Jojoba Propagation by Leafy Semi Hardwood Stem Cuttings

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Abstract: The present study was carried out on twelve years old jojoba [Simmondsia chinensis, (Link) Schneider] shrub during two consecutive experimental 2010 & 2011 seasons. Due to propagation of jojoba shrubs by seed, extreme genetic variation was detected. Herein the effect of three factors namely wounding, date of collecting cuttings and dipping in chemical treatments were investigated on cutting’s success percentage. Wounded cuttings recorded significantly higher success percentage than that of unwounded cuttings. Success percentage at the end of July date was significantly the highest. Indole butyric acid (3000 ppm) + Naphthalene acetic acid (500 ppm) treatment recorded the highest success percentage and didn't significantly differ from IBA (3000 ppm) + NAA (500 ppm) + vitamin C (1000 ppm) treatment. Success percentage at the end of July with wounded cuttings significantly gave the highest significant values. The best results were recorded by unwounded cuttings of IBA (3000 ppm) with NAA (500 ppm) treatment, wounded cuttings of IBA (3000 ppm) with NAA (500 ppm) plus vitamin C (1000 ppm) treatment and IBA (5000 ppm) + NAA (500 ppm) + boric acid (0.5 ppm) treatment with insignificant difference. The highest success percentage was recorded by using IBA (3000 ppm) plus NAA (500 ppm) treatment and with the addition of vitamin C (1000 ppm) with insignificant difference at the end of July date. Wounded cuttings of IBA (3000 ppm) with NAA (500 ppm) plus C (1000 ppm) and NAA (2000 ppm) treatments and unwounded cuttings of IBA (3000 ppm) + NAA (500 ppm) treatment at the end of July recorded the highest success percentage with insignificant difference between them.

Key words: Jojoba • Simmondsia chinensis • Propagation • Cuttings • Wounding • IBA • NAA • Vitamin C • Boric acid

INTRODUCTION

Jojoba [Simmondsia chinensis, (Link) Schneider], the only member of family Simmondsiaceae is an oil-yielding shrub native to the Sonora desert of northern Mexico and south western USA. Jojoba plants have an exceptionally deep tap root system which helps to survive in drought conditions. Hence, it could be a prime plant species for introduction for arid land cultivation [1]. Its importance due to its saturated seed oil waxes is well recognized for its utilization in cosmetics, lubricants and pharmaceuticals etc. [2]. Plantations are established by using seeds, seedlings, rooted cuttings, or plantlets produced from tissue culture. Being dioecious, the male plants outnumber the females when raised from seeds so it's important to plant sexually- known clones. Several asexual methods of propagation have been used to propagate jojoba, these include air-layering, grafting, stem cuttings and tissue culture [3-6]. Each of these asexual methods shares the major advantage over seed propagation in that these allow propagation of unique and desirable genotypes which will allow uniform, predictable plant growth and yield [1]. Also have shorter juvenile period than those grown from the seed [2]. This study was investigated to examine the probability of propagating jojoba shrub at Ali Mobarak Research Station (El-Behera Governorate) by leafy semi hardwood stem cuttings.

MATERIALS AND METHODS

The study was conducted during two successive seasons 2010 and 2011. Shoots were collected from a sexually propagated 12 years old healthy mother plant grown at Ali Mobarak Research Station at South of El-Tahrer (El-Behera Governorate) and were transported to Horticulture Research Institute greenhouse at Giza.
Governorate, Egypt in insulated boxes and kept under mist till the next morning whereas, a basal straight cut was done just below a node at the desired length (10-12 cm), beside 2-3 leaves were left per every semi hardwood stem cutting after omitting the terminal soft part of the shoot.

The Three Investigated Factors in this Experiment Were as Follows

Wounding: Wounded cuttings (a single edged razor was used to slice away a segment of bark on both sides of the base of the cutting of about 1.5 cm) were compared to unwounded ones.

Date of Collecting Cuttings: Three dates were chosen at the end of April (spring), at the end of July (summer) and at the end of October (autumn) for collecting cuttings [7].

