

## STUDIES ON SEXUAL AND ASEXUAL PROPAGATION ON SOME MANGO CULTIVARS

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**ABSTRACT:** *This study was conducted in the plastic house of Horticulture Research Institute, Agriculture Research, Center, Giza Egypt during seasons 2006 and 2007, using rootstock seedlings of mango cvs. (Zebda and Ewais) with good characteristics fit for grafting in shortest period using some seed treatments and different types of sowing media, also to find which scions are suitable for grafting. Results indicated that, soaking seeds of the two mango cvs. in running water for 3 days before planting recorded higher germination percentage and best vegetative growth followed by storage seeds for 7 days at room temperature. Moreover sowing mango seeds with side concavity led to earlier germination by 3-4 days than Horizontal one and gave higher germination percentage (90.0, 95.0) for Zebda and (80.0, 85.0%) for Ewais . planting intact seeds germinated after 28, 35 days for Zebda and Ewais cvs. while this period was shortened to 21 days for seeds planted decoated and gave higher percentage of germination . Moreover, sandy soil medium gave higher germination percentage and taller mango plants comparing with seeds planted in a mixture of soil sand and clay (2:1v/v). On the other hand, storing scions of ( Langra) cv. mango for 3 days prior to grafting gave the best results in terms of grafting success % and overall plant growth and side grafting produced the highest success percentage and vegetative growth parameters for the scion .*

**Key Words:** *Mango propagation, seed treatments, sowing media, seed storage, grafting methods, storage of scion before grafting, vegetative growth, chemical contents.*

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### INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important fruit of the tropical and subtropical countries, also in Egypt, because of its nutritive value and profitability for growers. It occupied about 184204 feddans, with total production of 532422 tons (according to Annals of Agricultural Economics, A. R. E. 2007) some orchards of this area is planted with seedling trees. Recently, it is common to purchase grafted mango plants for planting new orchards. However, these plants require about two years in the nursery to attain the suitable size. Therefore, stimulating the growth of mango seedling as a rootstock may shorten this period by some seed treatments on which they grafted or budded with the desired varieties.

Pillewan, *et. al.*, (1997, Padma and Reddy (1998) and Shalini *et. al.*, (1999) mentioned that, soaking mango seeds in water 24 or 48 h. gave highest germination percentage and increasing seedling growth. On mango seeds viability were significantly affected by storage time and temperature, where germination may occur between 25 and 40°C and the optimum temperature is 25-30°C. Corbineau *et.al.*, (1987) Parisot (1988), Doijode (1995) and Girija *et. al.*, (2001). Shahin *et. al.*, (1994) on peach, found that, stratification treatments increased seedling length. On cashew many investigations mentioned that, the seeds should be sown shallow with the concave side up or on one side, but not with the convex side up Rao *et.al.*, (1957), Ibikunle and Komolafe (1973) and Adams (1975). A bdel Galil (1992), Padma *et.al.*, (1996) and Padma and Reddy (1997) revealed that, when mango seeds coat and testa removed before sowing the seeds started germination after 10 days while the final germination was 78.57%). Nasir *et. al.*, (1990) on citrus rootstock showed that, sowing seeds in mixture of loam and sand (2:1) had a significant beneficial effect on growth of all seedlings. On Avocado, investigators found that different soil types significantly influenced on plant height.

Eddossa *et al.*, (2003) Ebeed *et al.*, (2006) on casimiroa mentioned that, the shortest seedlings was obtained when seeds grown in (sand + clay) soil.

El shall (1983), Said *et. al.*, (1993) and Sahin *et. al.*, (1994) on peach demonstrated that, total indolic compounds and total soluble sugar were increased markedly as stratification period while, total phenols were decreased. Concerning storage of mango scions Dhakal and Hoda (1987), Phuse *et. al.*, (1995), Dod *et. al.*, (1996), Roy and Hoda, (1996) and Roy *et al.*, (1999) mentioned that, when scions of mango were kept at room temperature for 3, 5,7 and 10 days before grafting, graft takes percentage declined as storage time increased. Dhakal and Hoda (1986), Abhay *et.al.*, (1999) and Rajesh *et.al.*; (1999) revealed that, the best growth and survival in mango scions which had been stored for 3 days before grafting. Side veneer and side grafting methods gave the best growth than top and approach grafting because the grafts completed its wound healing 1-2 month earlier than the other methods.

