

## A NEW TECHNIQUE FOR PLUM PROPAGATION

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### ABSTRACT

This study was carried out on grafting plum rootstock (Marianna) (*P. Cerasifera* x *P. munsoniana*) at El-Kanater Horticultural Research Station "Kalubia Governorate", during two successive seasons 1997 /1998 and 1998/1999 Two grafting methods were used for hardwood cuttings of Beauty cultivar (*Prunus triflora*, L.) on Marianna hardwood cuttings treated with 3000ppm IBA for 10seconds Results revealed the following:

- 1- The best success percentage was during December for treated Marianna hardwood cuttings grafted with two methods varied between 70.67 to 79.00%.
- 2- Tongue grafting gave the best success percentage comparing with top grafting during the three months (December, January, February).
- 3- High length per plant was for Marianna hardwood cuttings treated with IBA at 3000ppm grafted with tunge method during December.
- 4- The high values of total number and length of roots  $> 0.1\text{cm}$  were always for Mariana hardwood cuttings treated with IBA as a rootstock for Beauty plum cultivar, grafted with tunge method during December.
- 5- The high dry weight of roots per plant was for Marianna hardwood cuttings treated with IBA during December and January.
- 6- Suitable plum grafts could be obtained for planting after one year only.

### INTRODUCTION

Propagation by Stem Cuttings is one of the common vegetative methods for reproducing great number of plant species including fruit clones (Howard and Garner, 1965) . Propagation by hardwood cuttings are considered rapid, simple and inexpensive method.

The ability of hardwood cutting to produce roots varied from variety to another and may differ among the genus or species (Hartmann and Kester, 1978) . The best rooting of the Marianna plum hard wood cuttings occurred when taken in November, treated with IBA, then stored under moist conditions at 60°F (15°C), for six weeks . Cuttings were then transferred to cold storage (36°F or 2°C), until planted in the spring . In the handling of hardwood cutting by these procedures, root initials are formed during the warm storage conditions following auxin treatments yet the buds do not open since they are in the rest period. The subsequent low temperature storage slow further root activity and overcome the influence of the rest in the buds (Hartmann and Hansen, 1958).

Tognoni and Lorenzi, (1972) ; Iwasai and Weaver ; ( 1977 ) ; Munoz and Villalobos , 1977, studied the correlation between the physiological stages of the buds and rooting ability in hardwood cuttings They cleared that the degree of inhibition of rooting was related to the phase of bud development when the buds approached the end of dormancy and become ready to sprout, the inhibition progressively decreased.

Gorecki, (1979) reported that the best rooting was obtained in cuttings of M26, MM.104 and MM.106 treated with IBA (0.5 %) in a powder containing talc and 40% captan. Gur *et al.* (1982) found that application of hardwood

cuttings of Crab and some apple rootstocks with 50-200 ppm IBA for 24 hours; enhanced the rooting. Immersion of cuttings bases in water for 24 hours prior to IBA treatment promoted rooting and reduced the optimal IBA concentration to 50 PPM. Makarem (1985) postulated that stem hardwood cuttings of French pear treated with 8000ppm IBA gave the highest rooting percentage, highest values in number or total length of roots per cuttings and a highest percentage of survived cuttings. Holwah (1989) stated that the rooting ability of plum stem cuttings was increased by different chemical treatments such as IBA either alone or combined with other growth substances. El-Sabrouh and El-Shazily (1994) cleared that the highest rooting percentage was obtained with basal cutting, taken from girdled shoots and dipped in 2500ppm IBA. The optimum IBA concentration for apical and middle cuttings were 1500 and 2000ppm, respectively.

Hamoda and Makarem (1995) found that in apricot chip budding and double tongue gave a moderate percentage of success (around 65%). The same authors in 1995 stated that in persimmon the highest percent of success for whip tongue grafting was in January.

It is common to propagate commercial plum cultivars on Marianna rootstock, Cuttings of rootstock are usually planted at the first season in nursery, when they are suitable for grafting in the autumn of the same season (or) in the next spring, grafting is performed. Thus good grafts of plum cultivars can be obtained after two seasons.

The main objective of this study was to explore the relationship between plum rootstock (Marianna) and plum cultivars. The second objective for this study is to produce grafted seedlings in a short time (in the same season) with good specification.

