55	5.19	5.51	5.06	3.17	5.22	4.15	4.01	2.31	4.87
8	6.16	7.03	5.15	6.54	5.20	6.17	5.14	4.00	5.78	4.40	5.36	2.89	5.32

Mean(A)	6.12	6.93	5.53	5.16	5.10	5.33	4.98	3.59	5.03	4.63	3.58	3.00
	6.29	7.07	6.33	6.95	4.97	5.89	4.75	5.47	4.91	4.15	4.80	3.19
	6.80	7.96	6.49	6.88	6.26	6.43	5.91	5.06	4.93	4.17	5.00	3.18
	7.12	8.83	6.95	6.74	6.59	6.81	5.32	5.12	5.07	4.28	5.09	3.29
Mean(B)	6.16		5.62		5.30		4.21		3.06		2.45	
Mean(C)	6.94	5.37	5.16	6.09	5.00	5.60	4.48	3.94	3.32	2.79	3.01	1.89

L.S.D	A	B	C	ABC
	0.08036	0.05682	0.0328	0.2784

T1= 3000 ppm T2= 3000 ppm + Wounding T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm

T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm T9= 9000 ppm T10= 9000 ppm + Wounding

T5= 6000 ppm T6= 6000 ppm + Wounding T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm

* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date** ABC: **Interac**

Table (8): Effect of planting date, type of cutting and treating with hormone on the dry weight of roots (gm.) under mist in2008 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2.97	5.28	3.17	3.30	3.21	4.08	0.00	2.70	0.00	0.00	0.00	0.00	2.06
3	3.17	6.48	3.36	5.79	4.14	5.07	3.79	3.11	0.00	0.00	0.00	0.00	2.91
4	4.42	6.68	4.51	6.26	4.41	5.11	5.09	3.83	0.00	0.00	0.00	0.00	3.36
5	5.02	6.75	5.17	6.69	5.08	5.31	5.21	4.34	0.00	0.00	0.00	0.00	3.63
6	5.13	5.28	5.10	5.31	5.11	5.31	4.17	2.45	4.32	3.18	3.77	2.09	4.27
7	5.65	6.68	5.02	6.52	5.20	5.60	5.23	3.11	5.23	4.21	4.01	2.30	4.90
8	6.22	7.20	5.19	6.68	5.16	6.22	5.17	4.10	5.88	4.34	5.28	2.81	5.35

Mean(A)	6.05	7.18	4.83	6.76	4.70	6.21	4.58	4.53	4.57	4.63	4.43	2.74	5.10
	5.66	6.05	5.47	5.15	5.06	5.29	5.06	3.69	5.01	4.50	3.38	3.07	4.78
	6.23	7.98	6.24	6.92	4.93	5.83	4.77	5.48	5.06	4.09	4.78	3.18	5.46
	6.72	9.01	6.45	6.82	6.26	6.40	5.83	5.00	4.86	4.20	5.11	3.20	5.82
	7.00	8.98	6.83	6.68	6.65	6.82	5.28	5.09	5.10	4.30	5.14	3.30	5.93
Mean(B)	6.16		5.59		5.30		4.23		3.06		2.44		
Mean(C)	5.35	6.96	5.11	6.07	4.99	5.60	4.52	3.95	3.34	2.79	2.99	1.89	

L.S.D	A	B	C	ABC
	0.04866	0.03441	0.01986	0.1686

T1= 3000 ppm T2= 3000 ppm + Wounding T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm T5= 6000 ppm

T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date** ABC: **Intera**3.1.5- Survival after 2 months (%).

Data of statically evaluation of the percentage of survival cuttings, was illustrated in Tables (9&10). It indicated that treated carob cuttings at April and May were significantly achieved the highest values in this respect (80.60, 80.80&80.19, 89.89), (80.47,77.92,80.52,79.76) in both season respectively then the percentage of survival cuttings decreased from June till Sept.. Concerning the type of cutting the treated terminal and sub-terminal Carob cuttings significantly attained the maximum survival cuttings (80.56& 80.65 &80.98, 80.62), but in the second season the treated terminal cuttings significantly gave the higher value than sub terminal treated cuttings through April and may. As growth regulators; it can be said that terminal Carob cuttings treated with IBA at 9000 ppm plus wounding during April in the first season , while in the second season the same types of cuttings and month but treated with IBA at 6000ppm plus wounding NAAat2000 ppm were the superior in this treatment respect. Afterwards, the survival percentage of continuously decreased for both types of cuttings reaching the minimum value in August and Sept. (42.28, 37.98 & 42.69, 38.31) in both seasons, respectively. Meanwhile, the interaction among the factors under study was significantly affected on survival cuttings (%). In this respect when the terminal or sub terminal cuttings treated with IBA at 9000 ppm plus wounding significantly gave the highest values during April and May in both seasons.

