

EFFECT OF DATE OF GRAFTING ON SUCCESS PERCENTAGE AND GROWTH OF MANGO TRANSPLANTS

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ABSTRACT

This study was carried out during the seasons of 2006 and 2007 to present the suitable date of grafting for Zebda, Fagriklan, Seedek, Ewais and Keitt mango cultivars onto Zebda rootstock in order to obtain a higher successful grafts of mango cultivars.

Grafting mango cultivars with the cleft method especially on April produced a higher percent of successful grafts and gave highest scion growth with longer, thicker shoot and more number of leaves on the seedling than those taken in September. Furthermore, grafting both Zebda and Fagriklan on Zebda rootstock gave higher values of successful grafts and growth of the transplant than those obtained from grafting Seedek, Ewais and Keitt on the same rootstock. Whereas, Ewais and Keitt cultivars gave less vigorous grafts than that obtained from the other cultivars in the two dates of grafting.

INTRODUCTION

Mango (*Mangifera indica*, L.) is an important fruit crop of the tropical and subtropical regions. Also, it is one of the most common and popular fruits since, it considered the king of fruits having delicious taste, captivating flavor with multifarious color, and excellent source of nutritive values (Alam *et al.*, 2006).

In Egypt, mango occupied about 109018 feddans with total production of about 287317 tons according to the last statistics of the Ministry of Agriculture (2004). Nowadays the cultivated area was increased in the newly reclaimed land especially Ewais, Seedek, Zebda and in few cases with Keitt and Kent cultivars which are harvested late in the season.

Mango cultivars can be divided into two groups mono-embryonic and polyembryonic. The former when propagated from seed do not come true to type, whereas the latter breeds true. Furthermore, the most important cultivars of mango in the world are monoembryonic, hence, there is an urgent need to propagate them vegetatively (Majumder, 1988). Grafting is the most common method for mango propagation. In this respect, several methods of grafting are used such as veneer, soft wood and epicotyl grafting. Yet, cleft grafting is one of the most acceptable and excellent method of mango grafting. Since, these methods of grafting are easier to accomplish than the splice grafting and preferred by grafters (Kashyap *et al.* 1989; Pereira *et al.*, 2004 and Islam *et al.*, 2004).

Also, the time of grafting had high significant influence on the percent of successful grafts. Since, Ismail and Rao (1988) pointed that grafting mango from January to December gave a best result and produced higher percent of grafting success. So, moderate temperature and high relative

humidity are the major factors for increasing the percent of success grafting (Ram, 1997).

Therefore, the affinity between the rootstock and the scion represents the biochemical, physiologic and morphologic reactions happening in the grafted plants (Ramos, 1982).

This study was undertaken to find out the suitable time of grafting Zebda, Fagriklan, Seedek, Ewais and Keitt cultivars on Zebda rootstock and the effect on the percentage of successful grafts and growth of rootstock and scion in order to obtain a good nursery tree suitable for planting in mango orchard.

MATERIALS AND METHODS

This investigation was conducted during the two successive seasons of 2006 and 2007 at the nursery of the Fac. of Agric., Mansoura Univ. to study the time of grafting of Zebda, Fagriklan, Seedek, Ewais and Keitt mango cultivars on the percent of successful grafts and growth of shoot scion. In both seasons of study, the grafting operation was carried out in April and September by using cleft grafting for these cultivars onto Zebda rootstock. The experiment was arranged in a randomized complete block design with 12 grafts for each cultivar replicated 4 times.

Preparation of the rootstock :

Seeds of Zebda cultivar were extracted from sound fruits, thoroughly cleaned with water. Seeds were planted immediately in seed bed in the nursery during July. Vetafax at 0.5 % was mixed with the seeds as a fungicide at 0.5 gm/liter. Newly emerged seedlings were placed in polyethylene bags (20 x 30) filled with a mixture of sand and clay at 1:1. Uniform seedlings of Zebda were taken after 9 months old for making the first grafting in April and the other seedlings were taken after 14 month for making the second one in September.

Scion preparation:

Scions were obtained from a private mango orchard at EL-Nobarria area. Terminal shoots of about 6 months old with a length of 9-12 cm and 8-12 mm in diameter were selected from healthy mother trees of about 12 years old. Leaves were removed and these shoots were kept in wet burlap while transported to the nursery for grafting.