## **MATERIAL AND METHODS**

This study was carried out at El-Kanater Research Station, Kalubia Governorate, during two successive seasons 1997-1998 and 1998-1999, to study the propagation of plum using stem hardwood cuttings of Marianna (*P. cerasifera* x *P. munsoniana*), as a rootstock, grafted with stem hardwood cuttings of beauty plum cultivar (*P. triflora*) as a scion.

Hardwood stem cuttings were taken from one-year-old seedlings of Marianna (rootstock) on December, January and February. Cuttings were 20-25 cm in length and 8-10 mm in diameter. Hardwood stem cuttings of beauty cultivar (scion) were taken at the same months from uniform 5 trees 15 years old, equal in vigour and treated with normal agricultural practices. The stem cuttings of scion had 3-5 buds and had the same rootstock diameter (8-10mm).

Three hundred of Marianna and Beauty cuttings were prepared each month (on Dec. Jan. Feb) 1<sup>st</sup>, half of them (150 cuttings) were top grafted 1/7, and the other half were grafted by tongue grafting method. Seventy five cuttings for each grafting method were treated with IBA (indole 3 butyric acid) at concentration of 3000 ppm. Treatment of the cuttings was carried out by dipping the basal three cm of the cuttings in IBA solution for 10 seconds.

All the grafted cuttings were kept horizontally in wooden boxes ( 50x75 x60 cm ) until planting on the first of March , in a mixture of peatmose and saw dust( 1:1by volume ),and moisted with water periodically . The boxes were covered with wet cloth , and kept in the nursery . All cuttings were planted in the first week of March , on nursery lines , and treated with normal agricultural practices. The same procedure was followed in the second season.

A randomized complete block design was arranged and each treatment was replicated three times on 25 cuttings for each . At the end of each season (December ) , the following parameters were determined :

- 1- Grafting success percentage .
- 2- Scion measurements, including the length of scion , total number of shoots, total length of shoots, diameter of each scion , union and rootstock, fresh and dry weight of scion .
- 3- Rootstock measurements , included the total number and length for each of roots in diameter<0.5 ;0.5 to 0.1,cm and > 0.1 cm; and dry weight of total rootstock .

Data were statistically analyzed according to Snedecor and Cochran, (1990 ) and L.S.D test was used for comparison between treatments .

## **RESULTS AND DISCUSSION**

Table (1) summarizes the data of grafting time , grafting methods and treatment with IBA at 3000 ppm for the hard wood cuttings of Beauty plum , on Marianna (rootstock) in the first season . It shows that all grafted hard wood cuttings treated with IBA gave more success percentage than the untreated cuttings. Concerning the grafting methods, data shows that the tongue grafting was the best for all months (December, January and February) of the treated cutting .The stem cuttings were taken in December, grafted with tongue method and treated with IBA gave the highest value of success percentage (72.33 %), while the lowest one was for untreated stem cuttings top grafted in February (13.00 %). These results are in agreement with the previous results of Hamdoa and Makarem (1995), who cleared that the best success percentage for whip tongue grafting of persimmon was in January .

Data Presented in Table (1) also illustrates vegetative growth of plants at different treatments. The highest scion length was for stem grafting cuttings in December with tongue grafting method and treated with IBA at 3000 ppm (107.67 cm) while the shortest scion growth was for untreated rootstock cuttings top grafted method in February (32.67 cm). There were no significant differences in scion diameter for the two grafting methods under study, while it was noticed that grafted stem cuttings, treated with IBA were the thicker than untreated grafted stem cuttings. It is clear that the union and rootstock diameter of stem cuttings treated with IBA and grafted with top method in Dec. are always thicker. The total number of shoots per plant gave the highest value for treated rootstock cuttings with IBA and tongue grafted in January (16.67). The lowest value for untreated root stock top grafted cuttings in February (4.33). The total length of shoots per plant was the



highest for rootstock cuttings treated with IBA and grafted with top method in December (46.67 cm), while the lowest for untreated rootstock cuttings, grafted with tongue grafting method in February ( 9.67 cm). Concerning the fresh weight the highest value was for treated rootstock cuttings with I B A grafted with tongue method in December (122.00 gm ) while the lowest value was for the untreated cuttings grafted with top grafting in February (19.67gm) .With respect to recorded data for dry. weight the highest value was for treated root stock cuttings with IBA and grafted with tunge grafting method in January (30.00gm) , while the lowest value was for untreated rootstock cuttings, grafted with top grafting method in February (12.33 gm).

