

Studies on the Vegetative Propagation of Guava by Grafting

A. A. El-Taweel, I. M. S. Osman and E. G. Mikhail

Olive & Semi- Arid Zone Fruits Department, Horticulture Research Institute, Agricultural Research Centre, Cairo, Egypt.

THIS investigation was carried out during 2011 and 2012 seasons at the experimental farm of the Horticulture Research Institute Giza, Egypt. The aim of the present study was to investigate two factors affecting vegetative propagation of guava, date of grafting (15th January, 15th February and 15th March) and different grafting techniques *i.e.* cleft grafting, saddle grafting and tongue grafting. Generally, maximum success percentage (88.15 & 100 %) was achieved by cleft grafting method in mid-Feb. in both seasons, respectively. It is quite evident from the data presented that, grafting on 15th of January, increased fresh weight of leaves, stems and roots in both seasons, whereas, the dry weight of leaves, stems and roots surpassed the other treatments by using saddle grafting in the first season and tongue grafting in the second one. Moreover, the saddle grafting produced significantly higher number of leaves when grafted was done on 15th January in both seasons.. On the other hand, weight of fresh root was significantly higher when saddle grafting was done in the first season, while in the second the superior values were recorded with grafting by tongue method on 15th January. As for the union zone, it showed the highest values on 15th January, when the plants were grafted by saddle grafting in the first season and by cleft grafting in the second one. A significantly higher number of sprouted shoots / graft was recorded when grafting was done by saddle method on 15th Mar. in the first season and cleft grafting on 15th Jan in the second season. Also, when the grafting was done on 15th Jan. in the first season and 15th Feb. in the second season, using saddle grafting method, the maximum length of sprouted shoots was produced. It is obvious from binocular examination of graft unions that all the combinations gave good graft unions without any incompatibility symptoms. It can be concluded; that significantly better results can be achieved if the experiment was carried out via cleft grafting during the mid-Feb.

Keywords: Cleft, Saddle, Tongue, Date, Anatomy.

Guava (*Psidium guajava*, L.) is one of the important tropical fruit crop grown throughout the tropical and sub-tropical areas, since its native home is located at area between Mexico and Peru, but is now present in every tropical and subtropical countries all over the world (Samson, 1980, Ezz, 1989 and Arun Arya, 2004). Guava can be adapted to a very wide range of soil conditions because of its tolerance to drought and salinity as compared to most of the trees under the same conditions (Baily, 1960), In addition, guava responds most

generously to cultivation, manuring and irrigation particularly in the deep, but well drained soils (Altaweel, 2001). The fruit is eaten fresh or made into guava jelly. Juice is also extracted from the fruit and used as the basis for a beverage, while guava paste or guava cheese are popular dishes in some parts of the world (Singh *et al.*, 1963). This has prompted several farmers to grow orchards on a commercial scale, therefore the area and production of guava is increasing worldwide and the fruit is widely processed in many parts of the world. In Egypt, guava is considered as one of the most important fruit crops either for local consumption or export. Demands of guava acreage reached 39589 feddans equal 16627.38 hectares with total Egyptian production of 339,354 metric tons according to the statistics of the Ministry of Agriculture. Guava is usually propagated from seed and the species are highly cross pollinated in nature, exhibiting, as consequence of a great variation and inevitable heterozygosity with every tree different from the other. Moreover, seed propagated plants come into bearing much later than vegetative propagated plants (Malik, 2013). Grafting on rootstocks has been shown as a valuable technique for improving fruit trees, making it possible to control such important factors as vigorous, resistance to parasites, diseases, adverse environmental factors and adaptation to soil and climatic conditions (Sutter, 1994).

Hence, the aim of this investigation was to study the effect of different methods of grafting and the time of propagation on the percentage of the grafting union success.