Grafting technique :

Seedlings of Zebda rootstock uniform in size and growth were selected for cleft grafting. The rootstocks were topped at a height of 20-30 cm from the bag level. A vertical split 50 to 75 mm down the centre of the topped stock was made with a sharp knife. The lower end of the selected scions with at least 3-4 fully mature buds was given two slanting smooth cuts on either side each about 50-75 mm long forming a wedge with even slopes and inserted in the split. Tying was made with polyethylene tape and the grafts were covered with transparent bags. The grafts were irrigated regularly, and the polyethylene covers were removed after bud breaking according to Ram, (1993) and the grafts received normal cultural practices

The percent of success grafting, growth of grafts and number of leaves/graft were recorded as follow :

1- Percentage of successful grafts :

It was recorded after 120 days from grafting according to Shaban, (1996) and Rossetti *et al.* (2004).

2- Average graft length and diameter (cm) :

It was determined and the average of both length and diameter was estimated (cm).

3- Average number of leaves per graft :

Number of leaves per graft was recorded and the average was calculated.

4- Number of leaves :

The number of leaves on grafts was counted and the average was estimated.

5- Average leaf area (cm²) :

Leaves were taken from grafts after 6 months from grafting and the average leaf area was estimated using the following equation according (Jain and Misra, 1966).

$$\text{Leaf area (cm}^2\text{)} = \frac{3.14 \times (\text{leaf diameter})^2}{4}$$

6- Growth rate :

It was calculated using the following equation according to (Abdel-Metal, 1998).

$$\text{Growth rate \%} = \frac{\text{Final length} - \text{Initial length}}{\text{Initial length}} \times 100$$

7- Nursery tree weight (gm) :

Seedlings fresh weight was recorded and the average was estimated (gm).

Statistical analysis :

Data of both seasons of the study were statistically analyzed. The experiment design was the complete randomized block design according to (Snedecor and Cochran, 1980). The differences among each cultivar and date of grafting were compared using the least significant differences (L.S.D) at 5 % level.

RESULTS AND DISCUSSION

1- Percentage of successful grafts :

It is obvious from Table (1) that percent of grafting success was affected by using scion of Zebda, Fagriklan, Seedek, Ewais and Keitt mango cultivars on Zebda rootstock at the two dates of grafting. It is clear that the first date of grafting (April) produced a higher grafting success than the second one (September) for different mango cultivars. In this respect, the date of grafting and age of rootstock gave a higher effect in this respect,

since the first date rootstock aged 9 month but aged 14 month in the second one. Also, these data are agree with those found by Reddy and Melant (1988) who showed that using rootstocks with 7 month old gave the highest success 90 % followed by 58 % with 3 month old.

Table (1): Grafts success percentage of different mango cultivars.

Cultivar	First date (April) %			Second date (September) %		
	2006	2007	Mean	2006	2007	Mean
Zebda	86.9	82.8	84.9	77.7	76.2	77.0
Fagriklan	75.0	71.2	73.1	71.5	68.3	69.9
Seedek	71.2	64.6	67.9	63.4	60.2	61.8
Ewais	61.9	60.3	61.1	56.1	55.5	55.8
Keitt	60.6	59.8	60.2	52.5	53.5	53.0
L.S.D at 5 %	Cultivar : 2.37 Date : 1.50 Cultivar x Date : 3.00			Cultivar : 1.05 Date : 0.67 Cultivar x Date : 1.33		

In addition, Hamady and Ibrahim (1985) mentioned that April was the best time for grafting mango. Also, Shakur and Guha (1996) presented that the highest success percent was about 96.6% recorded when the grafting was done on 16 June and the lowest success 80 % required on September. Furthermore, Ismail and Rao (1988) pointed out that grafting mango from January to December gave a best result with higher percent of success.

The data also revealed that, grafting Zebda, Fagriklan and Seedek gave a higher percent of successful grafts than those obtained from Ewais and Keitt cultivars. Furthermore, grafting Zebda onto Zebda rootstock produced higher significant values than those obtained from Fagriklan and Seedek cultivars, since this cultivar gave about 84.9 and 77.0 % for the first and second dates. Whereas, grafting Keitt or Ewais onto Zebda rootstock gave a lower significant success percentage than those obtained from the other cultivars. Yet, grafting Keitt onto Zebda rootstock gave a lower percent of successful grafts than the other cultivars. So, this cultivar gave success percent of about 60.2 and 53.0 % for grafting in April and September during the both seasons. Likewise, Srivastava (1989) demonstrated that temperature and humidity were the main factors for successful grafts. Also, Gunjate (1989) found that grafting Alphonso mango on newly mango seedling in warm humid month of June and July scored the highest survival 72.7 %. Similarly, Islam *et al.* (2004) mentioned that the highest percent of grafts (94.09 %) was found when grafting operation was done on 15 June by modified cleft grafting and the lowest was 35.33% during 15 September operation.