Many investigators reported that the hardwood cuttings obtained in November or December are the best (Howard and Garner, 1965; Hartmann and Hansen, 1958).

Table (2) indicated that IBA at 3000 ppm significantly increased the success percentage for rootstock cuttings grafted with the two methods under study in any month in 1998. The highest percentage was for treated rootstock cuttings, grafted with tongue method in December (79.00 %). The lowest percentage was (17.33 %) for untreated rootstock cuttings grafted with top method and made in January. The highest plants was for the rootstock cuttings treated with IBA at 3000 ppm and grafted with tongue grafting method in December (112.67cm), while the shortest plants was for rootstock cuttings untreated with IBA and grafted with top grafting method in February (40.00cm) . As for the average diameter per scion, it is obvious that the highest values were always for the treated stem cuttings at both months.

There was slight difference between the two methods of grafting and the month in which the rootstock cuttings were made. Regarding the diameter of union per plant, it was found that rootstock cuttings treated with IBA ( 3000 ppm ) and grafted with top method are thicker . Diameter per rootstock are thicker when rootstock cuttings treated with IBA for any method in both months under this study. As for the total number of shoots per plant, it was found that rootstock cuttings treated with IBA and grafted with tunge grafting methods in December was (17.33). Untreated rootstock cuttings with IBA and grafted with tongue in February gave 5.00 shoots per plant. Regarding total length of shoots, it was found that the high value of total length of shoots (45.33 cm) for rootstock cuttings treated with IBA and grafted with top grafting method in Dec., the lowest value ( 9.67cm ) for untreated rootstock cuttings with IBA and grafted with tongue method in February.

No significant differences were noticed for dry weight between the two grafting methods and between three months of the study . There were significant differences were found between grafting stem cuttings when treated with IBA at 3000 ppm .

On the other hand in the two seasons , similar results were obtained from the grafting methods and using IBA 3000 ppm for rootstock cuttings of Beauty plum cultivar ( 1997 and 1998 ) . These results are in agreement with those obtained by Gur *et al.* (1982) in crab and some apple rootstocks .

Table (3) and (4) showed the effect of grafting time, grafting methods and treatment of IBA at 3000 ppm on root growth for rootstock cuttings









grafting with stem cuttings of Beauty plum cultivar in the two seasons 1997 and 1998 .

Results in Table ( 3 ) indicated that IBA at 3000 ppm increased the total number and length of roots < .0.5 cm for all rootstock cuttings grafted with any method and were taken in any month during the study in 1997 . The high values were 4.33 for total number and 139.67 cm for total length . The two grafting methods gave insignificant differences between all treatments, Regarding the total number and total length of roots ( 0.1-0.5 cm / plant ) , it is clear that the high values were for total number of treated rootstock cuttings with IBA and grafted with top grafting method in February ( 12.67 ) , while the lowest value for untreated rootstock cuttings and grafted with tunge grafting method ( 4.33 ) The highest values for total length of the same roots was for treated rootstocks cutting with IBA and grafted with tongue grafting method in February ( 214.00 cm ) , the lowest value was for untreated rootstock cuttings with IBA and grafted with top grafting method in the same month ( 102.00cm ) . As for the total number and total length of roots > 0.1 cm per plant , the highest values were for treated rootstock cuttings with IBA at 3000 ppm and grafted with tongue grafting method in December ( 379.67 for the total number and 625.00 cm for the total length ) . The lowest values were ( 71.67 and 230.00 cm respectively ) , for untreated rootstock cuttings with IBA and grafted with tongue grafting method in January ( 66.33 and 239.67 cm respectively ) .

Concerning the dry weight of total roots per plant the highest value was for treated rootstock cuttings with IBA at 3000 ppm and grafted with tongue grafting method in February (25.33gm), The lowest value was for untreated rootstock cuttings with IBA and grafted with top grafting method in December (10.67gm)

Tognoni and Lorenzi, (1972) cleared that, the inhibition progressively decreased when the buds approached the end of dormancy and become ready to sprout .

From the above mentioned results, it can be concluded that IBA at 3000 ppm significantly increased the success percentage of all stem cuttings. The tongue grafting method generally was the best comparing with the top grafting. December gave the best success percentage , high values of total number and total length of roots > ( 0.1 cm in diameter ) per plant and tallest plant at the end of season .