The aim of this investigation is attempts to improve growth of seedlings rootstock through some seed treatments, also to explore the effect of different methods of grafting and scions treatments before grafting on the percentage of success and subsequent growth of mango grafts.

## **MATERIALS AND METHODS**

This work was carried out to investigate some methods of propagation (sexual and asexual) of some mango varieties, the study was done in the green house of Horticulture Research Institute, Giza, Egypt during the two successive seasons of 2006 and 2007 on two mango varieties namely, Zebda and Ewais.

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The study contains two main parts:

### 1-Sexual propagation.

The experiment conducted to study some factors which affecting on germination of mango seeds, in all experiment seeds were extracted from fresh fruits collected from two mature trees of (Zebda and Ewais ) mango cultivars, then washed with tap water and kept for sowing at the second week of August. The study included four experiments as follows:

#### 1-1- Effect of seeds storage.

This experiment contains six treatments, i.e., control (directly sowing), Soaking in running water for three days, storing seeds at room temperature in moist Peat moss and sand (1:3 v/v) for 7, 15 days and cold storage in 5°C for 7, 15 days in Moist soil (peat moss and sand (1:3 v/v)).Seeds should be sown in boxes 60x60 cm filled with a mix of ( peat moss and sand ( 1: 1 v/v)) in the greenhouse.

#### 1-2- Effect of seeds position at planting.

This experiment included two treatments, sowing seeds on horizontal side and sowing seeds on side with concavity directed downwards.

#### 1-3- Effect of seed coat removal.

The experiment included two treatments i.e., intact and decoated seeds.

#### 1-4- Sowing media.

This experiment included two planting mango seeds in two sowing media i.e., sandy soil and mixture of soil (2 sand: 1 clay v/v) each treatment for the four studied experiments contains 50 seeds and replicated 3 times.

#### The vegetative growth parameters :

Germination rate and the percentage of germination

$$1- \text{Germination rate} = \frac{(A) + (A+B) + (A+B+C) + (\dots + x)}{n(A+B+C+ \dots + x)}$$

Where A,B,Cand x = Total number of germinated seed within consecutive weekly intervals = number of counts.

$$2- \text{Germination \%} = \frac{\text{Total number of germinated seeds} \times 100}{\text{Total number of planted seeds}}$$

3- The height, thickness at 3cm from soil surface, number of leaves per plant.

#### 1-5-Chemical analysis:

Samples of seeds representing the above mentioned treatments were taken at the end of storage period for chemical analysis.

Total Indoles were determined according to the method described by Selim *et al.*, (1978). Total phenols were carried out by coloremtric method (A.O.A.C., 1970), while total soluble sugar were evaluated according to Smith *et al.*, (1956).

## **2- Asexual propagation:**

This experiment was carried out to study two methods of grafting (top and side grafting).

### **2-1-Propagation by grafting scions of mango ( Langra) cv. on unnamed seedling rootstocks.**

Scions were in situ grafted by the softwood shoots during April 2006 and 2007. Scions shoots were selected at 16-18-month old (1- 1.5 cm thick) healthy terminal shoots stored and freshly detached. In addition, 18 months old mango plants (as rootstocks) were selected healthy with suitable thickness (1-1.5 cm.) growing in black plastic pots 30 cm height containing mixture of sand and clay (1:1 v/v). This experiment contains two types of grafting Top and side grafting, grafting was carried out on the first week of April in both seasons, in each type contain the following treatments:.

- 1- Grafting with scions at directly preparation.
  - 2- Grafting with stored wet scions for 3, 5, 7, 10 and 15 days at room temperature.
  - 3- Grafting with cold storage of wet scions for 3, 5,7,10 and 15 days at 5°C.
- Each treatment contains 25 plants (as rootstocks) and replicated 3 times.

