Effect of Seed Husk, GA_3, KNO_3 and Seed Orientation in Seedbed on Germination Characters of White Succary Mango Seeds

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Abstract: This experiment was conducted in two successive seasons (2012/13 & 2013/14). Under the condition of plastic house covered with seran. The objective was to study the effect of seed husk, GA_3, KNO_3 and seed orientation in seedbed on germination percentage and subsequent seedling growth of White Succary rootstock. From this study, the highest germination percentage and germination velocity of mango seeds and standard seedling growth could be achieved through husking seeds or sowing seed in position of vertical with the convex edge upwards after soaking in tap water (48h) or through soaking seeds in GA_3 at 1000 *ppm* for 48h.Moreover, there was a remarkable effect of husking, GA_3 and KNO_3 in increasing growth of the obtained seedlings in terms of stem length and leaf number as well as the fresh and dry weights of roots.

Keywords: *Mangifera indica,* seed husking, seed orientation, soaking, GA_3, KNO_3

INTRODUCTION

In Egypt, mango (*Mangifera indica* L.) is considered one of the most important fruit crops. Mango orchards are located mainly in the Governorate of Ismailia (100832 fed.), it occupies about 41% of the total mango area (Egyptian Ministry of Agric., 2013); about third of this area is cultivated by local seedling trees. Seed germination is a critical step in the nursery producers. Nevertheless, many problems encounter the process of producing mango rootstock seedlings. Such problems are slow seed germination in addition to the long period between the first and last seeds to germinate. In this respect, Abd El-Galil (1992&2002), Abd El-Zaher (2004) and Hamed (2009) found that the removal of seed coat gave faster and higher germination percentage than that of coated seed. However, this treatment required a high skill to be not damage the kernel of such seed and planted it within a short time. Thus, it is difficult to be used such treatment on a large scale for producing mango rootstocks.

On the other hand, many investigators (Mehanna and Mohammed, 1989; Bayerly, 2000) reported that soaking seeds improved seed germination for citrus rootstock.

However, studies on the effect of GA_3, KNO_3 and seed orientation on germination characters of mango seeds are very scarce.

For these reason, we need a suitable methods for obtaining maximum germination and rapid growth to produce a large number of healthy, sizable mango seedling and transplanting in shorter possible time.

The present work was conducted to study the effect of some treatments on seed of White Succary mango rootstock seeds to accelerate and increase seed germination and subsequent seedling growth. Also, to find easy method to produce sizeable mango rootstocks for a large-scale within a short period.

MATERIALS AND METHODS

The present work was performed during the two successive seasons of 2012/13 and 2013/14 under the condition of plastic house covered with seran located in the nursery of Horticulture Department, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt. The work was divided into two experiments.

Ripe mango fruits of White Succary cv were picked in early August of both 2012 and 2013 seasons from trees cultivated in a private orchard at Ismailia Governorate. Freshly extracted seeds were washed with tap water. Healthy seed with an average weight ranged between (40 - 45gm) were selected.

Table (1): Treatments program.

Treatment number	Husking application	Soaking application(48h)	Seed orientation in seed bed
T1	Unhusked	Tap water	Horizontal with flat side
T2	Unhusked	GA_3 500 *ppm*	Horizontal with flat side
T3	Unhusked	GA_3 1000 *ppm*	Horizontal with flat side
T4	Unhusked	KNO_3 0.2%	Horizontal with flat side
T5	Unhusked	Tap water	Vertical with convex edge downwards
T6	Unhusked	Tap water	Vertical with convex edge upwards
T7	Husked	Without	Horizontal with flat side

The husks of the mango seeds (T7) were removed just before sowing and at the end of soaking period (T1 to T6). Then, the seeds were separately sowed at a depth of about 5cm in a black polyethylene bags (30 × 20 × 20cm) filled with mixture of clean (disinfection) sand, peat moss and vermiculite (1:2:1, v:v), respectively.

The treated seeds were sown on the 6th and 9th August of 2012 and 2013, respectively. The treatments were watered regularly and subjected to the same agricultural practices. After the emergence of the first seedling, the numbers of germinated seeds were counted periodically at three days intervals until seed germination ceased.

The following parameters were estimated during the considered seasons of investigation.