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معهد البحوث البساتين \_ مركز البحوث الزراعية

أجريت هذه الدراسة فى محطة بحوث البساتين بالقناطر الخيرية محافظة القليوبية فى موسمى ١٩٩٧/١٩٩٨ & ١٩٩٨/١٩٩٩ تم تطعيم عقل الماريانا الخشبية كأصل بصنف البرقوق ببيوتى بطريقتين :-

١-طريق التطعيم القمى Top grafting

٢-طريقة التطعيم باللسان Tongue grafting

وفى شهور [ديسمبر- يناير- فبراير] تم معاملة قاعدة عقل الماريانا بـ ٣٠٠٠ جزء فى المليون من مادة اندول بيوتريك اسيد IBA لمدة ١٠ ثوان.

خزنت العقل الخشبية المطعومة داخل صناديق خشبية وفى خليط من البيتموس ونشارة الخشب بنسبة ١:١ حتى الأسبوع الأول من مارس حيث تم زراعتها فى خطوط المشتل وكان الغرض من هذه الدراسة هو الحصول على شتلة برقوق صنف البيوتى مطعومة على أصل الماريانا فى اقصر وقت ممكن وبأقل التكاليف وافضل المواصفات وكانت اهم النتائج كالأتى :-

١- اعلى نسبة نجاح كانت لعقل الماريانا المعاملة بحمض الأندول بيوتريك والمطعومة بصنف البرقوق البيوتى بالطريقتين تحت الدراسة خلال شهر ديسمبر وكانت بين ٧٠,٦٧ - ٧٩,٠٠ %.

٢- اعطيت طريقة التطعيم اللسانى نسبة نجاح اعلى من التطعيم القمى فى الثلاثة شهور تحت الدراسة.

٣- اعطيت عقل الماريانا المعاملة بحمض الأندول بيوتريك و مطعمة بطريقة اللسان خلال شهر ديسمبر اعلى طول للنبات.

٤- كانت اعلى قيم لعدد اطوال الجذور الأقل من ١ سم فى السمك لعقل الماريانا المعاملة بحمض الأندول بيوتريك المطعومة بصنف البيوتى بطريقة اللسان خلال شهر ديسمبر.

٥- اعطيت عقل الماريانا المعاملة بحمض الأندول بيوتريك والمطعومة خلال يناير و ديسمبر اعلى وزن جاف للمجموع الجذرى للنبات.

امكن الحصول على شتلات مطعومة من صنف البيوتى صالحة للزراعة فى الأرض المستديمة خلال عام واحد فقط.



**Table 1: Effect of grafting time, grafting methods and IBA at 3000 ppm on success percentage, and vegetative growth of plants during 1997**

Time	Treatments		Success percentage %	Length/ scion (cm)	Diameter/ scion (cm)	Diameter/ union (cm)	Diameter/ Root stock (cm)	Total number of shoots/ plant	Total length of Shoots/ plant(cm)	Fresh weight (gm)	Dry weight (gm)
	Grafting	IBA									
December A <sub>1</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	70.67	84.33	1.40	2.43	1.70	14.33	46.67	87.67	28.33
		Untreated C <sub>2</sub>	50.00	78.67	1.03	1.53	1.17	12.67	33.67	40.33	19.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	72.33	107.67	1.40	2.03	1.60	16.33	38.67	122.00	28.00
		Untreated C <sub>2</sub>	40.00	85.67	1.37	1.63	1.50	13.67	33.33	98.67	21.33
January A <sub>2</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	52.00	76.33	1.27	2.10	1.40	13.33	39.67	44.00	23.33
		Untreated C <sub>2</sub>	45.00	76.67	1.20	1.83	1.27	12.00	35.00	38.33	22.00
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	59.33	78.00	1.20	1.77	1.27	16.67	34.33	47.00	30.00
		Untreated C <sub>2</sub>	35.00	69.67	1.20	1.57	1.27	14.67	29.00	36.33	18.33
February A <sub>3</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	32.00	52.67	1.30	2.03	1.23	9.67	24.33	24.33	26.33
		Untreated C <sub>2</sub>	13.00	32.67	1.00	1.83	0.87	4.33	14.33	19.67	12.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	57.00	77.00	1.27	1.73	1.30	6.67	25.00	47.67	27.33
		Untreated C <sub>2</sub>	46.67	56.67	0.93	1.53	1.03	4.67	9.67	27.33	17.33
L.S.D	AT 5%	OF A	1.86	4.46	0.08	0.06	0.07	0.85	2.33	3.81	1.86
L.S.D	AT 5%	OF B	1.52	3.64	N.S	0.05	0.06	0.69	1.90	3.11	1.52
L.S.D	AT 5%	OF C	1.52	3.64	0.07	0.05	0.06	0.69	1.90	3.11	1.52
L.S.D	AT 5%	OF A X B	2.63	6.31	0.12	0.08	0.10	1.20	N.S	5.39	N.S
L.S.D	AT 5%	OF A X C	2.64	6.31	0.12	0.08	0.10	N.S	3.29	5.39	2.63
L.S.D	AT 5%	OF B X C	2.15	5.15	N.S	0.07	0.08	N.S	N.S	N.S	N.S
L.S.D	AT 5%	OF A X B X C	3.73	N.S	N.S	0.12	0.14	1.70	4.66	7.62	3.72