Chemical Treatments: The basal ends of the cuttings were dipped in the following thirteen treatments with the addition of 0.5% Rizolex-T50%WP fungicide for 10 seconds:

- Tap water (control).
- Potassium salt of indole butyric acid (K-IBA) 3000 ppm with naphthalene acetic acid (NAA) 500 ppm.
- K-IBA 3000 ppm with NAA 500 ppm plus vitamin C [Ascorbic acid] (C) 1000 ppm.
- K-IBA 3000 ppm with NAA 500 ppm plus boric acid (B) 0.5 ppm.
- K-IBA 5000 ppm with NAA 500 ppm.
- K-IBA 5000 ppm with NAA 500 ppm plus C 1000 ppm.
- K-IBA 5000 ppm with NAA 500 ppm plus B 0.5 ppm.
- K-IBA 7000 ppm with NAA 500 ppm.
- K-IBA 7000 ppm with NAA 500 ppm plus C 1000 ppm.
- K-IBA 7000 ppm with NAA 500 ppm plus B 0.5 ppm.
- NAA 1500 ppm.
- NAA 2000 ppm.
- NAA 2500 ppm.

IBA and NAA were reported to be of great importance for the rooting of jojoba cuttings according to Hammad [7] so the previously mentioned treatments was investigated.

After dipping in chemical treatments cutting were inserted to cover the basal two nodes in 1:1 v: v perlite: vermiculite media used to fill boxes which were placed under plastic tunnels in a shaded net plastic house [8].

The response to specific and interaction effects for three investigated factors were evaluated after 3 months of cuttings planting through determining the cutting success percentage (%).

Experimental Layout: The complete randomized block design with three replications was employed for arranging the variable 78 investigated treatments included in this experiment that representative of the differential combinations between the aforesaid three factors under study. Whereas, each replicate was represented by three cuttings.

The obtained data was statistically analyzed as a factorial experiment using MSTAT Computer Program according to MSTAT Development Team [9] and means were compared by Duncan's Multiple Range Test at 5% as described by Duncan [10] to verify differences among means of various treatments.

RESULTS AND DISCUSSIONS

Wounded cuttings were significantly higher in success percentage (19.60 – 24.88%) than that of not wounded cuttings (14.26 – 16.96%) in both seasons of study (Fig. 1). The same result was obtained by Sebastiani and Tognetti [11].

Success percentage at the end of July date was significantly the highest (32.66-40.68%) followed by the end of April date (13.61-14.81%) while, success percentage at the end of October was clearly the lowest didn't exceed 4.52-7.28% in both seasons of study (Fig. 2) These results are in line with Cao and Gao [12].

Regarding the effect of treatments, IBA (3000 ppm) + NAA (500 ppm) treatment recorded the highest success percentage (28.04 – 36.96%) and didn't significantly differ from IBA (3000 ppm) + NAA (500 ppm) + C (1000 ppm) treatment (24.79 – 31.96%) in both seasons (Fig. 3). The above results are in harmony with Hammad [7].

Concerning the effect of date of collecting cuttings and wounding as shown in Fig. 4, success percentage at the end of July with wounded cuttings significantly gave the highest significant values (47.74% and 39.73% in the 1st and 2nd season respectively). The obtained results didn’t agree with Hammad [7] who used wounded cuttings of jojoba and found that cutting of jojoba prepared on mid-May exhibited significantly the highest rooting percentage, this contradiction may be due to genotype, treatments and environmental conditions.

Dealing with the effect of wounding and treatments, best results treatments in both seasons of study was recorded by not wounded cuttings of IBA (3000) with
Fig. 1: The effect of wounding on success percentage of jojoba cuttings in 2010 and 2011 seasons.

Fig. 2: The effect of date of collecting cuttings on success percentage of jojoba cuttings in 2010 and 2011 seasons.

Fig. 3: The effect of treatments on success percentage of jojoba cuttings in 2010 and 2011 seasons.