These results were in agreement with the findings of *Mohamed (1980), El-Nabaway (1983), Alorda et al., (1987), Roman and Martin (2002), Ibrahim et al., (2009) and Luqman (2004)).*

Table (9): Effect of planting date, type of cutting and treating with hormone on survival (%) after 2 months under mist in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	78.20	81.30	82.40	83.57	78.80	79.90	0.00	71.27	0.00	0.00	0.00	0.00	46.29
3	79.87	79.73	81.90	81.47	80.00	79.50	73.00	75.30	0.00	0.00	0.00	0.00	52.56
4	79.33	80.87	83.00	81.40	74.90	76.10	67.00	75.67	0.00	0.00	0.00	0.00	51.52
5	79.90	79.90	78.87	78.20	79.87	75.07	64.30	74.03	0.00	0.00	0.00	0.00	50.84
6	80.28	78.53	80.63	79.07	80.70	75.07	70.23	77.43	65.83	63.67	55.27	55.37	71.84
7	81.30	80.37	82.47	83.47	77.90	78.20	74.23	76.57	65.77	66.67	56.40	58.23	73.46
8	77.70	81.03	80.50	82.43	76.30	79.40	70.97	65.13	64.17	55.00	50.53	53.63	69.73

9	81.37	79.83	78.60	80.40	74.33	75.57	71.57	72.87	61.70	57.30	53.00	53.70	70.02
10	82.97	79.83	81.60	81.33	77.43	73.03	75.33	77.07	67.73	61.20	55.67	60.53	72.81
11	83.08	83.27	80.70	79.47	80.57	74.70	75.57	77.83	68.87	66.47	63.97	61.00	74.46
12	81.33	82.33	79.67	79.60	79.20	78.80	71.03	75.53	64.80	70.60	58.40	60.07	73.45
13	81.37	80.80	81.47	77.03	77.27	74.83	67.53	74.27	56.77	58.10	57.97	57.77	70.60
Mean(B)	80.60		80.80		77.39		69.74		42.28		37.98		
Mean(C)	80.56	80.65	80.98	80.62	78.11	76.68	65.06	74.41	42.97	41.58	37.60	38.36	

L.S.D.	A	B	C	ABC
	0.7466	0.5279	0.3048	2.586

T1 = 3000 ppm
T2 = 3000 ppm + Wounding
T3 = 3000 ppm + Wounding + NAA 100 ppm
T4 = 3000 ppm + Wounding + NAA 200ppm
T5 = 6000 ppm
T6 = 6000 ppm + Wounding
T7 = 6000 ppm + Wounding + NAA 100 ppm
T8 = 6000 ppm + Wounding + NAA 200ppm
T9 = 9000 ppm
T10 = 9000 ppm + Wounding
T11 = 9000 ppm + Wounding + NAA 100 ppm
T12 = 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date** ABC: **Inter**

3.2.The second experiment:

The effect of some factors [time of cutting preparation (dates), concentration of growth regulators and cutting position (type)] on vegetative propagation of Carob by using stem cuttings under tunnel

3.2. 1- Rooting ability (%)

With regard to date of cutting preparation data generally showed highly significant differences in rooting ability among treated carob cuttings at different months. It can be clearly noticed in Tables (11&12) that all treated cuttings were done from Oct. to March failed to root in both seasons, while April and May were the proper time for preparing the treated cuttings (51.22, 46.85 & 50.79, 47.53) then rooting percent was gradually decreased from June to Sept..(18.26, 7.14, 5.79, 4.52 & 19.74, 8.39, 6.47, 5.59) in both seasons, respectively. As for type of Carob cuttings, significant differences were observed in rooting percent of cuttings. It was clear that treated terminal cuttings showed in general higher rooting percent than the sub terminal ones from April until Sept. in both seasons. Regarding the effect of different treatments on rooting percentage of each type of cuttings, it is obvious that all treatments induced the great increasing influence on rooting percentage compared with control except months from October to March which treated cutting failed to root, where, the differences reached up to significant level. Best treatments were IBA at 9000ppm + wounding or IBA at 9000 ppm with wounding plus NAA at 100 ppm (26.93, 36.83 &37.78, 28.08) respectively, in both seasons. Concerning the interaction it can be noticed that the treated

terminal cuttings with IBA at 9000 ppm with wounding plus NAA at 100 during April achieved the highest values (84.37, 85.07) respectively, in both seasons, Mohy Eldeen (2009).

Table (10): Effect of planting date, type of cutting and treating with hormone on the survival (%) after 2 months under mist in2008 season

	A		Ma		J		J		Au		S		
	Ter.	Sub ter.		Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
	78.87	79.37		81.20	79.37	80.50	0.00	72.43	0.00	0.00	0.00	0.00	65.85
	78.87	79.73		80.93	80.73	80.17	73.60	73.70	0.00	0.00	0.00	0.00	52.38
	78.87	78.30		80.33	75.60	76.77	67.80	74.73	0.00	0.00	0.00	0.00	51.15
	78.97	78.17		76.37	81.40	75.87	65.13	73.43	0.00	0.00	0.00	0.00	50.63
	82.18	77.37		78.23	81.47	75.07	70.80	76.60	67.17	64.33	55.73	56.03	72.33
	82.50	82.10		82.97	78.80	79.20	72.97	74.73	66.43	67.00	56.80	58.57	73.57
	79.33	82.97		81.43	78.23	80.03	72.20	63.33	65.17	54.50	51.20	53.63	70.16
	83.63	80.03		79.93	75.57	74.97	72.10	71.53	62.33	58.00	54.00	52.70	70.25
	80.27	78.27		80.67	78.60	72.03	73.93	74.33	67.07	61.97	56.47	61.50	72.08
	82.28	82.90		79.33	80.10	73.33	74.93	78.30	69.80	67.20	61.70	63.00	75.32
	77.97	81.37		79.13	79.13	79.10	71.63	76.53	63.30	70.60	59.30	60.70	73.15
	81.90	79.47		76.53	76.30	75.83	69.20	74.80	60.77	58.97	58.97	59.17	71.03
	80.19		89.89		77.84		69.53		42.69		38.31		
	80.47	79.92	100.02	79.76	78.78	76.91	65.36	73.71	43.50	41.88	37.85	38.78	
	0.6233		0.4407		0.2545		2.159						