Materials and Methods

The present study was carried out under tunnels in the nursery at the experimental farm of the Horticulture Research Institute, Giza, Egypt, during the 2011 and 2012 seasons. A randomized block design of 45 plants (15 grafted plants replicated 3 times) was adopted in each of three propagation methods, (cleft grafting, saddle grafting, and tongue grafting) which were performed at different three dates (15th Jan., 15th Feb. and 15th Mar.). Seedy guava plants of about 12 months old growing in the nursery served as rootstocks, that were grafted with scions of guava cultivar 'Montakhab EL-Sabahia when the seedlings attained pencil thickness at the grafting position). The selected seedlings were grown in black plastic bags (1 liter black plastic container as one seedling in a mixture of soil and sand (2 : 1). The containers were grown under polyethylene tunnels 80 micron in diameter and placed in a shaded net-house about 65 % porosity

Preparation of scion wood cultivar

- The scion wood of about (4-6) months old and 6-8 cm. length and about 5 mm. diameter was collected in mid Jan., mid Feb. and mid Mar. during the two seasons of the study.

*Grafting methods**Cleft grafting*

The cleft grafting (Fig. 1) was done on 40-60 cm length seedlings; the top 15 cm above the soil line being removed. After that, the stock was split from center to bottom with a very sharp knife, and then sharpening about 2-3 cm. long on each two sides of the scion forming a (v) shape. One scion was inserted into the cleft at one side of the stock. The scion was pushed downward so that, the cambium or inner bark of the scion and stock be contact the each other (Osman, 1986); Powell, 1998; Abou-Taleb *et al.*, 2011). The graft was then tightly wrapped using grafting tape to exclude air and to keep the graft aligned (Taylor, 1982, Mekky and Hamouda, 1997) After emerging the bud, the polyethylene was released, retaining the leaves under the union grafting.



Fig. 1. Steps of the cleft grafting method, (1, 2) Scion, (3) stock, (4) scion and stock together.

Saddle grafting

The saddle grafting (Fig. 2) was made at about 25 cm. above the soil surface. Then, the stock was prepared by swing off the trunk of 20 cm. in height, after which the stock was sharpened in from each two sides in a length almost 4 cm. The scion was prepared by splitting its base from the center with a knife till almost 5 cm depth. (Mekky and Hamouda, 1997).



Fig. 2. Steps of the saddle grafting method, (1) Scion, (2, 3) stock, (4) scion and stock together.

Tongue grafting

The tongue grafting (Fig. 3) was done by choosing a piece of scion wood with one to two healthy buds. The scion wood and stock should be equal in diameter. Both stock and scion were cut with a long slanting cut (4 cm). Then both, stock and scion, were split about 2 cm and the two ends were placed together so that the shorter tongue of each enters the split of the other ensuring the contact between both (stock and scion) cambium layers. After the scion is in place, the entire wound was wrapped with a rubber band covered with Raffia, and waxed. This procedure aids in healing the graft union. (Taylor, 1982, Mekky and Hamouda, 1997), then the containers were well watered and placed under tight polyethylene tunnels in a shaded net-house about 65% porosity.



Fig. 3. Steps of the tongue grafting method, (1, 2) Scion, (3, 4) stock, (5) scion and stock together.

To avoid the separation between scion and stock the polyethylene tie was not removed rapidly.

The tested treatments were arranged as follows

- Grafting on 15th Jan. using cleft grafting.
- Grafting on 15th Jan. using saddle grafting.
- Grafting on 15th Jan. using tongue grafting.
- Grafting on 15th Feb. using cleft grafting.
- Grafting on 15th Feb. using saddle grafting.
- Grafting on 15th Feb. using tongue grafting.
- Grafting on 15th Mar. using cleft grafting.
- Grafting on 15th Mar. using saddle grafting.
- Grafting on 15th Mar. using tongue grafting.

Forty five guava seedlings were selected per each treatment (3 replicates × 15 seedlings/replicate).

Egypt. J. Hort. **Vol. 42**, No. 1 (2015)

Parameters and measurements

Vegetative growth

After one month of grafting, plastic tunnels were removed gradually eradicating lateral branches under the graft union. The percentage of successful grafts (one month after grafting) and survival (2 months after grafting) were determined. One year later, fresh and dry weights of leaves, stems and roots (g.), diameter of rootstock (cm), diameter of graft union zone (cm.), diameter and length of sprouted shoots (cm.), No. of leaves/sprouted shoots and. number of sprouted shoots/ graft, were recorded.

