Propagation of white mulberry *Morus alba* L. fruitless cultivar using different cutting times and IBA.

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Abstract. The white mulberry *Morus alba* L. is an interesting tree that widely planted throughout the world for various uses. The effort was made in this study to propagate the fruitless cultivar of *Morus alba* L. by hardwood cuttings; comparing different cuttings collection time with using various concentrations of IBA (Indole-3-Butyric Acid) solution. Results showed that taking and planting cuttings on March 1st, gave the best survival percentage of rooted seedlings, which was (20.83%) compared to February 8th (16.33%) and March 22nd (12.5%). Cuttings treated with different concentrations of IBA significantly increased success percentage; 58.33, 66.67, 50.00 and 20.83% for 2000, 1500, 1000 and 0ppm respectively. Furthermore, the combination effect of previous factors had positive effects on studied characters; the highest values of success rate of rooting (66.67%) from cuttings taken on March 1st and immersed in 1500ppm of IBA solution (T7), while success rate of rooting (58.33%) and all other qualitative parameters of shoots height (70cm), vegetation fresh weight (74.9g), vegetation dry weight (24.06g), root length (41.17cm) roots fresh weight (5.26g), roots dry weights (1.5g), number of leaves per plant (32.33), and leaf area (84.32cm²) were obtained from cuttings taken on the same time but treated with 2000ppm. The results recommend taking cuttings on March 1st, and using 2000ppm of IBA directly before planting to enhance cuttings survival percentage and seedlings quality.

1. Introduction

Mulberry (*Morus* sp.) deciduous tree belong to the family Moraceae. It is perennial, fast growing fruit tree. There are approximately 68 to 100 mulberry species under the genus *Morus* in the world. The most common types are *Morus alba* and *Morus indica* [1].

Mulberry has been cultivated over thousands of years and has been adapted to a wide area of tropical, subtropical, and temperate zones of Asia, Europe, North and South America, and Africa [2; 3]. The most important use of mulberry leaf is rearing of the silk worms for silk production. It is also used for timber purpose such as making furniture, sports item as well as agricultural implements; and the bark is also used for making good quality paper [3].

Mulberry can be propagated by seeds or cuttings of softwood cuttings or hardwood cuttings. Alternatively, grafting or seeds may also be used for propagation these trees. Further cutting is
advantageous to get desired characters like maintenance of particular characters of the plant, speed in raising large number of saplings, adaptability to a particular habitat, resistance to pests and diseases and produce viable seeds. Different methods of vegetative propagation are depended in different countries according to the environmental conditions and soil nature [4].

[5] discovered that the seasonal timing, in which cuttings are taken, can play an important role in rooting. [6] compared the performance of mulberry (Morus alba L.) cuttings grown in open air with these grown under polyethylene low tunnel. Highest sprouting percentage, height of plants, and number of leaves were found in eight to six inch long cuttings, as well as parameters performed better in polyethylene tunnel as compared to open air. [7] studied the highest rooting percentage was determined from black mulberry in 2000 and 3000ppm IBA doses application (100%). Among all the treatments, numbers of sprouted cuttings, length of the roots, percentage of rooted cutting, lengths of longest sprouts of root were found higher in IBA 2000 mg.l-1 [8].

Mulberry is commercially propagated from hard wood cuttings because of distinct advantages like speedy multiplication of parent materials and maintenance of the desired characters of the plants. The time of preparation of cuttings in Mulberry greatly affected the extent and success of root formation, the optimum time of cuttings preparation and planting is related to the physiological condition of the plant and environmental conditions. Both, time of cutting collection and rooting success varies with the climatic condition and prevailing outdoor temperature. There are several factors that can affect the rooting potential of stem cuttings including species and specific cultivar needs; the source, position, and type of cutting taken; juvenility and condition of stock plant; wounding or leaf removal; stock plant wilting and girdling; cutting date. Also it is influenced by growing conditions such as media, mist, bottom heat, use of hormones, fertilizer, and supplemental lighting [9].

While stem cutting is the simplest and most economical method of vegetative propagation practiced for mass production within a short time [10], and it consider the only way to propagate this cultivar because of its fruitless characteristic. So, this study reports on the propagation of white mulberry Morus alba L. with cuttings to determine the best seasonal time for taking cuttings and the optimal IBA concentration, for successful root formation.