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date** ABC: **Inte**

Table (11): Effect of planting date, type of cutting and treating with hormone on the rooting ability (%) under tunnel in 2007 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	49.13	24.03	48.70	23.13	20.43	7.33	4.33	5.50	4.13	0.00	3.83	0.00	15.88
3	55.27	31.57	51.20	30.17	26.80	8.00	6.40	6.10	6.03	0.00	5.83	0.00	18.95
4	62.13	30.10	53.27	29.93	26.97	7.07	6.37	5.50	5.37	0.00	5.47	0.00	19.35
5	57.27	29.53	51.40	28.83	22.67	6.97	5.03	5.20	4.30	0.00	5.37	0.00	18.05I
6	62.93	35.70	60.10	32.90	22.70	10.37	8.00	6.10	6.07	4.50	5.73	4.47	21.63
7	71.17	37.27	61.50	35.70	24.73	11.57	9.13	6.63	9.13	5.53	7.63	4.33	23.69
8	75.47	37.33	64.20	33.90	25.80	10.07	8.83	5.60	8.67	5.47	5.00	4.07	23.70
9	68.47	35.00	62.10	35.03	24.87	10.00	8.50	5.40	8.40	5.53	5.20	4.00	22.71
10	73.20	38.00	66.10	37.23	24.83	14.50	8.73	6.27	9.20	5.00	6.80	4.03	24.49
11	77.33	39.03	68.10	38.40	28.70	17.07	13.47	7.67	12.97	5.83	8.90	4.70	26.93
12	84.37	39.07	71.13	37.17	30.00	15.23	11.23	5.53	11.23	6.33	7.53	4.17	26.83

13	79.33	37.13	67.33	36.13	26.63	15.03	10.33	5.57	9.77	5.43	7.37	3.93	25.33
Mean(B)	51.22		46.85		18.26		7.14		5.79		4.52		
Mean(C)	68.01	34.43	60.43	33.26	25.43	11.10	8.36	5.92 I	7.94	3.64	6.22 I	2.81	

L.S.D.	A	B	C	ABC
	0.3201	0.2263	0.1307	1.109

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date** ABC: **Int**

Table (12): Effect of planting date, type of cutting and treating with hormone on the rooting ability (%) under tunnel in 2008 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	50.00	23.67	49.17	23.23	28.63	7.33	6.53	5.70	6.67	0.00	6.07	0.00	17.25
3	36.37	31.57	51.43	30.33	27.30	8.03	8.80	6.17	8.63	0.00	8.03	0.00	18.06
4	62.33	29.50	53.80	29.53	28.30	7.00	10.70	5.63	7.63	0.00	7.40	0.00	20.15
5	66.23	28.97	51.73	28.47	24.53	7.03	9.50	5.17	7.67	0.00	7.23	0.00	19.71
6	63.37	35.17	61.23	32.63	23.53	10.40	9.93	6.40	7.27	4.47	6.50	4.50	22.12
7	73.07	37.73	64.40	35.83	26.27	11.33	11.63	6.40	8.90	5.60	8.63	4.37	24.51
8	75.93	35.50	65.30	34.17	28.30	10.10	11.87	6.00	8.53	5.57	8.10	4.57	24.49
9	69.70	35.00	62.67	35.00	25.80	10.23	10.33	5.33	8.07	5.40	7.17	4.00	23.23
10	72.77	37.60	67.63	37.17	29.17	14.70	10.73	6.33	10.93	6.07	10.23	4.17	25.63
11	77.87	37.30	68.97	39.37	31.57	17.17	15.27	6.93	14.83	6.50	11.10	5.10	27.78
12	85.07	38.63	74.67	37.20	35.83	15.40	13.20	6.23	12.13	5.37	10.33	4.27	28.08
13	79.03	36.70	70.93	35.77	30.70	15.10	10.87	5.80	10.00	5.00	8.53	3.97	26.03
Mean(B)	50.79		47.53		19.74		8.39		6.47		5.59		
Mean(C)	67.64	33.94	61.83	33.23	28.33	11.15	10.78	6.01	9.27	3.66	8.28	2.91	

L.S.D.	A	B	C	ABC
	0.9596	0.6785	0.3917	3.324

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): Growth regulators *(B): Cutting type *(C): Planting date ABC: In3.2.2- Length of roots(mm)

Results illustrated in Tables (13&14) showed that, carob cuttings prepared in April and May had the highest values in this respect, as well as, terminal treated carob cuttings gave significantly longer roots than sub terminal cuttings. Length of roots for both types decreased from April to Sept. in both seasons. As for the specific effect of treatments, it can be noticed that, application of IBA at 9000ppm + wounding was the best ones (9.02 & 8.74) in both seasons. Regarding the interaction, the available data indicated that the terminal carob cuttings treated with IBA at 9000ppm + wounding in April gave the longest roots (12.17,10.27) in both seasons (9.43, 9.27*). Ibrahim et al.,(2009*) on olive

Table (13): Effect of planting date, type of cutting and treating with hormone on length of roots (cm.) under tunnel in 2007 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	9.33	5.67	8.83	5.67	8.00	5.60	7.33	4.97	0.00	0.00	0.00	0.00	4.62
3	10.40	6.33	10.50	6.27	9.43	6.37	8.50	5.67	0.00	0.00	0.00	0.00	5.29
4	9.67	5.77	9.20	5.77	9.03	5.77	7.67	5.60	0.00	0.00	0.00	0.00	4.87
5	9.53	5.40	9.17	5.30	8.37	5.10	7.83	5.20	0.00	0.00	0.00	0.00	4.66
6	9.67	6.23	9.67	6.00	8.39	5.73	9.00	5.23	8.67	5.17	8.67	5.00	7.32
7	10.67	6.73	10.50	6.60	8.83	6.17	10.17	5.83	10.00	5.40	9.70	5.50	7.63
8	10.00	6.43	9.67	6.50	9.50	6.17	9.17	5.47	9.17	5.07	9.17	5.10	7.60