**The vegetative parameters for all experiments of this study was measured on September as follows:**

$$\text{Percentage of grafting success} = \frac{\text{Total number of succeeded grafts} \times 100}{\text{Total number of grafted rootstocks}}$$

- 2- The height and number of leaves per plant.

### **2-2-Chemical Analysis:**

Samples of dry scions at the end of storage period before grafting representing the above mentioned treatments were taken for chemical analysis. Total Indol were determined according to the method described by Selim *et al.*, (1978). Total phenols were carried out by coloremtric method (A.O.A.C., 1970), while total soluble sugar were evaluated according to Smith *et al.*, (1956). The obtained data were tabulated and statistically analyzed according to complete Randomized block design (Snedecor and Cochran, 1980).

## **RESULTS AND DISCUSSION**

### **1-Sexual propagation**

#### **1-1- Effect of seeds storage.**

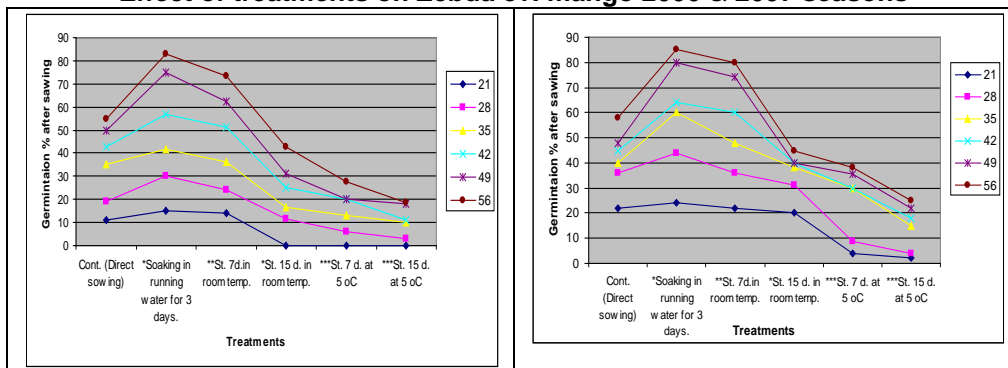
Table (1) and Fig (1) revealed that, in both seasons Zebda cv. gave higher germination percentage (29.4, 38.1%) than Ewais cv. (21.2, 24.7%). Meanwhile, it is noticed that, soaking seeds of two mango cvs. (Zebda and Ewais) in running water for 3 days before planting hastened germination and recorded higher germination percentage(83.0, 85.0%),(72.0,70.0%) in 2006 and 2007 on Zebda and Ewais cvs. respectively when compared with the untreated seeds or other storage treatments. The percentage of germination was affected by the period or type of storage, when the seeds stored in moist peat moss for 7 or 15 days at room temperature was superior to storage at 5°C at the same periods, also data pointed out that, germination percentage was gradually decreased by increasing the period of storage from 7 to 15 days. This is true for the two seasons and by Zebda and Ewais cultivars, meanwhile, soaking Zebda cv. seeds in running water for 3 days gave highest germination percentage after 56 days from sowing, while, stored seeds of Ewais cv. at 5°C for 7 or 15 days failed to germinate after 28 days from sowing.

Concerning the rate of germination it took the same trend of germination percentage, where Zebda cv. gave higher germination rate than Ewais cv., the treatment of soaking for 3 days in running water gave higher rate followed by these stored at room temperature for 7 days. Moreover, soaking seeds of both mango cvs. in running water for 3 days gave the highest germination rate in the final germination.