2. Materials and Methods

2.1 Preparing of cuttings and experiment site:
One year old cuttings of fruitless cultivar of White Mulberry Morus alba L. were obtained with the help of sterilized wood cutter from mature and healthy trees in the main campus gardens of University of Sulaimani. The testing filed was located at the nursery of the same campus, Sulaimani city, Iraq. Stem cuttings were between 18-20cm in length and 1-1.2cm in diameter, the top of cutting was slanted, which 1cm from top node and the lower part was perpendicular, which located exactly under the lower node. The cuttings were maintained and watered regularly under the natural shaded conditions of the nursery. Cuttings were planted in 15×25cm polyethylene bags, with river sand rooting medium.

2.2 Experimental design:
The cuttings were subjected to treatments which applied as a factorial experiment according to randomized complete block design (R.C.B.D.) in three replicates. Each treatment had 24 cuttings and a single stem cutting was planted per each pot. The applied experiment treatments were:

2.2.1 Cutting collection time: Stem cuttings were collected from mature trees on February 8th, March 1st and March 22nd 2018; intervals three weeks and planted at the same dates.
2.2.2 **IBA (Indole-3-Butyric Acid) concentration:** On February 8th, March 1st, and March 22nd 2018; sets of 24 cuttings were prepared. Thereafter, 1-2cm of the cuttings basal was quick dip into IBA solutions with various concentrations of 1000, 1500 and 2000ppm for 30seconds. Also in the same times, cuttings planted directly without dip in IBA solution.

Therefore; fruitless cultivar of white mulberry cuttings treatment combinations were twelve experiments as following table:

| Cutting collection and Planting Time | IBA Treatments   | Symbol |
|-------------------------------------|------------------|--------|
| February 8th                        | Control          | T1     |
|                                     | 1000ppm          | T2     |
|                                     | 1500ppm          | T3     |
|                                     | 2000ppm          | T4     |
| March 1st                           | Control          | T5     |
|                                     | 1000ppm          | T6     |
|                                     | 1500ppm          | T7     |
|                                     | 2000ppm          | T8     |
| March 22nd                          | Control          | T9     |
|                                     | 1000ppm          | T10    |
|                                     | 1500ppm          | T11    |
|                                     | 2000ppm          | T12    |

2.3. **Data collection:** At the early September 2018 three plants (cuttings) were selected randomly from each treatment to record all required data on quantity and quality parameters.

2.4 **Cuttings or plants quantity and quality parameters:**
- Survival percentage.
- Seedling height (cm).
- Vegetative fresh weight (g), weighted by digital balance directly after wash off any loose dust, then removing any free surface blot moisture.
- Vegetative dry weight (g), drying it at 105°C for 24 hours in the oven.
- Root length (cm).
- Root fresh weight (g), weighted by digital balance directly after the roots removed from the soil and wash off any loose soil, then removing any free surface blot moisture.
- Root dry weight (g), Drying the roots in an oven set to 100° C overnight.
- Number of Leaves per plant.
- Leaf area cm², measured by using software program application (Digimizer image analysis) (https://www.digimizer.com/); downloaded on the personal computer, and based on image analysis by determining the dark spot of the leaves images [11].

2.5 **Statistical analysis:**
The effects of the treatments on the measured parameters were evaluated by Analysis of Variance (ANOVA), significance difference was analyzed by Duncan’s multiple comparison tests (P ≤ 0.05). The whole data processing was completed via XLSTAT 2016 data analysis program for Windows software (https://www.xlstat.com) [12].
3. Results

3.1. Cuttings quantity parameter (Survival percentage):
At the end of the study, according to the values stated in the Figure 1, the cuttings of fruitless cultivar of white mulberry *Morus alba* L. which collected on March 1st influenced more than that collected on February 8th and March 22nd, survival percentage on February 8th (T1), March 1st (T5) and March 22nd (T9) was 16.33, 20.83 and 12.50 % respectively.

![Figure 1](image_url)

**Treatments**

**Figure 1.** Effect of cutting collection time on survival percentage of fruitless cultivar of white mulberry *Morus alba* L.

Based on statistical evaluation, the IBA concentration in the different collection time of the cuttings had important effects on the survival rates of white mulberry *Morus alba* L. cuttings. The data shown in Figure 2(a) indicated that the cuttings collected on February 8th and immersed in 1500ppm concentration of IBA for 30seconds; significantly increased to 50% as compared to control (16.67%), (33.33%) and (25%) for IBA 1000, 2000ppm respectively.