9	10.00	6.40	9.83	6.20	9.33	5.53	9.00	5.17	9.57	4.90	8.53	5.00	7.47
10	10.83	6.83	10.67	6.43	9.50	5.90	10.50	5.53	9.83	5.47	9.00	5.50	8.00
11	12.17	7.43	11.67	7.00	9.67	6.60	11.17	6.23	10.50	6.03	10.53	5.90	8.74
12	9.83	6.70	10.33	6.53	9.83	6.10	10.17	5.40	8.83	5.20	9.67	5.33	7.83
13	10.17	6.37	10.10	6.10	10.17	5.43	10.07	5.07	8.87	5.13	9.40	4.73	8.06
Mean(B)	8.03		8.10		7.18		7.33		4.91		4.86		
Mean(C)	10.19	6.36	10.01	6.20	9.26	5.87	9.21	5.45	6.29	3.53	6.22	3.51	

L.S.D.	A	B	C	ABC
	0.1587	0.1122	0.06478	0.5497

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

Table (14): Effect of planting date, type of cutting and treating with hormone on length of roots (cm.) under tunnel in 2008 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	8.33	6.83	8.23	7.00	8.17	6.67	0.00	6.17	0.00	0.00	0.00	0.00	4.28
3	9.47	7.97	9.80	8.00	9.50	7.33	7.17	7.00	0.00	0.00	0.00	0.00	5.52
4	9.00	7.47	8.50	7.50	8.83	7.27	8.50	6.23	0.00	0.00	0.00	0.00	5.28
5	8.90	7.33	8.27	7.50	8.33	6.90	7.50	6.23	0.00	0.00	0.00	0.00	5.08
6	9.47	7.73	8.67	7.33	8.77	7.33	7.33	6.37	7.50	6.07	7.53	6.00	7.51
7	9.50	8.53	9.83	7.67	9.50	8.47	9.00	7.00	9.83	6.47	9.67	6.33	8.28
8	9.57	8.03	8.33	8.60	8.83	8.13	10.00	6.70	9.40	6.07	9.20	5.97	8.24
9	9.67	8.00	8.50	8.17	8.40	7.83	9.00	6.33	9.20	6.00	9.17	5.73	8.00
10	9.17	8.50	10.47	8.43	9.67	7.50	8.17	7.00	8.20	6.60	8.33	6.40	8.20
11	10.27	8.83	11.00	8.90	11.00	8.40	9.57	7.67	9.50	7.17	9.57	6.83	9.02
12	10.00	8.37	10.00	8.47	10.17	8.00	9.17	7.17	8.87	6.67	8.50	6.83	8.52
13	9.77	8.39	9.67	8.00	9.27	7.70	8.83	7.10	8.47	6.40	8.40	6.33	8.48
Mean(B)	8.71		8.62		8.42		7.30		5.10		5.03		
Mean(C)	9.43	8.00	9.27	7.96	9.20	7.63	7.85	6.75	5.91	4.29	5.86	4.20	

L.S.D.	A	B	C	ABC
	0.1620	0.1146	0.06615	0.5613

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
*** (A):** Growth regulators ***(B):** Cutting type ***(C):** Planting date

Table (15): Effect of planting date, type of cutting and treating with hormone on number of roots under tunnel in 2007 season

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.00	4.33	4.33	5.00	4.00	4.00	3.67	4.00	0.00	0.00	0.00	0.00	2.78
3	5.00	5.33	4.33	5.33	4.67	4.33	5.00	5.33	0.00	0.00	0.00	0.00	3.28
4	6.33	7.33	6.00	6.67	5.33	6.00	6.33	6.67	0.00	0.00	0.00	0.00	4.22
5	7.33	8.00	5.67	7.00	6.00	6.00	7.00	7.33	0.00	0.00	0.00	0.00	4.53
6	7.00	7.33	6.67	8.00	5.33	5.00	5.33	6.00	5.33	4.67	4.00	3.67	5.69
7	7.67	8.00	7.33	8.67	5.67	7.00	7.33	8.00	8.33	7.33	5.67	5.33	7.19
8	8.67	9.33	7.67	9.33	6.00	8.33	7.67	8.00	9.00	8.00	8.33	7.67	8.17
9	9.00	9.67	8.67	9.67	6.33	9.00	8.67	9.67	9.00	8.67	8.67	7.33	8.69
10	9.00	9.67	8.67	9.33	8.00	8.33	7.33	8.00	6.33	5.67	6.00	5.67	7.67
11	10.67	11.67	10.33	11.33	8.33	9.67	8.67	9.67	8.33	7.33	7.67	6.33	9.17
12	11.67	12.33	11.33	12.33	9.00	10.00	9.00	10.00	9.00	8.00	8.33	7.00	9.83
13	10.67	12.00	10.33	10.67	8.67	9.33	8.67	9.33	8.67	8.33	8.67	6.33	9.31
Mean (B)	8.42		8.11		6.85		7.36		5.08		4.44		
Mean C)	8.08	8.75	7.61	8.61	6.44	7.25	7.06	7.67	5.33	4.83	4.78	4.11	