2- Graft length and diameter:

Table (2) presented that the first date of grafting (April) gave a higher graft length than the second date (September) for all mango cultivars. Moreover, grafting Zebda or Fagriklan cultivars onto Zebda rootstock produced a higher graft length than those obtained from grafting Seedek, Ewais and Keitt cultivars on the same rootstock. Furthermore, grafting Zebda cultivar onto Zebda rootstock produced longer grafts than those obtained from grafting Fagriklan onto Zebda rootstock at the two dates of grafting. Yet,

no significant differences were obtained on average graft length of Seedek and Ewais at the two date of grafting. Whereas, grafting Keitt onto Zebda rootstock gave a lower significant graft length than the other mango cultivars at the two dates of grafting during the two seasons. Furthermore, grafts produced from Zebda were about 30 % longer than those obtained from Keitt cultivar.

Table (2) : Graft length (cm) of different mango cultivars.

Cultivar	First date (April) (cm)			Second date (September) (cm)		
	2006	2007	Mean	2006	2007	Mean
Zebda	23.8	22.8	23.3	16.7	16.3	16.5
Fagriklan	21.2	20.9	21.1	14.8	14.7	14.8
Seedek	15.6	15.8	15.7	11.2	11.2	11.2
Ewais	15.0	13.0	14.0	10.6	9.7	10.2
Keitt	10.5	11.0	10.8	8.3	8.7	8.5
L.S.D at 5 %	Cultivar : 1.36 Date : 0.86 Cultivar x Date : 1.72			Cultivar : 1.11 Date : 0.70 Cultivar x Date : 1.40		

Concerning effect of grafting on graft diameter, data from Table (3) revealed that similar trend of graft diameter was obtained to those found from graft length at the two dates during the two seasons. Since, grafting Zebda cultivar onto Zebda rootstock produced thicker grafts than the other cultivars but Keitt gave a thinner one in this respect.

Table (3) : Graft diameter (cm) of different mango cultivars.

Cultivar	First date (April) (cm)			Second date (September) (cm)		
	2006	2007	Mean	2006	2007	Mean
Zebda	1.13	1.00	1.07	0.95	0.91	0.93
Fagriklan	0.92	0.87	0.90	0.82	0.79	0.81
Seedek	0.90	0.81	0.86	0.79	0.75	0.77
Ewais	0.84	0.80	0.82	0.76	0.73	0.75
Keitt	0.71	0.68	0.70	0.66	0.65	0.66
L.S.D at 5 %	Cultivar : 0.082 Date : 0.052 Cultivar x Date : 0.10			Cultivar : 0.51 Date : 0.032 Cultivar x Date : 0.06		

3- Number of leaves:

Data from Table (4) showed that grafting Zebda and Fagriklan cultivars gave a higher significant number of leaves on the graft than those obtained from the other cultivars on the same rootstock at the two dates of grafting. Furthermore, Fagriklan cultivar produced a higher number of leaves per graft than Seedek cultivar. Whereas, Ewais and Keitt cultivars gave a lower number of leaves than the other cultivars. Yet, Keitt gave a lower significant number of leaves than that obtained from Ewais cultivar at two dates of grafting. The data also showed that the nursery tree which produced from grafting in first date (April) gave a higher number of leaves than those obtained from the second one (September).

Table (4) : Number of leaves on different grafts of mango cultivars.