I. Effect of Treatments on Germination Characters:

1. Germination velocity was evaluated by calculating the percentage of sprouting seedlings after 30 days from sowing (El-Khoreioby and Abbas, 1988).
2. Germination percentage was evaluated by calculating the percentage of seedlings after 40 day from sowing (El-Khoreioby and Abbas, 1988). However, germination percentage at any of the aforementioned character was calculated by the following equation.

$$\text{Germination percentage } \% = \frac{\text{Number of germinated seeds}}{\text{Total number of sown seeds}} \times 100$$

3. Germinating time and duration:

The dates corresponding to the beginning and ceasing of germination for each treatment were recorded and estimated (in days) from sowing. The germinating duration was also estimated from beginning and ceasing of such parameter by days.

II. Effect of Seed-Treatments on Seedling Growth:

The following determinations were conducted on 6 seedlings (12 month old) per replicate selected randomly from each treatment.

1. Stem length and diameter/seedling (cm). (Stem diameter was measured at10cm above the soil surface using a Vernier caliper).
2. Number of leaves/seedling.
3. Average area of leaf blade/seedling at the median portion of the stem using a planimeter (cm^2).
4. Root length/seedling (cm).
5. Fresh and dry weight of the root/seedling (gm).

The experimental treatments were arranged in a completely randomized block design. The obtained data were statistically analyzed according to Sendecor and Cohran (1980). Means were compared by " Multiple Range Test" Duncan (1955) at 5% by using Co-Stat program version 6.303 1998-2004 Co-Hort. software 798 Lighthouse Ave PMP 320, Monterey, CA, 93940, US. Thus, the selected seeds were divided to seven treatments (60 seeds for each treatment) according to table1. Each treatment was divided into 3 replicates (20 seeds for each) and subjected to one of the following treatments.

RESULTS AND DISCUSSION

I- Effect of Seed-Treatment on Germination Characters:

Data of germination characters as shown in Table (2) indicated that all treatments of soaking unhusked mango seeds with GA_3 (500&1000 *ppm*) or KNO_3 (0.2%) for 48h significantly increased the percentage of seed germination and accelerated the germination than that of soaking with tap water for 48h (control). The soaking of unhusked seeds with GA_3 at 1000 *ppm* (T3) was better than that of both treatments of GA_3 at 500 *ppm* (T2) and KNO_3 at 0.2% (T4) but the differences were not significant.

Similar results were obtained by Mehanna and Mohamed (1989), Gupta (1992) and Ibrahim (2003) when soaking seeds of some citrus rootstocks in GA_3 at 500 & 1000 *ppm*. Also, Mello *et al*. (2009) working on seeds of *Pentemosa digitalis* treated with GA_3 at 1000 *ppm*.

Reports on these aspects with GA_3on mango seeds are very scarce. However, Ram (1997) stated that soaking mango seeds in GA_3 for 24- 48h led to hasten germination.

Also, the data reported here with KNO_3 are in harmony with those obtained by Leonel and Rodrigues (1995) on Rangpur lime seeds, Padma and Reddy (1998) on mango kernels and El-Boowab (2002) on seeds of sour orange rootstocks.

The stimulating effect of GA_3 and KNO_3 on germination characters may be due to greater permeability of such chemicals from the seed- coat and inducing acceleration of the internal physiological changes of kernel constituents. It is worth to mention that Filner and Varner (1967) with barley seeds, stated that treating seeds with GA_3 enhanced the activity of hydrolytic enzymes, rapidly break down the cell wall of endosperm and subsequently hydrolysis starches and proteins along with liberating the nutrients and energy needed for embryo development. Further, Mayer and Poljakoff–Mayme (1975) reported that the changes induced by GA_3 during seed germination were accompanied by stimulation of protein synthesis and mRNA of the embryo.

In regard to seed orientation in seed bed, it was found that treatment of soaking unhusked seeds in tap water (48h) and sown with convex edge upward (T2) markedly increased the percentage of germination and velocity than that of soaking unhusked seeds in tap water (48h) either sown with convex edge downward (T5) or with flat side (control, T1).

Thus, planting mango seeds in vertical position with convex edge upward was superior to that of both vertical position with convex edge downward and the horizontal position with flat side. These finding may be due to the straight growth of seedling without any curvature when planted seed on convex edge upward but curvature is done when planted on the convex edge downward in horizontal position.

The obtained result came in line with the finding of Abbas (1999) who found that sowing mango seeds with convex edge upward gave the best results of germination characters.