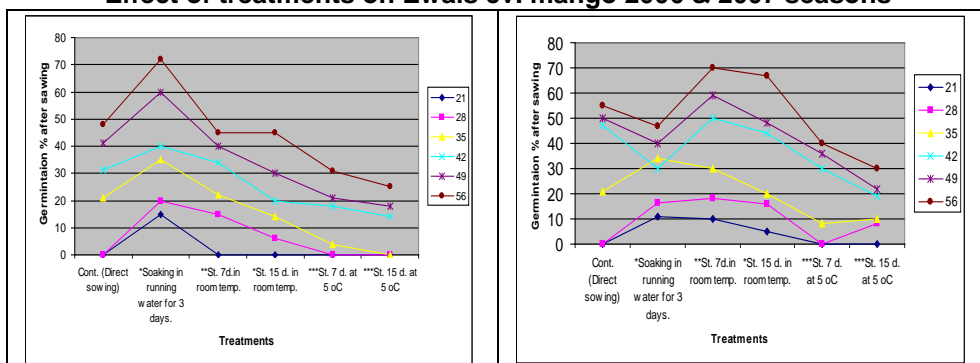
**Table (1)**

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**Effect of treatments on Zebda cv. mango 2006 & 2007 seasons**



**Effect of treatments on Ewais cv. mango 2006 & 2007 seasons**



**Figure (1): Effect of storing seeds of two mango cvs. on seed germination percentage at weekly intervals during two successive seasons of 2006 and 2007 seasons.**

Table (2 and 3) show the vegetative growth parameters of seedlings, revealed that, in both seasons, Ewais cv. gave taller plants (16.2, 18.2cm) than Zebda cv. plants (11.9, 11.3 cm), data also showed that, soaking seeds in running water gave taller plants compared with the control, it is noticed a gradually increase in plant height after 30 to 90 days in all treatments. Meanwhile, the increasing period of storage from 7 to 15 days at room temperature produced an increase in plant height of the two cvs. of mango. On the other hand the plant height was nearly similar in storage at 5°C in 7 or 15 days. This is true for two seasons of study.

**Table 2**



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**Table 3**

Concerning the number of leaves per plant it showed that, Ewais cv. gave higher number of leaves per plants (3.6, 4.1) than Zebda cv.( 3.1, 2.5), while, it showed that, treatment of soaking in running water and the untreated seeds gave similar number for the two mango cvs. Moreover, it noticed a gradual increase by increasing the period of germination from 1 to 3 months and On the other hand increasing the period of storage at room temperature from 7 to 15 reduce the number of leaves/ plant comparing with cold storage which produce opposite results. This is true for the two seasons and in Zebda and Ewais cvs.

As for plant thickness it was showed that, storage of seeds of the two cvs. at 50C produced higher thickness plants compared with the control or soaking in running water or stored at room temperature which gave nearly similar results.

This result was confirmed by Pillewan, *et. al.*, (1997), Padma and Reddy (1998) and Shalini *et.al.*, (1999) who mentioned that, soaking mango seeds in water for 24 or 8 h.gave highest germination percentage and stimulate seedling growth.

## **1-2- Effect of seed planting position.**

Data in table (4) indicated that, sowing mango seeds with the concavity side position germinated gave on Zebda cv. higher germination percentage (90.0, 95.0%) than Ewais (80.0, 85.0%) one, it was also showed that, concavity position gave the highest germination percentage than sowing seeds at the horizontal side. Moreover, it is clear that, concavity position led to earlier germination than planted them with Horizontal side by 3-4 days. It showed that, when sowing Zebda cv. seeds with the concavity side position germinated gave higher germination percentage.

As shown in table (5) it is noticed that, plant height of Ewais seedlings was higher than Zebda seedlings especially when plant reached 2 or 3 months. Moreover, the highest value was obtained by sowing seeds on side with concavity directed downwards (28.0, 27.0cm), (33.0,31.5cm) in both seasons for Zebda and Ewais respectively comparing with the horizontal one.It is clear in both seasons and for the two mango cvs. that, there was a gradual increase in plant height during growing season from 30 days until 90 days (33.0, 30.0 cm), (42.0,42.0cm) for Zebda and Ewais respectively, however, sowing seeds of Ewais cv. on side with concavity directed downwards gave highest plant height.