Cultivar	First date (April)			Second date (September)		
	2006	2007	Mean	2006	2007	Mean
Zebda	27.2	24.3	25.8	17.9	16.6	17.3
Fagriklan	19.0	21.0	20.0	13.5	14.2	13.9
Seedek	18.0	17.5	17.8	12.6	12.8	12.7
Ewais	16.2	15.5	15.9	11.5	12.0	11.8
Keitt	8.5	10.0	9.3	7.8	8.6	8.2
L.S.D at 5 %	Cultivar : 1.37 Date : 0.87 Cultivar x Date : 1.73			Cultivar : 1.21 Date : 0.77 Cultivar x Date : 1.53		

From the above data it is obvious that grafting Zebda cultivar onto Zebda rootstock produced nursery trees with longer, thicker shoots and higher number of leaves than those obtained from the other cultivars. In addition, Fagriklan and Seedek gave higher values of these parameters than those obtained from Ewais and Keitt. Since, grafting Keitt on Zebda rootstock gave a shorter and thinner grafts with lower number of leaves. Therefore, the data showed that making grafting in April gave a higher growth than those from grafting mango gained at September. Similarly, Islam *et al.* (2004) mentioned that propagation of mango by cleft grafting gave a higher percent of grafts (87.2 %) with the highest scion growth and number of leaves and shoots.

4- Leaf area :

Leaf area (cm²) of mango cultivars grafting on Zebda rootstock are presented in Table (5). In this respect, the data revealed that no significant different in leaf area was obtained from grafts produced from grafting in April and September. Furthermore, grafting Zebda cultivar on its rootstock gave a higher significant leaf area than the other cultivars at the two dates of grafting. Also, grafting Fagriklan gave higher significant leaf area than those obtained from Seedek, Ewais and Keitt cultivars. Whereas, grafting Keitt on Zebda rootstock produced a lower significant leaf area than those obtained from the other cultivars during both seasons.

Table (5) : Leaf area (cm²) on different grafts of mango cultivars.

Cultivar	First date (April) (cm ²)			Second date (September) (cm ²)		
	2006	2007	Mean	2006	2007	Mean
Zebda	519.0	522.2	520.6	514.8	506.5	510.7
Fagriklan	422.3	426.8	424.6	420.3	423.6	422.0
Seedek	311.5	335.0	323.3	306.5	329.5	318.0
Ewais	226.8	265.0	245.9	236.5	255.6	246.1
Keitt	183.9	188.5	186.2	158.5	163.9	161.2
L.S.D at 5 %	Cultivar : 33.46 Date : 21.16 Cultivar x Date : 42.28			Cultivar : 39.14 Date : 24.93 Cultivar x Date : 49.78		

In this respect, Jha and Brahmachari (2002) found that grafting required the shortest time for success (15-17 days) and the highest values of scion length after 6 months (18.9cm), diameter (0.52 cm), number of leaves per graft (17.8) and leaf area (167.3 cm²).Also, Islam *et al.* (2004) reported

that modified cleft grafting showed the highest scions growth with the highest number of leaves and shoots.

6- Growth rate :

It is obvious from Table (6) that growth rate was almost similar to those obtained from graft length since, growth rate was estimated by knowing the changes in graft growth of the nursery tree (Abdel-Metal, 1998). In this respect, the data mentioned that the growth rate for Zebda grafting onto Zebda rootstock was higher than grafting the other mango cultivars on the same rootstock. Also, Fagriklan cultivar gave a higher growth rate than Seedek, Ewais and Keitt. Whereas, grafting Keitt on Zebda rootstock gave lower significant values of growth rate than those obtained from Ewais and the other mango cultivars.

Table (6): Growth rate on different grafts of mango cultivars.

Cultivar	First date (April)			Second date (September)		
	2006	2007	Mean	2006	2007	Mean
Zebda	270.8	238.5	254.7	259.9	245.4	252.7
Fagriklan	258.9	230.6	244.8	233.9	232.1	233.0
Seedek	222.7	220.5	221.6	222.1	207.7	214.9
Ewais	203.9	184.7	194.3	190.5	183.8	187.2
Keitt	177.8	175.8	176.8	166.4	171.0	168.7
L.S.D at 5 %	Cultivar : 20.76 Date : 13.13 Cultivar x Date : 26.22			Cultivar : 18.73 Date : 11.85 Cultivar x Date : 23.67		

It is obvious that, no significant differences were obtained on grafts growth rate either grafting was done in April or September during both seasons of study.

7- Nursery tree weight :

Table (7) presented that the first date of grafting (April) produced a higher plant weight than that obtained in the second one (September). That is not astonished since the first date of grafting produced seedling with longer and thicker grafts than in the second date of grafting (September) during the both seasons. Furthermore, Zebda and Fagriklan grafted onto Zebda rootstock gave a higher significant weight of nursery trees than those obtained from the other mango cultivars. Moreover, seedling weight of Seedek was also higher than those obtained from Ewais and Keitt cultivars. Since, the plant weight of Keitt was significantly lower than the other nursery trees.