Also on March 1st Figure 2(b); results were 20.83, 50.00, 66.67 and 58.33% while on March 22nd Figure 2(c) were achieve 12.50, 20.83, 25.00 and 33.33% respectively for control, 1000, 1500 and 2000ppm of IBA.

![Figure 2](image_url)

**Figure 2.** Effect of IBA concentration and cutting collection time (a) February 8th, (b) March 1st and (c) March 22nd 2018; on survival percentage of fruitless cultivar of white mulberry *Morus alba* L.

Data was taken for white mulberry (Figure 3); average of cuttings survival percentages affected by combination of cutting collection time and IBA concentration ranged from 12.5 to 66.67%. The highest percentage occurred with interaction of cuttings collected on March 1st and quick dip into IBA solution with concentration 1500ppm (T7) and the lowest percentage obtained in cuttings collected on March 22nd control (T9).
Figure 3. Combination effect of cutting collection time and IBA concentration on survival percentage of fruitless cultivar of white mulberry Morus alba L.

3.2 Seedlings quality parameters:
While between collection times; differences in all other parameters were also significant, but values increased significantly in cutting collected on March 1st (T5) which were 27.67cm seedling height, 25.65g vegetative fresh weight, 10.20g vegetative dry weight, 15.17cm root length, 1.93g root fresh weight, 0.55g root dry weight, 12.33 leaves per plant and 31.90cm² leaf area.

The lowest value were 15.67cm seedling height for cuttings collected on March 22nd (T9), and 11.01g vegetative fresh weight, 4.28g vegetative dry weight, 8cm root length, 1.09g root fresh weight, root dry weight 0.29g and 16.18cm² leaf area, for cuttings collected on February 8th (T1), (Table 2).

Table 2. Effect of cutting collection time on studied seedling growth parameters of fruitless cultivar of white mulberry Morus alba L.

| Treatment | Seedling Height (cm) | Vegetative Fresh Weight(g) | Vegetative Dry Weight (g) | Root Length(cm) | Root Fresh Weight (g) | Root Dry Weight (g) | Leaves Number per plant | Leaf Area cm² |
|-----------|----------------------|-----------------------------|---------------------------|-----------------|----------------------|--------------------|------------------------|----------------|
| T1        | 19.17 b              | 11.01 b                     | 04.28 b                   | 08.00 b         | 01.09 b              | 0.29 b             | 07.00 b                | 16.18 b         |
| T5        | 27.67 a              | 25.65 a                     | 10.20 a                   | 15.17 a         | 01.93 a              | 0.55 a             | 12.33 a                | 31.90 a         |
| T9        | 15.67 c              | 14.43 b                     | 05.46 b                   | 08.00 b         | 01.51 b              | 0.43 a             | 06.00 b                | 28.18 a         |

* Columns values followed by the same letter did not differ significantly (P ≤ 0.05) according to Duncan’s multiple range tests.

It is clear from Table (3) that, in different collection time of cuttings, treatments of IBA concentration was affected significantly in a positive manner and increases all of vegetative and root growth parameters, which were differ according to the concentration of IBA solution as compared to controls. Which were on February 8th (Table 3a) the highest values were (T3); 36.67, 26.45, 8.75, 19.17, 1.85, 0.53, 15 and 25.39 for seedling height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g), leaves number per plant and leaf area cm² respectively, while the lowest value were 19.17, 11.01, 4.28, 8, 1.09, 0.29, 7 and 16.18 for control (T1).

On March 1st Table 3(b); the advanced value were 70, 74.90, 24.06, 41.17, 5.26, 1.50, 22.84 and 84.32 for (T8), as compared with control values (T5); were 27.67, 25.65, 10.20, 15.17, 1.93, 0.55, 12.33 and 31.90. While on March 22nd (Table 3c); greatest values for (T12) were 24.50, 27.41, 9.10, 14.67, 2.39, 0.68, 10.37 and 42.20, as compared to smallest values for (T11) values were 10.33, 7.73, 2.98, 6.50, 1.09,
0.32, 4 and 19.46 for each of seedling height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g), leaves number per plant and leaf area cm² respectively.