Concerning the effect of husking seed, the percentage of velocity and germination were significantly increased in comparison with that of unhusked seeds for other treatments under study.

The hard husk may be responsible for delayed emergency of the seedling by restricting the movement of gases (oxygen and CO_2) and water to the embryos. Thus, the preferable effect of removing the hard husk of mango seeds just before sowing might be attributed to the supply of oxygen and moisture to the embryos in order to help the seedling to emerge. This finding is in parallel with Abd El-Galil (1992 & 2002), Abd El-Zaher (2004) and Hamed (2009) who pointed that husked-seed resulted in the highest germination characters.

According to Table (3), soaking with chemical treatments (GA_3& KNO_3) led to advance the beginning of germination (2-4 days), ending of germination (9 - 14 days) and reduced the period of germination (18- 23 days) than that of soaking with tap water (31- 32 days) (control) in the two seasons, respectively.

Mehanna and Mohamed (1989), Salem *et al.* (1989) and Leonel and Rodrigues (1995) worked on citrus seeds and Ram (1997), Padma and Reddy (1998) on mango seeds and obtained similar results.

The less number of days taken by seed treatment with former chemicals might be due to altered physiological condition of the embryo. It may be also due to liberation of enzymes, thus rapidly increasing in the production of soluble nutrients. In this respect, Hartmann *et al*. (1990) reported that gibberellins comprise the class of hormones most directly implicated in the control and promotion of seed germination.

It is clear also from data in Table (3), there was a significant differences only between husked and unhusked seeds while, there were no significant differences between treatments for all unhusked seeds in the second season.

The seed orientation especially in unhusked treatments (T6) in the first season significantly earliness beginning and ending germination comparing to (T5) but in the second season this earliness was not significant between those two treatments. The obtained result came in line with finding of Abbas (1999) on mango seeds.

The treatment of husked seeds was most effective in earliness beginning, ending and shorting period of germination than those of other treatments under study. This result was in accordance with the findings of Padma and Reddy (1998), Abbas (2000), Abd El-Zaher (2004) and Hamed (2009) on mango seeds.

II. Effect of Seed-Treatment on Seedling Growth.

From Tables (2, 3, 4 and 5) a parallel trend could be noticed between increased germination velocity and efficacy of seedling growth (stem length and diameter, number of leaves/seedling, average area per leaf blade, root length and both fresh and dry weights of root) as affected by seed-treatment under studied.

Stem length and diameter (Table 4) were significantly increased by the treatment of husked seeds and markedly higher by the treatment of unhusked seeds and planted with convex edge upward than those of other treatments in the second season while the differences were significant in the first season only with the control and husked seeds for stem length but it was not significant with the rest treatments. Thus, both previous treatments were superior in this respect.

The favorable effect of husked seeds on stem length and diameter was parallel with those results of Abd El-Zaher (2004) and Hamed (2009) who reported higher growth of mango rootstocks when seeds were subjected to husked coat.

As shown in Table (4), both treatments of husked seeds with flat side and unhusked seeds soaked in tap water and planted with convex edge upward were more effective in enhancing number of leaves/seedling and leaf area in the first season and no significant increases in the second season, same treatments increased both plant fresh and dry weights than those of other treatments and control but the differences were not significant. However, the other treatments were markedly higher than the control in this respect in the two seasons study.

The enhancement in number of leaves/seedling, leaf area and both plant fresh and dry weights with the previous treatments (husked seeds with flat side and unhusked seeds soaked in tap water and planted with convex edge upward) could be attributed to their effect on the increase root length as well as plant length. In this respect, Russell (1982) stated that roots are considered the anchor of the plant in the soil and absorb water and nutrients, which their growth is interdependent. In addition, Went (1962) postulated that influence of the roots on shoot elongation is not only due to the known function of the root system such as water and salt uptake but also they supplied one or more hormonical factor required for stem growth. Also, Roa and Reddy (2005) recorded that the number of leaves per seedling and leaf area was correlated positively with plant length.

The favorable effect of such seed treatment (husked seeds with flat side and unhusked seeds soaked in tap water and planted with convex edge upward) in seedling growth was parallel with those results of Choudhari and Chakrawar (1981 & 1982), Ibrahim (2003) and Mohamed *et al*. (2010) on seeds of citrus rootstocks and Abd-El-Zaher (2004) and Hamed (2009) on mango seeds.