NAA (500) treatment (26.08 – 41.75%), wounded cuttings of IBA (3000) with NAA (500) plus C (1000) treatment (27.83 – 37.84%) and IBA (5000) + NAA (500) + B (0.5) treatment (26.08 – 36.15%) with no significant difference (Table 1). Similar results were found by Hegazi [13].

Concerning the effect of date of collecting cuttings and treatments, in 2010 and 2011 seasons the highest success percentage was recorded by using IBA (3000 ppm) with NAA (500 ppm) treatment (54.73 - 72.36%) and with the addition of C (1000 ppm) treatment (50.87 - 72.36%) with no significant difference between them at the end of July date (Table 2). The previously mentioned results agree with the findings of Hegazi et al. [14].

Regarding the effect of wounding, date of collecting cuttings and treatments, the best results were obtained at the end of July date by wounded cuttings of IBA (3000 ppm)
## Table 1: The effect of wounding and treatments on success percentage of jojoba cuttings in 2010 and 2011 seasons

<table>
<thead>
<tr>
<th>Treatments</th>
<th>First season</th>
<th>Second season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wounded</td>
<td>Unwounded</td>
</tr>
<tr>
<td>Control</td>
<td>0.00 k</td>
<td>0.00 k</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)</td>
<td>32.16 b-d</td>
<td>41.75 a</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+C</td>
<td>37.84 ab</td>
<td>26.08 df</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+B</td>
<td>30.00 c-e</td>
<td>13.92 ij</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)</td>
<td>27.83 de</td>
<td>17.83 hi</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+C</td>
<td>19.59 f-i</td>
<td>17.83 hi</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+B</td>
<td>36.15 a-c</td>
<td>25.67 d-g</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)</td>
<td>0.00 k</td>
<td>23.51 e-h</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+C</td>
<td>32.05 b-d</td>
<td>26.08 ab</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+B</td>
<td>27.83 de</td>
<td>18.24 g-i</td>
</tr>
<tr>
<td>NAA(2)</td>
<td>18.24 g-i</td>
<td>0.00 k</td>
</tr>
<tr>
<td>NAA(3)</td>
<td>37.84 ab</td>
<td>0.00 k</td>
</tr>
<tr>
<td>NAA(4)</td>
<td>23.92 e-h</td>
<td>7.84 j</td>
</tr>
</tbody>
</table>

Means designated with the same letter within column, line, or interaction in each season is not significantly different at 0.05 level of probability, IBA (1): 3000 ppm, IBA(2): 5000 ppm, IBA(3): 7000 ppm, NAA(1): 500 ppm, NAA(2): 1500 ppm, NAA(3): 2000 ppm, NAA(4): 2500 ppm, C: Ascorbic acid 1000 ppm, B: Boric acid 0.5 ppm.

## Table 2: The effect of date of collecting cuttings and treatments on success percentage of jojoba cuttings in 2010 and 2011 seasons

<table>
<thead>
<tr>
<th>Treatments</th>
<th>First season</th>
<th>Second season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End of April</td>
<td>End of July</td>
</tr>
<tr>
<td>Control</td>
<td>0.00 i</td>
<td>0.00 i</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)</td>
<td>38.50 cd</td>
<td>72.36 a</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+C</td>
<td>11.75 gh</td>
<td>48.24 b</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+B</td>
<td>5.88 hi</td>
<td>38.50 cd</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)</td>
<td>30.00 de</td>
<td>38.50 cd</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+C</td>
<td>5.88 hi</td>
<td>38.50 cd</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+B</td>
<td>20.88 e-g</td>
<td>44.99 bc</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)</td>
<td>17.63 fg</td>
<td>17.63 fg</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+C</td>
<td>20.88 e-g</td>
<td>48.24 b</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+B</td>
<td>17.63 fg</td>
<td>51.49 b</td>
</tr>
<tr>
<td>NAA(2)</td>
<td>0.00 i</td>
<td>27.36 e</td>
</tr>
<tr>
<td>NAA(3)</td>
<td>0.00 i</td>
<td>45.00 bc</td>
</tr>
<tr>
<td>NAA(4)</td>
<td>23.51 ef</td>
<td>24.12 ef</td>
</tr>
</tbody>
</table>

Means designated with the same letter within column, line, or interaction in each season is not significantly different at 0.05 level of probability, IBA (1): 3000 ppm, IBA(2): 5000 ppm, IBA(3): 7000 ppm, NAA(1): 500 ppm, NAA(2): 1500 ppm, NAA(3): 2000 ppm, NAA(4): 2500 ppm, C: Ascorbic acid 1000 ppm, B: Boric acid 0.5 ppm.