Anatomical studies

Anatomical studies were carried out on the grafting union. The union zone of grafted plants were taken and cut to two halves longitudinally across the union zone with a very thin saw. The cut surfaces were softened with soft sand glass paper, and the samples were examined with cival binocular to study the symptoms of success or failure of grafting and were illustrated by photographs (Singer, 1997).

Statistical analysis

Data from the parameters used for evaluating vegetative growth taken in both seasons were subjected to analysis of variance according to **Snedecor and Cochran** (1980). Differences between treatments were compared using Duncan's Multiple Range Test Duncan, (1955).

Results

Vegetative growth parameters

% Successful grafts

Table 1 revealed that cleft grafting in mid Feb. gave maximum success percentage of grafts (54.57, 79.01%) in both seasons, respectively. The comparison between the interactions showed that grafting by cleft grafting on Feb. gave relatively higher percent of successful grafts (88.15, 100%) in both seasons. These findings are in harmony with those reported by Pinheiro *et al.* (1970), Jose (1982), Taylor (1982), Tworkoski (2006), Doaa (2009) and Abou-Taleb *et al.* (2011).

Leaf fresh weight (g.)

Results in Table 2 show that the saddle grafting gave the highest value of leaves fresh weight (16.14 g.) in the first season. The highest value in the second season was closely linked with grafting using tongue grafting (21.38 g.). As for the interaction effect, when grafting was done on 15th of Jan. tongue grafting gave the highest values (21.00 & 22.17g.) in the both seasons, respectively.

Stem fresh weight (g.)

Table 2 shows that grafting with saddle method gave the highest stems fresh weight (53.50g.) in the first season. In the 2nd season the tongue grafting in mid Jan. gave the highest significant values (34.67 g.).

Roots fresh weight (g.)

Data presented in Table 2 revealed that the differences were slight to be significant in the 1st one, whereas the grafting done in mid Jan. with tongue grafting gave the highest values of roots fresh weight in the second season. As for interaction, it was so clear that saddle grafting in Feb. gave the highest value (34.67g.) in the first season. In the 2nd season, the highest values were recorded in the case of grafts in Mar. by tongue grafting method.

TABLE 1. Effect of different methods and dates of grafting on % of successful grafts after one year from practicing for Montakhab El-Sabahia guava cultivar during 2011 and 2012 seasons.

Dates	% successful grafts			Mean
	Cleft grafting	Saddle grafting	Tongue grafting	
1st season				
Jan. 2011	24.44e	15.66g	4.44h	14.81C
Feb. 2011	88.15a	60.00c	82.22b	76.79A
Mar. 2011	51.11d	20.00f	15.56g	28.89B
Mean	54.57A	31.85C	34.07B	
2nd season				
Jan. 2012	55.56d	8.89f	25.18e	29.88C
Feb. 2012	100.00a	100.0a	82.22b	97.07A
Mar. 2012	81.48b	68.15c	57.78d	69.14B
Mean	79.01A	59.01B	55.06C	

Values with column having different letters showed statistically significant differences ($P < 0.05$)

* Values of successful and survival are equal.

TABLE 2. Effect of different methods and dates of grafting on total plant (fresh weight g.) after one year from practicing for Montakhab El-Sabahia guava cultivar during 2011 and 2012 seasons.

Dates	Leaves fresh weight (g.)				Stems fresh weight (g.)				Roots fresh weight (g.)			Mean
	Cleft grafting	Saddle grafting	Tongue grafting	Mean	Cleft grafting	Saddle grafting	Tongue grafting	Mean	Cleft grafting	Saddle grafting	Tongue grafting	
1st season												
Jan. 2011	10.33d	15.50b	21.00a	15.61A	43.83c	57.50b	43.17c	48.17A	22.83bc	25.17bc	25.83bc	24.61A
Feb. 2011	7.17e	19.93a	13.67bc	13.59B	28.00de	69.50a	26.33e	41.28B	22.83bc	34.67a	23.00bc	26.83A
Mar.2011	7.00e	13.00bc	12.50cd	10.83C	26.83e	33.50d	41.17c	33.83C	20.83c	22.67bc	27.67b	23.72A
Mean	8.17B	16.14A	15.72A		32.89C	53.50A	36.89B		22.17B	27.50A	25.50A	
2nd season												
Jan. 2012	10.00c	22.50a	22.17a	18.22A	32.50cd	37.67b	43.00a	37.72A	28.67b	30.50ab	33.50a	30.89A
Feb. 2012	9.50c	22.50a	21.00a	17.67A	32.00d	18.67f	25.33e	35.33C	23.67c	14.33d	20.00c	19.33C
Mar.2012	11.17c	14.17b	20.67a	15.33B	28.50e	19.33f	35.67bc	27.83B	22.00c	19.83c	34.67a	25.50B
Mean	10.22C	19.72B	21.38A		31.00B	25.22C	34.67A		24.78B	21.56C	29.39A	