L.S.D.	A	B	C	ABC
	0.3355	0.2372	0.1370	1.162

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

Table (16): Effect of planting date, type of cutting and treating with hormone on number of roots under tunnel in 2008 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.33	4.33	4.67	4.67	3.67	4.00	3.67	4.00	0.00	0.00	0.00	0.00	2.78
3	5.67	5.67	5.67	5.33	4.33	4.67	4.00	5.00	0.00	0.00	0.00	0.00	3.36
4	7.00	8.00	6.33	6.67	6.33	5.33	5.67	6.33	0.00	0.00	0.00	0.00	4.31
5	8.33	8.33	7.33	7.33	7.00	5.67	6.33	7.00	0.00	0.00	0.00	0.00	4.78
6	7.00	7.67	6.00	7.00	5.00	4.67	4.67	5.67	4.00	4.67	3.67	3.67	5.31
7	8.00	8.33	8.33	7.33	5.67	6.67	6.00	7.00	4.67	5.00	4.33	5.00	6.36
8	9.33	10.00	9.33	8.67	6.33	8.33	6.67	7.33	5.67	5.33	5.00	5.33	7.28
9	9.67	10.00	10.00	9.00	7.00	8.67	7.00	8.33	6.00	6.33	5.33	6.33	7.81
10	8.67	9.67	7.33	8.00	8.00	6.33	5.33	7.00	5.33	5.33	5.00	5.33	6.78
11	11.00	10.67	8.67	8.33	8.67	7.33	7.33	8.67	6.67	6.00	6.33	6.00	7.97
12	12.00	11.67	9.67	9.33	9.33	8.33	8.00	9.00	7.33	6.67	7.00	6.33	8.72
13	10.33	11.00	10.33	8.33	9.67	7.33	9.00	8.33	8.33	6.00	8.00	6.00	8.56
Mean(B)	**8.61**		**7.65**		**6.60**		**6.56**		**3.89**		**3.69**		
Mean(C)	8.44	8.78	7.81	7.50	6.75	6.44	6.14	6.97	4.00	3.78	3.72	3.67	

L.S.D.	A	B	C	ABC
	0.2721	0.1924	0.1111	0.9426

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
*** (A):** Growth regulators ***(B):** Cutting type ***(C):** Planting date

3.2.3- Number of roots

The available data illustrated in Tables (15&16) showed the average of root number on treated carob cuttings as significantly affected by the preparation time, it can be seen that April and May were the proper time in this respect in both seasons . As for type of cutting, it was generally apparent that sub terminal treated cuttings gave higher number of roots than terminal cuttings through April May, June and July in first season but was not clear in the second season. Regarding the growth regulators there were significant difference. Among tested treatments, where, the best treatment was IBA at 9000ppm + wounding plus NAA at 100ppm in first season. But in the second one, treatment with IBA at 9000ppm + wounding plus NAA at 100ppm or IBA at 9000ppm + wounding plus NAA at 200ppm exhibited highest number of roots. Concerning interaction among factors data showed that sub terminal cuttings treated with IBA at 9000ppm + wounding plus NAA at 100ppm during April had the highest number of roots in the 1st season but in the 2nd one the treated terminal ones had the highest values Gerakakis and Ozkaya,.(2005).

3.2.4 Dry weight of roots (gm):

Data in Tables (17&18) indicated that maximum dry weight of roots was noticed in April following by May, then the value was gradually decreased from June to Sept. Concerning cutting type, the sub terminal carob cuttings recorded significant higher values than the terminal ones from April until July in the first season. But through April and May; only in the second season. As for treatment effect, it can be noticed that the cuttings treated with IBA at 9000ppm + wounding plus NAA at 100ppm recorded significant heaviest dry weight of roots followed by IBA at 9000ppm + wounding in both seasons. Regarding the interaction among factors, the highest were obtained from sub terminal cuttings treated with IBA at 9000ppm + wounding plus NAA at 100ppm in April and May in both seasons. Elgimabi (2009).

3.2.5- Survival after 2 months (%):

The percentage of survival cuttings after 2 months for both terminal and sub-terminal cutting at the different collection dates from January to December in 2007 and 2008 are shown in Tables (19&20). It can be seen that, treated carob cuttings on May following by April were the proper times for giving the highest survival percentage (80.42, 79.46 & 80.56, 79.55 %) in both seasons, respectively, then the value was gradually decreased from June to Sept. in both seasons. Concerning the type of cuttings it is worthy to note that the treated sub terminal cuttings in April was higher than terminal ones (82.02, 81.56) in both seasons respectively. While in May no significant differences between both types of cuttings in both seasons. With regard to growth regulators, the obtained data reveal that, carob cuttings treated with IBA at 9000 ppm + wounding recorded the highest significantly values in both seasons. Concerning the interaction, data clearly showed that, survival % increments were more pronounced with sub terminal cuttings treated with IBA at 9000ppm + wounding in April in both seasons .

These results were in agreement with the findings *of Çelik et al., (1994*) and *Ibrahim et al.,(2009*) on olive.

Plastic tunnels with water mist gave the best rooting and vegetative growth followed by the cutting under plastic tunnels without mist in Hamelia patens, *Elgimabi,(2009)* .

Loach (1997) studied the leaf water potential and the rooting of cuttings of rhododendron under mist and polythene. He stated that, propagation under polythene gave better results than mist in the lower radiation conditions. He studied also the variation in water potential in cuttings under mist and polythene and found that cuttings in mist depended on three variables namely; current days radiation; number of days from insertion of cuttings and either the previous days leaf water potential which was relatively unimportant, probably because cuttings were able to take up water over night from condensation on the under surface of the polyethene.