**Table 2: Effect of grafting time, grafting methods and IBA at 3000 ppm on success percentage, and vegetative growth of plants during 1998**

Treatments			Success %	Length/ scion (cm)	Diameter/ scion (cm)	Diameter / union (cm)	Diameter/ Root stock (cm)	Total No.of shoots/ plant	Total length of Shoots/ plant (cm)	Fresh weight (gm)	Dry weight (gm)
Time	Grafting	IBA									
December A <sub>1</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	74.33	95.33	1.53	2.50	1.73	14.33	45.33	90.33	30.33
		Untreated C <sub>2</sub>	54.33	77.33	1.17	1.63	1.27	12.33	34.33	49.00	20.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	79.00	112.67	1.57	2.10	1.67	17.33	44.67	118.00	33.00
		Untreated C <sub>2</sub>	50.00	77.00	1.37	1.80	1.57	16.67	33.33	83.67	25.33
January A <sub>2</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	35.33	80.00	1.33	2.17	1.47	13.33	38.67	48.33	28.33
		Untreated C <sub>2</sub>	17.33	73.00	1.27	1.97	1.37	12.00	31.33	38.67	23.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	70.67	90.00	1.40	1.87	1.47	16.67	36.00	55.67	24.33
		Untreated C <sub>2</sub>	50.33	72.33	1.23	1.67	1.33	15.00	30.33	46.67	24.33
February A <sub>3</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	62.00	60.67	1.27	2.20	1.37	8.67	17.00	37.00	33.33
		Untreated C <sub>2</sub>	48.00	40.00	1.07	1.73	1.13	9.33	10.67	28.00	20.67
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	66.67	73.00	1.43	1.80	1.53	11.00	25.00	50.00	35.33
		Untreated C <sub>2</sub>	39.33	56.00	1.17	1.63	1.27	5.00	9.67	32.33	23.33
L.S.D AT 5% OF A			1.75	4.30	0.05	0.08	0.05	0.75	1.83	3.17	N.S
L.S.D AT 5% OF B			1.43	3.51	0.04	0.06	0.04	0.61	N.S	2.59	N.S
L.S.D AT 5% OF C			1.43	3.51	0.04	0.06	0.04	0.61	1.50	2.59	3.96
L.S.D AT 5% OF A X B			2.48	N.S	N.S	0.11	0.07	1.06	2.59	4.49	N.S
L.S.D AT 5% OF A X C			2.48	6.08	0.07	0.11	0.08	N.S	2.59	4.49	N.S
L.S.D AT 5% OF B X C			2.02	4.96	N.S	0.09	0.06	0.87	N.S	N.S	N.S
L.S.D AT 5% OF A X B X C			3.51	8.59	0.10	0.15	0.11	1.50	3.67	N.S	N.S