As for the number of leaves per plant it showed a similar trend achieved as a plant height but Zebda cv. showed a slight increase than Ewais cvs., this is true for the two seasons when the planted seeds with concavity side was superior than planting them with horizontal position, and there was a gradually increase in the number of leaves/ plant through the growing season for the two seasons The results are contrary with Rao *et. al.*, (1957), Ibikunle and Komolafe (1973) and Adams (1975) on cashew who mentioned that, the seeds should be sown shallow with the concave side up or on one side, but not with the convex side up.

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**Table 4**

**Table 5**

### **Studied on sexual and asexual propagation on some mango cultivars**

It can be concluded that, the beneficial effect of seed sowing on side with concavity downwards to keep them in a warm and watering soil

#### **1-3- Effect of seed coat removal.**

Table (6) indicates the difference between sowing mango seeds with their intact coat or without. Regarding the different between the two cvs. for germination percentage, it is clear that, Zebda cv. achieved higher percentage than Ewais one either sown intact or without coat. From data it is obvious that, decoated seeds germinate earlier than the intact ones by one week for Zebda cv. and two weeks for Ewais . Moreover, the percentage of germination was increased gradually from the 4 weeks after sowing and reached the maximum at 8 weeks for the two cvs. in the two seasons. Generally it is clear from data that, sowing decoated seeds of Zebda gave higher germination percentage than sowing them intact coat.

This is true for the two mango cvs. through all periods of germination. The results are in harmony with the findings of Abdel Galil (1992), Padma *et. al.*, (1996) and Padma and Reddy (1997)who revealed that, when the seeds coat and testa removed before sowing mango seeds started germination after 10 days and the final germination was 78.57%.

Table (7) showed the different of height and number of leaves per seedling for the two types of seeds for the two mango cvs. it is obvious from data that, Ewais cv. was superior in the height (26.2 and 28.2cm) than Zebda plants (18.7 and 16.9 cm) for seasons 2006 and 2007, respectively. Also it is clear from data that, removal seed coat had induced highly tallest seedling than the intact one for Zebda and Ewais cvs. through the third months of growing season. Moreover, sowing decoated seeds of Ewais led to highest plants.

Concerning the number of leaves per plant it showed the same trend of plant height. It is obvious in the two seasons that, Ewais cv. gained higher number of leaves/plant than Zebda one, while this number was increased by sowing seeds with removed coat at 30 or 60 and 90 days from sowing. It was noticed that, sowing decated seeds of Ewais gained higher number of leaves/plant

#### **1-4- Sowing media.**

Table (8) indicate the difference in germination percentage for the two cvs when planted in two types of media ( sandy only or mixed with clay (2:1 v/v). it is showed that, Zebda cv. gave the highest germination percentage after 90 days from sowing seeds (80 and 77%) comparing with (48.0 and 70.0%) for Ewais cv. in the two seasons of the study, respectively. Data in the table indicate that, seeds planted in sandy soil produced significantly higher germination percentage during the period of growing season. It is clear that; planted of Zebda cv. seeds in sandy soil gave the highest germination percentage

**Table 6**

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**Table 7**

**Table 8**



### **Studied on sexual and asexual propagation on some mango cultivars**

The vegetative growth of seedlings derived from sowing in different types of media was shown in table (9). It is noticed that, Ewais seedlings height was higher than Zebda seedlings. From the table it is clear that, the height of two mango cvs. plants germinated in sandy soil was tallest than seedlings grown in the mixture of sandy and clay soil. This is true through all periods of growing, and for the two seasons of study. Results showed that, sowing Ewais seeds in sandy soil gave tallest seedlings.

Concerning the number of leaves per plant it is clear that, plants Zebda cv. had higher number of leaves than Ewais one, while, plants of Zebda and Ewais cvs. were higher when seeds were sown in sandy soil against plants in the other mixture. This is true in the first and second seasons of study. These results are in agreement with the findings of Pertuit and Mazur (1981) who found that, different soil had varied greatly in rooting success and growth of newly established plants. Nasir *et.al.*, (1990) on citrus rootstock showed that, sowing seeds in mixture of loam and sand (2:1) had a significant beneficial effect on growth of all seedlings. Eddossa *et al.*, (2003) on Avocado seeds, found that different sowing media types significantly influenced plant height. On the other hand, Ebeed *et al.*, (2006) on casimiroa showed that, the shortest seedlings were obtained from seeds grown in (sand + clay) soil.