Table (17): Effect of planting date, type of cutting and treating with hormone on dry weight under tunnel in 2007

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.08	3.96	4.13	4.14	3.92	3.77	3.95	3.73	0.00	0.00	0.00	0.00	2.64
3	4.16	4.16	4.14	4.19	4.28	3.99	5.07	4.50	0.00	0.00	0.00	0.00	2.87
4	4.29	5.35	4.18	4.97	3.92	3.88	4.58	4.00	0.00	0.00	0.00	0.00	2.93
5	4.31	5.21	4.25	4.74	4.05	3.77	4.17	4.37	0.00	0.00	0.00	0.00	2.91
6	4.06	4.95	4.12	5.16	3.58	4.06	3.22	4.75	3.17	3.87	3.00	2.97	3.91
7	4.04	5.18	3.90	5.27	3.18	4.22	4.19	5.08	4.33	4.35	3.19	3.24	4.18
8	4.91	5.55	4.63	5.63	3.84	5.29	4.21	5.07	5.04	5.08	4.97	4.30	4.88
9	5.24	6.14	5.03	6.15	4.59	5.94	5.32	6.03	5.30	4.53	5.25	4.20	5.31
10	5.93	6.09	5.47	6.00	5.03	5.85	4.81	4.70	4.45	4.12	4.03	4.15	5.05
11	6.26	6.83	6.00	6.41	5.50	5.16	5.21	5.16	4.95	4.00	4.89	3.75	5.34
12	6.93	6.96	6.68	6.86	5.82	5.01	5.27	5.11	5.11	4.33	4.83	3.89	5.57
13	7.46	5.42	6.97	4.32	6.49	4.03	6.08	4.22	5.13	4.00	5.09	3.17	5.20
Mean(B)	5.31		5.14		4.55		4.70		2.99		2.70		
Mean(C)	5.14	5.48	4.96	5.32	4.52	4.58	4.67	4.73	3.12	2.86	2.94	2.47	

L.S.D.	A	B	C	ABC
	0.05682	0.04018	0.02320	0.1968

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm

* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

Table (18): Effect of planting date, type of cutting and treating with hormone on the dry weight (gm.) under tunnel in 2008 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	Ter.	Sub ter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.10	3.83	4.12	4.18	3.93	3.72	3.91	3.76	0.00	0.00	0.00	0.00	2.63
3	4.12	4.24	4.19	4.22	4.28	3.93	5.43	4.59	0.00	0.00	0.00	0.00	2.92
4	4.41	5.32	4.24	5.11	4.05	3.83	4.75	4.18	0.00	0.00	0.00	0.00	2.99
5	4.34	5.24	4.28	4.79	4.18	3.76	4.22	4.21	0.00	0.00	0.00	0.00	2.92
6	4.06	4.86	4.18	5.18	3.75	4.22	3.20	4.82	3.19	3.81	3.00	3.15	3.95
7	3.93	5.22	3.72	5.65	3.23	4.31	4.23	5.13	4.25	4.25	3.15	3.18	4.19
8	4.92	5.65	4.66	6.19	3.82	5.22	4.24	5.22	5.13	5.23	5.22	4.34	4.99
9	5.09	6.10	5.12	6.14	4.70	6.13	5.34	6.18	5.29	4.72	5.16	4.25	5.35
10	5.75	5.59	5.62	6.32	5.17	5.78	4.73	4.59	4.38	4.20	4.22	4.24	5.05
11	6.52	6.75	6.12	6.76	5.69	5.14	5.25	5.14	5.15	4.22	4.83	3.79	5.45
12	7.07	6.68	6.62	7.00	5.81	5.01	5.20	5.19	5.18	4.32	4.94	4.10	5.59
13	7.58	5.33	7.12	4.22	6.58	4.17	6.21	4.26	5.24	4.20	5.15	3.32	5.28
Mean(B)	5.28		5.24		4.60		4.75		3.03		2.75		

Mean(C)	5.16	5.40	5.00	5.48	4.60	4.60	4.73	4.77	3.15	2.91	2.97	2.53

L.S.D.	A	B	C	ABC
	0.0529	0.0374	0.02159	0.1832

T1= 3000 ppm T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

Table (19): Effect of planting date, type of cutting and treating with hormone on the survival (%) after 2 month under tunnel in 2007season.

Treatments	**April**		**May**		**June**		**July**		**August**		**Sept.**		**Mean (A)**
	Ter.	**Sub ter.**	**Ter.**	**Sub ter.**	**Ter.**	**Sub ter.**	**Ter.**	**Sub ter.**	**Ter.**	**Sub ter.**	**Ter.**	**Sub ter.**	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	77.00	82.13	80.47	80.23	77.27	75.83	0.00	69.30	0.00	0.00	0.00	0.00	45.19
3	75.33	84.20	81.40	81.60	78.47	80.20	71.70	78.43	0.00	0.00	0.00	0.00	52.61
4	75.33	81.87	79.53	80.50	71.77	74.30	70.43	68.13	0.00	0.00	0.00	0.00	50.16
5	72.27	82.90	78.53	78.87	72.50	71.00	70.00	64.57	0.00	0.00	0.00	0.00	49.22
6	73.73	83.57	80.40	81.40	78.63	77.70	72.47	65.03	66.37	66.53	67.37	60.67	72.82
7	75.33	83.57	81.93	80.57	81.40	78.67	74.50	73.37	68.63	70.27	69.10	68.33	75.47
8	78.67	80.17	77.30	80.30	77.23	77.17	70.27	70.50	65.37	64.83	66.27	59.70	72.31
9	70.98	79.50	80.27	78.80	76.40	73.03	67.37	68.73	67.23	63.97	66.47	61.03	71.15
10	81.37	80.70	81.53	81.17	78.80	79.70	74.53	74.50	72.63	77.27	67.00	69.67	76.57
11	82.07	83.53	83.13	82.77	82.43	82.07	75.60	77.67	74.10	78.07	65.17	69.80	78.03
12	80.20	81.77	79.67	80.73	79.13	75.57	74.17	72.87	69.57	70.80	60.27	56.93	73.47
13	80.27	80.57	78.77	80.13	79.37	74.77	71.37	71.67	66.30	67.53	58.87	57.60	72.27
Mean(B)	79.46		80.42		77.23		68.63		46.23		42.68		
Mean(C)	76.88	82.04	80.24	80.59	77.78	76.67	66.03	71.23	45.85	46.61	43.38	41.98	