Values with column having different letters showed statistically significant differences ($P < 0.05$).

Leaf dry weight (g.)

Perusal of the results presented in Table 3 reveals that, tongue grafting gave the highest value (16.87g.) in the first season, and also (19.17g) in the second one. Regarding the interaction, tongue grafting in the both seasons was better than other methods (cleft and saddle grafting).

Stem dry weight (g.)

It is clear from the findings of both years of experimentation in Table 3 that grafting by saddle method seemed to be the best treatment in the first season. Furthermore, in the second season, the highest values were closely linked with tongue grafting. Concerning the interaction, it was so clear that saddle grafting gave the best value (32.88 g.) whereas in the second season, the tongue grafting in mid Jan. gave the highest value (26.28g.).

Root dry weight (g.)

Results in Table 3 revealed that, differences were so slight to be significant in the first season. In the 2nd season, the highest significant value was recorded in the case of grafts by tongue grafting in mid Jan. (23.83g.). As for the response of interaction, it was so clear that saddle grafting in mid Feb. gave the highest value (17.55 g), in the first season whereas the differences were slight to be significant in the 2nd season.

TABLE 3. Effect of different methods and dates of grafting on total plant (dry weight g.) after one year from practicing for Montakhab El-Sabahia guava cultivar during 2011 and 2012 seasons.

Dates	Leaves dry weight (g.)			Mean	Stems dry weight (g.)			Mean	Roots dry weight (g.)			Mean
	Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting	
1st season												
Jan. 2011	7.43c	11.04b	16.87a	11.78A	28.61bc	31.01b	26.23bc	28.62A	13.96d	17.73bc	17.29bc	16.32A
Feb. 2011	4.26d	16.17a	9.31bc	9.91B	16.34d	43.65a	14.36d	24.78B	13.10d	24.40a	15.16cd	17.55A
Mar.2011	4.26d	9.72bc	9.79bc	7.93C	16.11d	23.98c	27.27bc	22.45B	15.31cd	17.51bc	17.70b	17.51A
Mean	5.32B	12.31A	11.99a		20.35B	32.88A	22.62B		14.12C	19.88A	17.38B	
2nd season												
Jan. 2012	7.33c	19.17a	19.17a	15.22A	21.17b	27.83a	29.83a	26.28A	20.67bc	24.50ab	26.33a	23.83A
Feb. 2012	6.83c	18.83a	17.83a	14.50A	21.00b	11.17e	15.83cd	16.00C	17.83cd	8.00f	14.17de	13.33C
Mar.2012	8.50c	11.83b	17.67a	12.67B	18.50bc	13.17de	27.50a	19.72B	14.67de	11.83ef	26.50a	17.67B
Mean	7.56C	16.61B	18.22A		20.22B	17.39C	24.39A		17.72B	14.28C	22.33A	

Values with column having different letters showed statistically significant differences (P < 0.05)

Diameter of rootstock (cm)

It is clear from the findings of both years of experimentation Table 4 that cleft grafting method caused highly significant increase in diameter of rootstock (0.69cm.) in mid Jan. in the first season. The results also revealed that highest

diameter of rootstock (1.00cm.) on 15th March using saddle grafting in the second season. The interaction between such factors declared that cleft grafting on Jan. in the first season was the best (0.85 cm.) from statistical point of view. As for second season, the plants were grafted by saddle grafting on 15th Feb. gave statistically highest averages (1.05 cm.).