#### **1-5-Chemical analysis:**

Table (10) shows the effect of seed storage of two mango cvs. on total indoles, total phenols and total sugars. From the table it is clear that, all treatments increased indoles in seeds comparing with control and increasing the period of storage from 7 to 15 days (either storage at room temperature or at 5°C led to increase seed indole content that is clear for Zebda cv. on the contrary, Ewais cv. gave opposite results where the control treatment gave the higher value of indoles followed by soaking seeds in running water followed by storage at room temperature.

Concerning the total phenols, it is clear from data that, the untreated seeds had a higher content as compared with running water seed treatment which came next. Comparing the two types of storage it is noticed that, seed stratification (at 5°C) gave lower values than room temperature storage and also showed a gradual decrease when period of storage increased from 7 to 15 days either at room temperature or cold storage, and value seeds of Zebda cv. had higher than Ewais cv.

On the other hand, the total sugars were significantly increased gradually in storage treatments (at 5°C) than at room temperature and by increasing the period of storage from 7 to 15 days. This is similar of the two mango cvs. but the value of total sugars was higher for Zebda cv. than Ewais one.

**Table 9**

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**Table 10**

These findings are in line with the results previously obtained by El shall (1983), Said *et.al.*, (1993) and Sahin *et.al.*, (1994) on peach who demonstrated that, total indolic compounds and total soluble sugars were increased markedly as stratification period proceed while, total phenols were decreased.

## **2- Asexual propagation:**

### **2-1-Propagation by grafting scions of ( Langra) mango cv. on unnamed rootstocks.**

It is clear from table (11) that, all treatments of storage of Langra scions before grafting gave higher percentage of success than control when they grafted on mango seedlings either by any grafting method (Top or Side). Generally from data it noticed that, the storage of scions at room temperature gave higher percentage of success than scions storage at 5°C in all periods of the growing season and the highest percentage was obtained by storage for 3 days then decrease at 5 days then sharp decrease was occurred by storage at 10 days for the two types of storage. Moreover the scions failed to success when its stratification prolonged for 15 days. This is true for the two types of grafting and for the two seasons of study. On the other hand when comparing the two types of grafting it is obvious from data that, side grafting gave higher percentage of success at all periods of growing season.

Table (12) indicate the vegetative growth parameters of grafted mango seedlings as affected by the two types of grafting, it is shown from data that, the two types of storage of scions produced higher length for scions than control and the side grafting gave the highest scion length than seedlings which grafting by Top method.

Regarding the effect of period of storage, it noticed that, increasing this period from 3 or 5 days to 10 or 15 days gave longer height this is clear for those stored at room temperature or by storing them at 5°C. On the other hand, it obvious from data that, side grafting was superior to the Top method this is true for the two seasons 2006 and 2007.

Regarding to the number of leaves / seedling it took the same trend where the Side grafting gave the highest number comparing with Top grafting method, and it showed a gradual increase in this number by increasing the period of storage regardless the type of grafting and the stratificated scions at 5°C produced plant with more leaves than those stored at room temperature.

Dhakai and Hoda (1987), Phuse *et.al.*,(1995), Dod *et.al.*, (1996), Roy and Hoda,(1996) and Roy *et al.*, (1999) mentioned that, when scions of mango were kept at room temperature for 3, 5,7and10 days before grafting, graft takes percentage declined as storage time increased. Dhakai and Hoda (1986), Abhay *et.al.*, (1999) and Rajesh *et.al*; (1999) revealed that, the best growth and survival in scions which had been stored for 3 days before grafting.