L.S.D.	A	B	C	ABC
	0.7178	0.5074	0.2929	2.486

T1= 3000 ppm T2=3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm T4=3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm T6=6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm T8=6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm T12= 9000 ppm + Wounding + NAA 200ppm
* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

From the above mentioned presentation, it could be concluded that, vegetative propagation of Carob by cuttings under mist or under tunnel affected by many factors such as: time of preparing cuttings, type of cuttings, and treated with growth regulators. Rooting ability of Carob, length, dry weight, survival after 2 months and average number of roots increased by increasing concentration of IBA from 3000 ppm to the maximum in 9000 ppm with wounding with NAA at 100 ppm or 200 ppm in both April and May with either terminal or sub-terminal cuttings, but decrease to the little extent in August and September, while fluctuated greatly exhibiting very low values to reach to zero during the period from October to March.

Mist propagation technique costly whereas in areas characterized by poor facilities (electricity and equipments), propagation under white plastic tunnels is cheaper and save the electricity cost, so can be used commercially

Figure (1): Sub-terminal cuttings of Carob after treated with 9000 ppm + wounding under tunnel.

Table (20): Effect of planting dates, types of cutting and treating with hormone on the survival (%) after 2 month under tunnel in 2008 season.

Treatments	April		May		June		July		August		Sept.		Mean (A)
	Ter.	Subter.	Ter.	Subter.	Ter.	Subter.	Ter.	Subter.	Ter.	Subter.	Ter.	Subter.	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	77.87	82.80	79.90	80.57	76.63	74.83	0.00	70.47	0.00	0.00	0.00	0.00	45.26
3	77.10	84.80	82.27	82.40	78.08	79.40	72.00	79.53	0.00	0.00	0.00	0.00	53.03
4	75.33	81.37	78.73	79.77	70.90	73.64	71.45	69.17	0.00	0.00	0.00	0.00	50.03
5	74.73	81.80	78.83	78.87	71.53	69.53	69.63	65.34	0.00	0.00	0.00	0.00	49.19
6	74.53	82.50	80.67	82.07	79.17	78.03	73.04	65.92	65.50	67.17	65.81	66.13	72.54
7	75.33	84.20	83.07	81.17	81.83	79.41	74.87	75.40	69.63	71.23	68.43	69.33	76.16
8	77.63	79.50	78.17	79.37	77.60	76.27	69.43	71.18	64.62	64.83	66.60	58.37	71.96
9	70.55	79.50	79.40	78.13	75.73	72.43	67.90	69.93	65.64	65.07	67.57	61.87	71.14
10	81.37	82.27	82.17	82.17	80.57	80.83	75.70	75.20	73.34	77.80	67.67	69.37	77.37
11	82.07	84.53	84.13	82.77	83.23	82.77	76.30	79.23	75.03	78.97	65.97	67.77	78.96
12	79.57	80.90	79.83	80.60	79.00	74.73	75.37	71.73	69.03	69.27	61.43	57.63	73.26
13	79.44	79.60	79.20	79.20	79.03	75.77	72.57	70.04	65.50	66.90	59.77	56.60	71.97
Mean(B)	79.55		80.56		77.12		69.26		46.23		42.51		
Mean(C)	77.13	81.98	80.53	80.59	77.78	76.47	66.59	71.93	45.69	46.77	43.60	41.42	
L.S.D.	A	B	C	ABC									
	0.5523	0.3905	0.2255	1.913									

T1= 3000 ppm
T2= 3000 ppm + Wounding
T3= 3000 ppm + Wounding + NAA 100ppm
T4= 3000 ppm + Wounding + NAA 200ppm
T5= 6000 ppm
T6= 6000 ppm + Wounding
T7= 6000 ppm + Wounding + NAA 100ppm
T8= 6000 ppm + Wounding + NAA 200ppm
T9= 9000 ppm
T10= 9000 ppm + Wounding
T11= 9000 ppm + Wounding + NAA 100ppm
T12= 9000 ppm + Wounding + NAA 200ppm

* (A): **Growth regulators** *(B): **Cutting type** *(C): **Planting date**

4. References

Ahmed, M., Ahmed I., Laghari M. H. and Hidayatullah (1998).
Effect of growth regulators on rooting in softwood cuttings of guava under mist condition. Sarhad, J. Agric., 14: 423 – 425.

Alorada, M., Estodes J., Galmes J .and Medrano H. (1987).
Promotion of rooting in Carob cuttings. Gartenbauwissens chaft, Valencia, Spain, 52(1): 31 – 34.

Avallone, R., Plessi M., Baraldi M.and Monzani A., (1997)
Determination of chemical composition of carob (Ceratonia siliqua): protein, fat, carbohydrates and tannins, J. Food Compos. Anal. 10 (1997) 166–172

Cabrita, R. J. M. Graca, L. Schwab and M. A. Martins – Loucâo (1988). Evaluation of parameters affecting the rooting of Hardwood cuttings in ceratonia siliqual. Pp. 237-244 in proceedings of the international Carob symposium (P. Fito and A. Mulet, eds.). Valencia, Spain.