Diameter of graft union zone

Grafting on 15th Jan. with saddle grafting method proved to be the most successful in increasing diameter of graft union zone with diameter of (1.22 cm) in the first season whereas in the second the tongue grafting was the best (0.98 cm) (Table 4).

Diameter of sprouted shoots

Results in Table 4 revealed that cleft grafting in mid Mar. produced wider sprouted shoots (0.88 cm) as a mean of cleft procedure in the first season. In the second season, the highest records were obtained in the case of grafts in mid Feb. with tongue grafting method (0.47cm) as mean value of different dates.

Referring to the interaction between treatments, when grafting was done in mid. Mar. using cleft grafting gave the highest value (0.98cm) in the first season. In the second season, the highest recorded in case of grafts (0.57cm) in mid Feb. using tongue grafting.

TABLE 4. Effect of different methods and dates of grafting on diameter of rootstock, graft union zone and sprouted shoots after one year from practicing for Montakhab El-Sabahia guava cultivar during 2011 and 2012 seasons.

Dates	Diameter of rootstock (cm.)			Mean	Diameter of graft Union zone (cm.)			Mean	Diameter of sprouted shoots (cm.)			Mean
	Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting	
1st season												
Jan. 2011	0.85a	0.56bc	0.48c	0.63A	1.13a-c	1.22a	1.18ab	1.18A	0.93ab	0.90ab	0.88ab	0.90A
Feb. 2011	0.60b	0.62b	0.56bc	0.59AB	0.87e	1.11bc	0.81e	0.93B	0.72cd	0.94ab	0.58e	0.75B
Mar.2011	0.61b	0.59bc	0.48c	0.55B	1.05cd	1.00d	0.84e	0.96B	0.98a	0.83bc	0.64de	0.82B
Mean	0.69A	0.59B	0.50C		1.02B	1.11A	0.94C		0.88A	0.89A	0.70B	
2nd season												
Jan. 2012	0.91c	0.94bc	0.87c	0.91A	0.96ab	0.83d	0.87cd	0.88A	0.53ab	0.40c	0.41c	0.45B
Feb. 2012	0.75d	1.05a	0.76d	0.85B	0.97a	0.70e	0.98a	0.88A	0.45bc	0.50a-c	0.57a	0.51A
Mar.2012	0.95bc	1.01ab	0.87c	0.94A	0.89c	0.72e	0.91bc	0.84B	0.40c	0.45bc	0.44bc	0.43B
Mean	0.87B	1.00A	0.83B		0.94A	0.75B	0.92A		0.46A	0.45A	0.47A	

Values with column having different letters showed statistically significant differences (P < 0.05)

Length of sprouted shoots

Results in Table 5 show that guava grafts were significantly produced (41.30, 45.11 cm), for mid Jan. and for saddle grafting method, in the first season *Egypt. J. Hort.* **Vol. 42**, No. 1 (2015)

respectively. As for second season, guava grafts produced the highest value (26.86, 27.29cm) for both mid Feb., and saddle grafting method, respectively.

No. of leaves/sprouted shoots

Results reported in Table 5 showed that, grafted by saddle grafting produced values significantly higher No. of leaves per graft (14.92) on Jan. with (18.27) in the saddle grafting method in the first season, respectively. The same data were in consistent in the second season of the study.

No. of sprouted shoots/graft

Data in Table 5 show that grafting in March using saddle grafting gave the highest No. of sprouted shoots/graft (2.22, and 2.22) in the first season, respectively. As for the second season, grafting in mid Jan. were (0.70, and 0.52) for cleft method.

TABLE 5. Effect of different methods and dates of grafting on length of sprouted shoots, No. of leaves/sprouted shoots and No. of sprouted shoots/graft after one year from practicing for Montakhab El-Sabahia guava cultivar during 2011 and 2012 seasons.