Table (7) : Weight of nursery tree (gm) of different mango cultivars.

Cultivar	First date (April) (gm)			Second date (September) (gm)		
	2006	2007	Mean	2006	2007	Mean
Zebda	149.8	141.3	145.6	132.0	126.9	129.5
Fagriklan	135.8	126.7	131.3	117.2	113.2	115.2
Seedek	98.6	89.0	93.8	82.4	79.0	80.7
Ewais	91.6	79.4	85.5	76.0	72.4	74.2
Keitt	82.9	72.9	77.9	66.6	64.7	65.6
L.S.D at 5 %	Cultivar : 1.77 Date : 1.12 Cultivar x Date : 2.24			Cultivar : 1.39 Date : 0.88 Cultivar x Date : 1.77		

The highest rootstock growth in (April) operation might be due to the excellent physiological condition for rootstock growing. Since, the optimum temperature and adequate irrigation water enhanced good physiological condition for the growth of rootstocks. Slow growth of the plant during August and September might be due to the gradual decrease in temperature and relative humidity and the gradual increase in dryness of the soil (Hartman *et al.*, 1997). Furthermore, Islam *et al* (2004) presented that the highest scion growth, number of shoots and leaves which noticed in the plants grafted on 15 June, might be due a rapid graft union process. At this time, the excellent climate condition of optimum growth temperature, adequate relative humidity and soil moisture provided excellent growth for the scions. This is in agreement with the finding of (Upadhyay and Prasad, 1988) who found that the highest scion growth was noticed in June grafted plants. The numerous numbers of leaves also provided a lot of food materials for the excellent growth of the scion. In the late summer (August-September) there is low growth of the scion, with a lower number of shoots and leaves might be due the low relative humidity and soil moisture and subsequent low night temperature which retarded the cambial activity of the graft union and inhibited the growth of the scion resulting in less shoots with leaves.

From this study, it is clear that using cleft grafting was suitable for mango propagation especially when carried in April, since this date presented a higher percent of successful grafts, longer and thicker grafts, and higher leaf area of seedling than those making in September. Moreover, grafting Zebda or Fagriklan cultivars onto Zebda rootstock produced a higher percent of grafting success and longer grafts with higher number of leaves and leaf area of the nursery trees than those obtained from grafting Seedek, Ewis and Keitt on the same rootstock. It is evident that the size of nursery tree can play an important role in planting the orchard. Therefore, it is recommended to carry out cleft grafting in April for producing standard mango nursery trees.

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تأثير ميعاد التطعيم على نسبة النجاح و نمو شتلات بعض أصناف المانجو عبد العال حجازى حسن - باسم نبيل سمره - ايناس على صادق قسم الفاكهة - كلية الزراعة - جامعة المنصورة

أجريت هذه الدراسة خلال موسمي ٢٠٠٦، ٢٠٠٧ لتحديد الميعاد المناسب لتطعيم أصناف المانجو زبدية - فجرى كلان - صديق - عويس - كيت على أصل الزبدة بغرض معرفة نسبة نجاح التطعيمات و كذلك الحصول على شتلات قياسية .
لقد أوضحت النتائج أن تطعيم أصناف المانجو بطريقة التطعيم القمي بالشق في شهر إبريل أظهرت زيادة واضحة ومؤكدة في نسبة نجاح التطعيمات و كذا معدل نمو الطعوم من حيث زيادة معدل نمو الطعوم و كذا عدد الأوراق و المساحة الورقية مقارنة بالتطعيم في شهر سبتمبر.
علاوة على ما سبق فإن تطعيم صنفى الزبدة و كذا الفجرى كلان على أصل الزبدة أظهرت زيادة مؤكدة في نسبة نجاح التطعيمات و كذلك معدل نمو الشتلات عن تلك المتحصل عليها عند تطعيم أصناف المانجو صديق - عويس - كيت على نفس الأصل إذ أظهر تطعيم صنف العويس و كذا الكيت إنخفاض ملحوظ في نسبة نجاح التطعيمات و كذا نمو الشتلات مقارنة بباقي الأصناف خلال موسمي الدراسة.
لذلك توصى هذه الدراسة بإجراء التطعيم القمي بالشق خلال شهر إبريل لأصناف المانجو وذلك للحصول على نسبة نجاح مرتفعة و كذا الحصول على شتلات قياسية تصلح للغرس في البستان المستديم.