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**Table 11**

**Table 12**

### Studied on sexual and asexual propagation on some mango cultivars

Side veneer and side grafting methods in mango gave the best growth than top grafting and approach grafting because the grafts completed its wound healing 1-2 month earlier than the other methods

#### **2-2 chemical Analysis:**

Table (13) indicates the effect of scions storage before grafting on total indoles, total phenols and total sugars percentage of scions. From data it is showed that, all periods of storage either at room temperature or cold storage gave marked increase. The stored scions and the stratificated scion gave higher figures than at room temperature storage it is also noticed that, a gradually increase in Indole value by increasing the period of storage. This is true for the two types of storage.

**Table (13): Effect of storage of Langra cv. scions before grafting on chemical content total indoles(mg/100g dry wt.),total phenols (g/100g)and total sugars% of scions (Calculated as an average of two seasons)**

Treatment	Total indole (mg/100g dry wt.)	Total phenol (g/100g)	Total sugar %
Control(without storage scion)	0.39	0.20	0.61
Storage scion at room temperature for:			
3d	0.42	0.230	0.63
5d.	0.54	0.200	1.06
7d.	0.65	0.150	1.50
10d	0.82	0.010	1.52
15d.	1.19	0.008	2.85
Storage scion at 5°C for:			
3d.	0.46	0.088	0.17
5d.	0.70	0.019	0.81
7d	1.06	0.011	1.74
10d	1.31	0.013	1.85
15d.	1.36	0.008	2.34
LSD at 5%	0.0339	0.02567	0.06135

Regarding the total sugars contents, data indicated that, a gradual increase in this value was shown by increasing the period of storage for any type of storage and this value was higher in scions stored at room temperature until 5 days whereas it showed opposite trend when the cold stratification done for 7,10 or15 days

As for the total phenols content, data indicated that, a gradually decrease was shown by increasing the period of storage for the two types of storage and the sharp decrease was happened by the storage for 2 weeks. On the other hand, it is noticed also that, the cold storage gave highest value of

scions success in all periods of storage except the last period (15days) comparing with the ordinary storage (at room temperature). El shall (1983), Said *et. al.*, (1993) and Sahin *et. al.*, (1994) on peach demonstrated that, total indolic compounds and total soluble sugar were increased markedly as stratification period proceed while, total phenols were decreased. It can be conclude that, soaking mango cvs. seeds in running water for 3 days before sowing and planting them with concavity side after seed coat removal in sandy soil gave earlier germination and highest germination percentage. Moreover, storage of scions before grafting for 3 days at room temperature with side grafting method gave the highest percentage of success and higher shoots growth.

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## دراسات على الاكثار الجنسي والخضري في بعض أصناف المانجو

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### الملخص العربي

أجريت هذه التجارب بمعهد بحوث البساتين بالجيزه- مركز البحوث الزراعيه داخل صوبه بلاستيك خلال موسمين متتاليين ٢٠٠٦-٢٠٠٧ على بذور صنفين من المانجو ( زبده و عويس) بهدف أنتاج شتلات ذات صفات جيده صالحه للتطعيم فى أقصر فتره ممكنه باستخدام معاملات للبذور و بيئات للزراعه

وقد أوضحت النتائج المتحصل عليها أن المعامله بنقع البذور فى الماء الجارى لمده ٣ أيام أعطت أعلى نسبة مئوية للانبات وأعلى قيم لنمو الشتلات يليها المعامله بتخزين البذور لمده ٣ أيام فى درجه حراره الغرفه.

كما وجد أن زراعه البذورجانبيا" مع أتجاه الجانب المقعر لأسفل أعطى أعلى نسبة مئوية للانبات فى أقصرفتره ممكنه. كما أن نزع غطاء البذور قبل زراعتها أدى الى التبيكر وزيادة النسبه المئويه للانبات كما أن الزراعه فىالرمل كبيئه زراعه أعطى أعلى نسبة مئوية للانبات كما وجد أن تخزين الاقلام قبل التطعيم لمده ٣ أيام فى درجه حراره الغرفه أعطى أعلى نسبة فى نجاح التطعيم

كما وجد أن التطعيم الجانبي للاقلام أعطى أعلى نسبة لنجاح التطعيم وأكثر طول للنموات الناتجه على الاقلام.