Dates	Length of sprouted shoots (cm.)			Mean	No. of leaves/sprouted shoots			Mean	No. of sprouted shoots/graft			Mean
	Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting		Cleft grafting	Saddle grafting	Tongue grafting	
1st season												
Jan. 2011	32.23c-e	56.47a	35.20cd	41.30A	10.63c	23.80a	10.33c	14.92A	0.00d	2.22ab	2.33ab	1.52B
Feb. 2011	35.43c	46.00b	29.40dc	36.94B	10.67c	17.80b	6.10d	11.52B	0.00d	2.00bc	1.67c	1.22C
Mar.2011	34.10cd	32.87c-e	27.90e	31.62C	11.33c	13.20c	10.47c	11.67B	2.67a	2.45ab	1.56c	2.22A
Mean	33.92B	45.11A	30.83C		10.88B	18.27A	8.97C		0.89C	2.22A	1.85B	
2nd season												
Jan. 2012	28.13bc	29.90ab	19.00f	25.68A	18.23cd	26.23a	17.10de	20.52A	0.33cd	0.89a	0.89a	0.70A
Feb. 2012	24.70de	24.43de	31.43a	26.86A	18.33cd	14.90e	20.57c	17.93B	0.67ab	0.00e	0.33cd	0.33B
Mar.2012	25.70c-e	27.53b-d	23.53e	25.59A	23.10b	19.13cd	18.33cd	20.19A	0.56bc	0.33cd	0.22de	0.37B
Mean	26.18AB	27.29A	24.66B		19.89AB	20.09A	18.67B		0.52A	0.41A	0.41A	

Values with column having different letters showed statistically significant differences ($P < 0.05$).

Anatomy of grafting union zone

Figures (4, 5 and 6) show longitudinal sections in the graft union of the guava plants (Montakab El-Sabahia cv. grafted on guava rootstock). It is obvious from the data aforementioned and the binocular examination of graft unions that all the combinations gave good graft unions without any incompatibility symptoms.



Fig. 4. Hand made longitudinal section in the union zone of cleft grafting method.



Fig. 5. Hand made longitudinal section in the union zone of saddle grafting method.



Fig. 6. Hand made longitudinal section in the union zone of tongue grafting method.

Discussion

Reviewing the aforementioned results it could be deduced that the variation among plant species and in their grafting ability was probably related to their production of callus which is essential for a successful graft Osman (1986), Doaa (2004), Abou-Taleb *et al.* (2011) and Doaa (2009). More, environmental factors may affect the union of the scion and stock, high temperature and lack of water are unfavorable to callus formation, (Jose, 1982). Also, collecting propagation the graft wood and grafting in mid Feb. gave relatively higher % of successful and survival grafts. (Hegazy and Ashmawy, 1974). Further, plants grafted in greenhouse may be due to controlled conditions or due to varietal response (Singh *et al.*, 1963). Finally time of guava grafting is considered a particular factor that affects graft union success (Abou-Taleb *et al.*, 2011).

On 400 day (13 months) and subsequently perfect graft union was observed and complete healing was noticed in cleft grafting and chip budding methods besides the other three methods. There was a substantial amount of new tissues, which filled the internal air pockets between the two parts. (Osman, 1986).

Rapid cambial activity played a role in transformation and production of secondary tissues which joined the vascular tissues of both stock and scion. The success of grafted plants depends on the used technique and the ability of healing callus to proliferate rapidly (Hartman and Kester, 1978). This cambial zone in the graft union was initiated at the union of stock and scion progressed into the scion tissues. Our results are in accordance with findings of many investigators (Simons, 1968, Hoque & Husain, 1974, Galkina, 1979 and Singer, 1997) who concluded that meristematic cells, in healing zone changed into thin wall parenchyma cells as a result of a wound stimulus for cambial initiation.

Humidity has a pronounced effect on the production of callus tissues. A great care must be taken with grafted plants in maintaining them in high humidity conditions to avoid the irremediable drying out of the scion. Air moisture levels below the saturation point inhibited callus formation, the rate of desiccation of the cells increased as the humidity dropped (Shippy, 1930). On the other hand, the propagation technique played a role and there were numerous possible variables which may affect the success of operation. Some methods of grafting gave better results than others, or budding may be more successful than grafting, or versa (Hartmann and Kester, 1978).