## Table 3: The effect of wounding, date of collecting cuttings and treatments on success percentage of jojoba cuttings in 2010 and 2011 seasons

<table>
<thead>
<tr>
<th>Treatments</th>
<th>First season</th>
<th>Second season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End of April</td>
<td>End of July</td>
</tr>
<tr>
<td>Control</td>
<td>0.00 f</td>
<td>0.00 f</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)</td>
<td>41.75 bc</td>
<td>54.73 b</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+C</td>
<td>0.00 f</td>
<td>90.00 a</td>
</tr>
<tr>
<td>IBA(1)+NAA(1)+B</td>
<td>11.75 ef</td>
<td>54.73 b</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)</td>
<td>48.24 bc</td>
<td>35.26 cd</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+C</td>
<td>0.00 f</td>
<td>35.26 cd</td>
</tr>
<tr>
<td>IBA(2)+NAA(1)+B</td>
<td>0.00 f</td>
<td>54.73 b</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)</td>
<td>0.00 f</td>
<td>0.00 f</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+C</td>
<td>0.00 f</td>
<td>41.75 bc</td>
</tr>
<tr>
<td>IBA(3)+NAA(1)+B</td>
<td>0.00 f</td>
<td>41.75 bc</td>
</tr>
<tr>
<td>NAA(2)</td>
<td>0.00 f</td>
<td>0.00 f</td>
</tr>
<tr>
<td>NAA(3)</td>
<td>0.00 f</td>
<td>48.24 bc</td>
</tr>
<tr>
<td>NAA(4)</td>
<td>23.51 de</td>
<td>48.24 bc</td>
</tr>
</tbody>
</table>

Means designated with the same letter within column, line, or interaction in each season is not significantly different at 0.05 level of probability, IBA (1): 3000 ppm, IBA(2): 5000 ppm, IBA(3): 7000 ppm, NAA(1): 500 ppm, NAA(2): 1500 ppm, NAA(3): 2000 ppm, NAA(4): 2500 ppm, C: Ascorbic acid 1000 ppm, B: Boric acid 0.5 ppm.
with NAA (500 ppm) plus C (1000 ppm) treatment (60.00 – 90.00%), NAA (2000 ppm) treatment (48.24 - 90.00%) and not wounded cuttings of IBA (3000 ppm) + NAA (500 ppm) treatment (54.73 – 90.00%) with no significant difference between them (Table 3).

It can be concluded from the above results that wounded cuttings significantly surpassed not wounded ones, the end of July date was significantly the best, IBA (3000 ppm) + NAA (500 ppm) treatment was the best treatment, the end of July with wounded cuttings significantly gave the highest significant values, unwounded cuttings of IBA (3000 ppm) with NAA (500 ppm) treatment, wounded cuttings of IBA (3000 ppm) with NAA (500 ppm) plus vitamin C (1000 ppm) and IBA (5000 ppm) + NAA (500 ppm) + boric acid (0.5 ppm) treatments were the best, using IBA (3000 ppm) plus NAA (500 ppm) treatment and with the addition of vitamin C (1000 ppm) at the end of July date recorded the best results and wounded cuttings of IBA (3000 ppm) with NAA (500 ppm) plus C (1000 ppm), NAA (2000 ppm) treatments as well as unwounded cuttings of IBA (3000 ppm) + NAA (500 ppm) treatment at the end of July were the best in the respect of success percentage of jojoba shrub under study.

REFERENCES