**Table 3: Effect of grafting time, grafting method and IBA at 3000 ppm on root growth of plants in 1997.**

Time	Treatments		Total number of roots < .5 cm/plant	Total length of roots < .5 cm/plant	Total number of roots .1 - .5 cm/plant	Total length of roots .1 - .5 cm/plant	Total number of roots > .1 cm/plant	Total length of roots .> .1 cm/plant	Dry weight of total root/plant
	Grafting	IBA							
December A <sub>1</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	4.33	139.67	7.67	137.67	331.67	610.00	17.00
		Untreated C <sub>2</sub>	3.67	84.00	6.33	126.67	181.33	387.67	10.67
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.00	112.67	7.67	144.00	379.67	625.00	19.67
		Untreated C <sub>2</sub>	3.33	64.00	6.33	126.00	232.00	422.67	13.00
January A <sub>2</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	3.33	51.00	8.00	194.00	168.67	426.67	14.67
		Untreated C <sub>2</sub>	2.00	60.00	5.00	125.33	165.33	396.33	14.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.00	106.67	11.33	205.00	121.00	476.00	20.00
		Untreated C <sub>2</sub>	2.33	46.33	4.33	135.00	71.67	230.00	11.67
February A <sub>3</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	4.33	97.33	12.67	211.00	293.00	336.33	14.33
		Untreated C <sub>2</sub>	1.33	33.33	7.00	102.00	194.00	235.33	7.33
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.00	93.33	11.67	214.00	109.33	242.00	17.33
		Untreated C <sub>2</sub>	3.33	90.33	5.00	105.00	99.67	356.67	10.00
L.S.D	AT 5 %	OF A	0.60	6.42	0.63	5.89	6.50	10.53	1.45
L.S.D	AT 5 %	OF B	N.S	5.25	N.S	4.81	5.31	8.60	1.87
L.S.D	AT 5 %	OF C	0.49	5.25	0.51	4.81	5.31	8.60	1.87
L.S.D	AT 5 %	OF A X B	N.S	9.09	0.89	N.S	9.19	14.90	N.S
L.S.D	AT 5 %	OF A X C	N.S	9.09	0.89	8.33	9.19	14.90	2.06
L.S.D	AT 5 %	OF B X C	N.S	N.S	0.73	6.80	7.50	12.16	1.68
L.S.D	AT 5 %	OF A X B X C	N.S	12.85	1.26	11.77	13.00	21.07	2.91

**Table 4: Effect of grafting time, grafting method and IBA at 3000 ppm on root growth of plants in 1998.**

Time	Treatments		Total number of roots < .5 cm/plant	Total length of roots < .5 cm/plant	Total number of roots .1 - .5 cm/plant	Total length of roots .1 - .5 cm/plant	Total number of roots > .1 cm/plant	Total length of roots . > .1 cm/plant	Dry weight of total root/plant
	Grafting	IBA							
December A <sub>1</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	4.67	143.00	7.67	133.00	354.33	630.67	18.33
		Untreated C <sub>2</sub>	4.00	88.00	6.33	124.67	199.67	398.33	10.67
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.67	116.67	8.67	149.33	384.33	650.67	21.33
		Untreated C <sub>2</sub>	3.67	66.67	7.00	126.67	244.67	448.33	14.00
January A <sub>2</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	3.67	53.33	7.67	192.67	182.33	461.00	18.33
		Untreated C <sub>2</sub>	2.33	50.00	5.67	132.00	168.33	400.00	12.67
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.33	104.67	9.67	216.67	127.33	478.33	24.67
		Untreated C <sub>2</sub>	2.67	54.00	5.67	138.33	66.33	239.67	16.67
February A <sub>3</sub>	Top grafting B <sub>1</sub>	Treated C <sub>1</sub>	4.00	98.67	12.33	230.67	315.67	371.00	22.67
		Untreated C <sub>2</sub>	1.67	37.33	6.33	114.67	212.00	263.33	11.00
	Tongue grafting B <sub>2</sub>	Treated C <sub>1</sub>	4.00	94.00	12.33	217.67	124.33	573.33	25.33
		Untreated C <sub>2</sub>	3.33	85.33	6.67	118.00	99.67	373.00	12.67
L.S.D AT 5 % OF A			0.44	4.72	0.48	6.22	6.07	8.67	N.S
L.S.D AT 5 % OF B			0.36	3.85	0.40	5.08	4.96	7.08	2.11
L.S.D AT 5 % OF C			0.36	3.85	0.40	5.08	4.69	7.08	2.11
L.S.D AT 5 % OF A X B			N.S	6.67	N.S	8.80	8.59	12.26	N.S
L.S.D AT 5 % OF A X C			N.S	6.67	0.68	8.80	8.59	12.26	N.S
L.S.D AT 5 % OF B X C			N.S	N.S	N.S	N.S	2.01	10.01	N.S
L.S.D AT 5 % OF A X B X C			0.87	9.44	N.S	12.44	12.15	17.34	N.S