Using plastic sac for 30 days after the grafting raised % success in cold months (Jan., Feb. and March). Tip zone of stock contains cells capable to growth and development scion and stock. Therefore, these transplants in the field have high percentage of success with strong union between stock and scion. Best results can be achieved when the vegetative shoots were removed in rare cases. High percentage was also observed when the surfaces of cuts were relatively longer and the edges in a complete correspondence (Mekky and Hamouda,

1997). This may explain why certain grafts had a complete healing while others, partially failed to obtain a good union and gradual return of the cambium to its former position under the same environmental conditions.

Conclusion

- Guava could be vegetatively propagated through cleft, saddle and tongue grafting methods. The most successful methods was cleft grafting for production of Montakhab El-Sabahia plants under white tunnels system .
- The best time to cleft grafting is 15th Feb.
- Anatomical studies revealed the success of gathering between scion and stock in all methods under study.

References

- Abou-Taleb, A. Safia, Eltaweel, A.A. and Ali, A.A. (2011)** Studies on vegetative propagation of pecan (Pecan grafting by cleft grafting method under white tunnels system. *J. Agric. Res. Kafer El-Sheikh Univ.*, **37** (1), 162-182.
- Al-Taweel, A. A. (2001)** Studies on use of potassium for quality improvement of guava fruits. *M.Sc. Thesis*, Faculty of Agric. El.Mansoura Univ., Egypt.
- Arun Arya (2004)** Tropical fruits , Diseases and Pests, Kalyani Ludhiana, New Delhi, Cuttack India, pp. 217.
- Baily, L.H. (1960)** "*Manual of Cultivated Plants*" The Macmillan company, New York, 1116 p.
- Doaa, M.H.L (2009)** Studies on grafting grapevine. *M.Sc. Thesis*, Faculty of Agric., Mansoura Univ. A. R. E.
- Duncan, D.B. (1955)** Multiple Range and Multiple F. Test. *Biometrics*, **11**, 1-42.
- Ezz, T.M.D. (1989)** Nitrates, Nitrates and other constituents in leaves and shoots and different fruit parts of seedy and seedlings guavas. *Ph.D. Thesis*, Fac. Agric., Alex. Univ. Egypt.
- Galkina, I.F. (1979)** Factors determining the extent of take in bench grafting of apples. *Sadovodstvo, Vinogradarstvo I Vinodelia Moldavii* No. 11, 59-60. *Ivanovskaya Gos. Sel-Khoz. Opytnaya stantsiya, USSR.* (Hort. Abst. 51:6000).
- Hartman, H.T. and Kester, D.E. (1978)** Plant Propagation, Principles and Practices. 3rd ed., Prentice-Hall of India, New Delhi, pp.314-371.
- Hegazy, M.K. and Ashmawy, M.F. (1974)** Studied on vegetative propagation of pecan. *Egypt. J. Hort.*, **1**, 23-29.
- Hoque, M.E and Husain, A. (1974)** Graft union studies in mango. *Bangladesh Horticulture* **2**(2), 1-3. Bangladesh Agricultural University, Mymenzingh, Bangladesh. (Hort. Abst. 46: 9790).
- Egypt. J. Hort. Vol. 42*, No. 1 (2015)