From Table (5) it is clear that the effect of soaking with two chemical treatments (GA_3 & KNO_3) and both treatments of convex edge with up and down wards and husked treatments on root length and both fresh and dry weights of root were not significant in comparison with that of the control in the two seasons. The high root volume is apt to have sufficient absorb water and nutrient to foliar surface and a considerable photosynthetic capacity to support a high seedling growth. Herein, husked seeds with flat side and unhusked seeds with convex edge upward were more effective than other treatments under study.

Similar results were obtained by Ibrahim (2003) who worked on seeds of citrus rootstocks emphasized the effect of GA_3& KNO_3 on increasing root length. Also, Abd El-Zaher (2004) who worked on husked seeds coincided the present results.

From the aforementioned discussion, it is clear that there are three superior treatments each of which significantly increased germination characters and seedlings growth more than the control. Two treatments were unhusked seeds + soaking $GA_3$1000*ppm* (48h) + horizontally with flat side and unhusked seeds + soaking tap water (48h) + vertically with convex edge upward, while the third treatment was husked seeds + horizontally with flat side. Each of these treatments increased (the average of two seasons) by about 114, 60 and 180% for germination percentage and 51, 70 and 123% for stem length, respectively.

Accordingly, the treatment of husked seeds seems to have superior effect on germination and growth.

Therefore, the two previous treatments [unhusked seeds + GA_3 (1000 *ppm*, 48h) + horizontally, flat side and unhusked seeds + tap water (48h) + vertically, convex edge upward] are undoubtedly more useful, faster and economic than that of the husked seeds.

Table (2): Effect of seed husk, GA_3, KNO_3 and seed orientation in seed bed on germination characters of White Succary mango seeds in 2012/13 and 2013/14 seasons.

Treatments	Germination velocity (%) (at 30-day)		Germination percentage (%) (at 40-day)	
	2012/13	2013/14	2012/13	2013/14
T1- Unhusked + tap water (48h) + flat side (control)	15.00 d	22.22 d	28.33 d	36.11 d
T2- Unhusked + GA_3 500ppm (48h) + flat side	41.67 bc	47.22 b	51.67 b	69.44 bc
T3- Unhusked + GA_3 1000ppm (48h) + flat side	46.67 b	47.22 b	60.00 b	77.77 b
T4- Unhusked + KNO_3 0.2% (48h) + flat side	38.33 bc	44.44 bc	53.33 b	63.88 c
T5- Unhusked + tap water (48h) +convex edge downward	10.00 d	27.77 cd	26.67 d	44.44 d
T6- Unhusked + tap water (48h) +convex edge upward	25.00 cd	33.33 bcd	41.67 c	61.11 c
T 7- Husked + flat side	86.67 a	94.44 a	86.67 a	94.44 a

* Values followed by the same letter in each column are not statistically different (Duncan 5%).

Table (3): Effect of seed husk, GA_3, KNO_3 and seed orientation in seed bed on number of days required for germination of White Succary mango seeds in 2012/13 and 2013/14 seasons.

Treatments	No. of days required first germination		No. of days required final germination		Germinating duration (day)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
T1- Unhusked + tap water (48h) + flat side (control)	21 b	22 a	53 a	53 a	32 a	31 a
T2- Unhusked + GA_3 500ppm (48h) + flat side	17 c	21 a	44 c	40 cd	27 b	19 c
T3- Unhusked + GA_3 1000ppm (48h) + flat side	17 c	21 a	39 d	39 d	22 d	18 c
T4- Unhusked + KNO_3 0.2% (48h) + flat side	17 c	20 a	40 d	42 bcd	23 cd	22 b
T5- Unhusked + tap water (48h) +convex edge downward	24 a	22 a	50 b	45 b	26 b	23 b
T6- Unhusked + tap water (48h) +convex edge upward	19 c	21 a	44 c	44 bc	25 bc	23 b
T 7- Husked + flat side	13 d	15 b	28 e	27 e	15 e	12 d

* Values followed by the same letter in each column are not statistically different (Duncan 5%).

Table (4): Effect of seed husk, GA_3, KNO_3 and seed orientation in seedbed of White Succary mango seeds on seedling measurements (stem & leaves) at age of 12-month- in 2012/13 and 2013/14 seasons.