Çelik, M., Özkaya M.T., Dumanoglu H. (1994) .
The research on possibilities of using the shaded polyethylene tunnels (spt) for the rooting of olive (Olea europaea L.) Acta Horticulturae 356: II International Symposium on Olive Growing 1994

Elgimabi, M. E. N. E.(2009)
Improvement of propagation by hardwood cuttings with or without using plastic tunnel in (Hamelia patens). Journal World Journal of Agricultural Sciences 2009 Vol. 5 No. 5 pp. 522-524

El-Nabawy, S.; Bondok, A. and Ikram S. El-Din (1983).
Studies on some factors affecting rooting olive leafy cutting. Amals of Agric. Sci.,Fac. Agric. Ain Shams Univ., Cairo, Egypt. 28; (3): 1649 – 1662.

El-Said, M. E.; Ikram Saad El-Din and Youssef, N. F. (1990)
Studies on some factors affecting rooting abaility of leafy olive cultings. Zagazig, J. Agric. Res.Vol. 17 No. 3 (B).

Gerakakis,A.C.and Ozkaya,M.T.(2005): Effects of cutting size, rooting media and planting time on rooting of Domat and Ayvali live (Olea europea L.) cultivars in shaded polyethylene tunnel (Spt)TARIM BILIMLERI DERGISI,11(3) 334- 338.

Gomez, K.A. and Gomez A.A. (1984). Statical producers for Agriculture Research 2ed. New Yourk, john wiley and sons .Inc .

Hartman, H. T. and D. E Kester (1983). Plant propagation, principles and practices. 4th edition. Prontice Hall, Englewood a: FF, NJ.

Hartmann, H. T., Kester, D. E., Davies, F. T. and Geneve, R. L., (2002).
Plant Propagation,Principles and Practices, 6th edition, prentice Hall of India Pvt. Ltd., New Delhi, India.

Haselberg E. Van (2000).
Growth and fertilization in Carob (ceratonia siliqual) Nacis Nerd court, 9, 55-58.

Hillcoat, D. Lewis, G, and Verdcourt, B. (1980).
A new species of Carob from a radio and Smoalia, Republic New Bulletin 35(2), 261-271.

Ibrahim M. Osman S., Emad G. Mikha, and Adel M. Gowda (2009).
Effect of rooting media and planting time on rooting of Manzanillo and Coratina olive (Olea europaeal) cultivars under shaded.

Laubscher ,C.P. and Ndakidemi ,P.A. (2008).
The effect of indole acetic acid growth regulator and rooting mediums on rooting of Leucadendron laxum (Proteaceae) in a shade tunnel environment.American-Eurasian J. agric. &Environ. sci., 4(3):326-331,2008.

Lee, C. L., Paul J. L. and Hackett W.P., (1977).
Promoting of rooting stem cutting of several ornamental plants by pre-treatment with acid or base. Hort Science 12(1): 41-42.

Loach (1997)
Promoting of rooting in stem cuttings of several ornamental plants .Hort Scince 12(1) :41- 42 .

Loeb, H. ; Vandenplas Y., Wursch P., Guesry P., (1989)
Tannin-rich carob pod for the treatment of acute-onset diarrhea, J. Paediatr. Gastroenterol. Nutr. 8 (4) (1989) 480–485.

Luqman, M., N. Ali and M. Sajid (2004). Effect of different concentrations of indolebutyric acid (IBA) on semi-hardwood guava cuttings. Sarha DJ. Agric., 20 : 219 – 222.

Manan, A. M. , Khan A, Ahmad W.and Sattar A. (2002)
Clonal Propagation of Guava (Psidium guajava L.) Int. J. Agri. Biol., Vol. 4, No. 1, 2002.

Mencuccin, M.; Fontanazza, G. and Badidoni, I. (1988).
Effect of basal temperature cycles on rooting of olive cuttings. Acta Horticulture

(1988) No. 227, 263 – 265 (En, 4 ref., International symposium on vegetative propagation of woody species, Pisa, Italy, 3 – 5 Sep. 1987. (Hort Abst., 58: 5313).

Mohamed A. I. Salama (1980). .
Studies on Carob propagation by cuttings. PhD. Deoartment of Horticulture, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Mohy Eldeen Nour Eldaim Elgimabi (2009).
Improvement of Propagation by Hardwood Cuttings with or Without Using Plastic Tunnel in (Hamelia patens World J. Agric. Sci., 5 (5): 522-524, 2009)

Mostafa S. Fadl; Seif A. Sari El-Deen and Mohamed A, El-Mahdy (1979).
Physiological and chemical factors controlling adventitious root initiation in Carob. Faculty of Agriculture, Al-Azhar University, Desert Institute Material, Cairo, Egypt.

Priolo, A., Waghorn G.C., Lanza M., Biondi L., Pennisi P.,(2000):
Polyethylene glycol as a means for reducing the impact of condensed tannins in carob pulp: effects on lamb growth, performance and meat quality, J. Anim. Sci. 78 ,810–816.

Ramon, A., Barros, S. and Martins – Loucan, M. (2002).
Micro propagation of the Mediterranean tree (Ceratenia siliqual). Plant cell tissue organ culture 68(1), 35 – 41.

Ramon – Laca, L. and M. abberley, D. J (2004).
The ecological status of Carob trees in Mediterranean – Betauical Journal of Linnean Society, 144(4), 431-436.

Sayed,W. T.;EL- Taweel, A .A. and Madlen R. Sawarsan (2010)
Study on vegetative propagation of Jojoba. J. Plant Prod., Mansoura Univ., Vol. 1(12) :1605-1623, 2010

7/12/2011