- Jose, I.S. (1982)** The pecan quarterly, **16** (3), 21-28.
- Malik, M.A. (2013)** Grafting techniques in guava (*Psidium guajava*). *J. Agric. Res.*, **51**(4), 465-471.
- Mekky, M.A. and Hamouda, A.M.M. (1997)** Horticulture Science Book, *Methods of Fruit Production*. (Part I), Oman, 595 p.
- Osman, I.M.S. (1986)** Physiological studies on the vegetative propagation of guava fruits. *M.Sc. Thesis*, Faculty of Agric, Moshtohor, Zagazig Univ., Egypt.
- Pinheiro, R.V., Andersen, O. and Fortes, J.M. (1970)** Comparison of grafting methods for propagation of mango. *Rev. Ceres*, **17**, 264-273. (Hort. Abst. 41:5104).
- Powell, A. (1998)** Budding and grafting Fruits and Nuts Alabama Cooperative Extension System. p.4.
- Samson, F.A. (1980)** *Tropical Fruits*. Tropical Agriculture Series, pp.214- 216. Long man ISBN, London, New York.
- Shippy, W.B. (1930)** Influence of environment on callusing of apple cuttings and grafts. *Amer. J. Bot.*, **17**, 290-327.
- Simons, R.K. (1968)** Phloem tissue development in stock scion union of East Malling IX apple, rootstock. *Hort. Res.*, **8**, 97-103. (Hort. Abst., 39: 2065).
- Singer, A.A.A. (1997)** Effect of interstock on vegetative and floral characteristics of peaches. *M.Sc. Thesis*, Fac. Agric., Cairo University.
- Singh, S., Kresnamrty, S. and Katyal, S.J. (1963)** *Fruit Culture in India*, The India Council Agric. Res. New Delhi, pp.451.
- Snedecor, G.W. and Cochran, W.G. (1980)** "*Statistical Methods*" 7th ed., Oxford and J.B.H. Bub.Com.
- Sutter E. (1994)** Olive cultivars and propagation. In olive production manual (Eds. I., Ferguson, G. S. Sibbett and G.C. Martin). Univ. of California. Division of Agriculture and Natural Resources. Oakland. CA. USA, Puplication, 3353, 23-31.
- Taylor, G. (1982)** Collecting and storing pecan propagation wood. Oklahoma State University Extension Factors. No. 5-6.
- Tworkoski, T.T. (2006)** Rootstock effect on growth of apple scions with different growth habits. *Sci. Hort.*, **111** (4), 335-343.

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دراسات على الإكثار الخضري في الجوافة بالتطعيم

عبد العزيز أحمد الطويل، إبراهيم محمد سيد عثمان و عماد جرجس ميخائيل
قسم بحوث الزيتون وفاكهة المناطق شبه الجافة - معهد بحوث البساتين - مركز
البحوث الزراعية - القاهرة - مصر.

تم إجراء هذا البحث خلال موسمي ٢٠١١ و ٢٠١٢ في المزرعة التجريبية بحديقة
معهد بحوث البساتين، الجيزة - مصر، وكان الهدف من هذه الدراسة هو تأثير
التطعيم عن طريق الطرق الآتية:
- طريقة التطعيم بالشق والتطعيم السرجي والتطعيم اللساني في منتصف يناير
وفبراير ومارس من كل موسم.
وكانت النتائج المتحصل عليها كالآتي:

- أعلى نسبة نجاح تم الحصول عليها عند إجراء التطعيم بالشق في منتصف
فبراير (٨٨,١٥ و ١٠٠ %) في كلا الموسمين على التوالي.
- الزيادة في الوزن الطازج لكل من الأوراق والسيقان والجذور في منتصف
يناير في طرق التطعيم خلال الموسمين.
- لوحظ زيادة في الوزن الجاف لكل من الأوراق والجذور عند إجراء
التطعيم السرجي في الموسم الأول والتطعيم اللساني في الموسم الثاني .
- لوحظ زيادة معنوية في أوزان الجذور الطازجة في الموسم الأول في
التطعيم السرجي، في حين كانت الزيادة في منتصف يناير عند إجراء
التطعيم اللساني في الموسم الثاني .
- أعلى قيم لسمك منطقة الالتحام عند إجراء التطعيم السرجي في منتصف
يناير في الموسم الأول، والتطعيم بالشق في الموسم الثاني.
- أعلى زيادة في طول نمو الطعم تم الحصول عليه عند إجراء التطعيم
السرجي في منتصف يناير في الموسم الأول، ومنتصف فبراير في
الموسم الثاني.
- أعلى زيادة معنوية في عدد الأفرع على الطعم تم الحصول عليها عند
إجراء التطعيم السرجي في مارس في الموسم الأول، والتطعيم بالشق في
منتصف يناير في الموسم الثاني.
- لوحظ أن استخدام البيونيوكلر في فحص منطقة الالتحام بين الأصل
والطعم ، أن كل التركيبات أعطت التنام جيد بدون ظهور أي أعراض
لعدم التوافق.

وعليه يوصى باستخدام طريقة التطعيم بالشق في منتصف فبراير عند إجراء
التطعيم في الجوافة.