Treatments	Stem length (cm)		Stem diameter (cm)		Number of leaves/seedling		Average area of leaf blade (cm²)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
T1- Unhusked + tap water (48h) + flat side (control)	31.61 c	28.67 e	0.40 d	0.47 f	14.33 c	11.67 d	43.48 b	53.65 bc
T2- Unhusked + GA_3 500ppm (48h) + flat side	40.47 bc	40.30 d	0.54 c	0.56 c	19.00 c	21.00 bc	49.52 b	46.09 c
T3- Unhusked + GA_3 1000ppm (48h) + flat side	42.10 bc	48.76 c	0.54 cd	0.48 cde	15.67 c	17.67 bcd	56.37 b	48.38 c
T4- Unhusked + KNO_3 0.2% (48h) + flat side	39.99 bc	41.80 d	0.58 c	0.51 cd	14.67 c	15.67 cd	49.87 b	52.23 bc
T5- Unhusked + tap water (48h) +convex edge downward	42.86 bc	42.63 d	0.51 cd	0.41 ef	14.67 c	12.67 d	59.20 b	55.38 bc
T6- Unhusked + tap water (48h)+convex edge upward	48.72 b	53.25 b	0.72 b	0.71 b	25.00 b	22.67 ab	90.00 a	89.87 b
T 7- Husked + flat side	65.42 a	69.02 a	0.93 a	0.91 a	34.17 a	28.80 a	100.35 a	101.56 a

* Values followed by the same letter in each column are not statistically different (Duncan5%).

Table (5) : Effect of seed husk, GA_3, KNO_3 and seed orientation in seed bed of White Succary mango seeds on root measurements/seedling (length and fresh & dry weights) in 2012/13 and 2013/14 seasons.

Treatments	Root length (cm)		Fresh weight of root/seedling (g)		Dry weight of root/seedling (g)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
T1- Unhusked + tap water (48h) + flat side (control)	21.53 c	17.00 b	12.47 b	12.87 bc	7.2 c	7.48 b
T2- Unhusked + GA3 500ppm (48h) + flat side	26.60 bc	22.47 ab	13.9 b	16.46 abc	8.49 bc	10.19 b
T3- Unhusked + GA3 1000ppm (48h) + flat side	24.87 bc	25.20 a	15.86 b	14.67 bc	8.88 bc	9.37 b
T4- Unhusked + KNO3 0.2% (48h) + flat side	22.60 c	23.33 a	13.53 b	13.53 bc	8.17 bc	8.58 b
T5- Unhusked + tap water (48h) +convex edge downward	26.60 bc	26.33 a	12.4 b	9.67 c	7.91 bc	7.97 b
T6- Unhusked + tap water (48h) +convex edge upward	29.13 ab	26.60 a	15.93 b	20.4 ab	9.66 b	10.51 b
T 7- Husked + flat side	32.40 a	28.07 a	21.8 a	23.23 a	12.13 a	17.26 a

* Values followed by the same letter in each column are not statistically different (Duncan5%).

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دراسات علي إكثار بعض أصول المانجو

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أجريت هذه التجربة في موسمين متتاليين (٢٠١٣/٢٠١٢ و٢٠١٤/٢٠١٣) تحت ظروف الصوبة البلاستيك المغطاة بالثيران، وتهدف هذه الدراسة إلى تقييم تأثير قشرة البذرة، النقع في كل من الجبرالين ونترات البوتاسيوم ووضع البذرة لصنف المانجو السكري الأبيض عند الزراعة على نسبة الإنبات ونمو شتلات الأصول الناتجة. من خلال هذه الدراسة أمكن التوصل إلى أعلى نسبة وسرعة إنبات لبذور المانجو وكذلك النمو المثالي للشتلات عن طرق تقشير البذور أو زراعتها عموديا بحيث يكون السطح المحدب لأعلى بعد نقعها في الماء لمدة ٤٨ساعة أو عن طريق نقعها في الجبرالين بتركيز ١٠٠٠ جزء في المليون لمدة ٤٨ ساعة، كما أن هناك تأثير واضح للتقشير والنقع في كل من الجبرالين ونترات البوتاسيوم على زيادة نمو الشتلات الناتجة بالإضافة لطول الساق وعدد الأوراق والوزن الطازج والجاف للجذور.