**Table 3.** Effect of IBA concentration on studied cuttings growth parameters of fruitless cultivar of white mulberry *Morus alba* L., (a) cuttings collected on February 8th, (b) on March 1st and (c) on March 22nd 2018.

| Treatment | Seedling Height (cm) | Vegetative Fresh Weight (g) | Vegetative Dry Weight (g) | Root Length (cm) | Root Fresh Weight (g) | Root Dry Weight (g) | Leaves Number per plant | Leaf Area cm² |
|-----------|----------------------|-----------------------------|---------------------------|------------------|-----------------------|---------------------|-------------------------|--------------|
| T1        | 19.17 c              | 11.01 c                     | 0.428 c                   | 08.00 c          | 01.09 c               | 0.29 c              | 07.00 c                 | 16.18 c      |
| T2        | 23.17 b              | 16.36 b                     | 11.15 b                   | 13.67 b          | 01.72 b               | 0.61 a              | 09.67 b                 | 38.51 a      |
| T3        | 36.67 a              | 26.45 a                     | 17.25 a                   | 19.17 a          | 01.85 ab              | 0.53 b              | 15.00 a                 | 25.39 b      |
| T4        | 25.83 b              | 17.69 b                     | 12.50 b                   | 15.17 b          | 02.39 a               | 0.68 a              | 11.33 ab                | 42.62 a      |
| T5        | 27.67 d              | 25.65 c                     | 10.20 c                   | 15.17 b          | 01.93 c               | 0.55 b              | 12.33 c                 | 31.90 c      |
| T6        | 42.67 c              | 37.18 b                     | 12.51 b                   | 20.00 b          | 02.90 bc              | 0.82 b              | 15.67 bc                | 49.21 b      |
| T7        | 55.83 b              | 41.99 b                     | 12.17 b                   | 35.50 a          | 03.91 b               | 1.12 ab             | 19.00 b                 | 58.17 b      |
| T8        | 70.00 a              | 74.90 a                     | 24.06 a                   | 41.17 a          | 05.26 a               | 1.50 a              | 22.84 a                 | 84.32 a      |
| T9        | 15.67 b              | 14.43 c                     | 05.47 b                   | 08.00 bc         | 01.51 bc              | 0.43 b              | 06.00 bc                | 28.18 b      |
| T10       | 18.50 b              | 20.24 b                     | 06.31 b                   | 10.00 b          | 02.10 ab              | 0.61 a              | 08.91 ab                | 40.86 a      |
| T11       | 10.33 c              | 07.73 d                     | 02.98 c                   | 06.50 c          | 01.09 c               | 0.32 c              | 04.00 c                 | 19.46 c      |
| T12       | 24.50 a              | 27.41 a                     | 09.10 a                   | 14.67 a          | 02.39 a               | 0.68 a              | 10.37 ab                | 42.2 a       |

* Columns values of (a), (b) and (c) individually followed by the same letter did not differ significantly (P ≤ 0.05) according to Duncan’s multiple range tests.

It is evident from data presented in Table (4) that the vegetative and root growth parameters of white mulberry; seedling height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g) number of leaves per plant and leaf area (cm²) affected by combination of cutting collection times with IBA rooting hormone concentrations. Results indicate that (T8) had superior values in all of the vegetative and root growth parameters of; seedling height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g), leaves number per plant and leaf area cm² were 70, 74.90, 24.06, 41.17, 5.26, 1.50, 22.84 and 84.32 respectively, as compared to all of other combination factors between cutting collection times and IBA solution concentrations.
Table (4)*: Effect of cutting collection time and IBA concentration on studied seedling growth parameters of fruitless cultivar of white mulberry *Morus alba* L.

| Treatment | Seedling Height (cm) | Vegetative Fresh Weight (g) | Vegetative Dry Weight (g) | Root Length (cm) | Root Fresh Weight (g) | Root Dry Weight (g) | Leaves Number per plant | Leaf Area cm² |
|-----------|----------------------|-----------------------------|--------------------------|------------------|----------------------|---------------------|------------------------|--------------|
| T1        | 19.17 e              | 11.01 f                     | 04.28 f                  | 08.00 e          | 01.09 d              | 0.29 c              | 07.00 d                | 16.18 e      |
| T2        | 23.17 d              | 16.36 de                    | 05.58 ef                 | 13.67 d          | 01.72 cd             | 0.61 b              | 09.67 c                | 38.51 c      |
| T3        | 36.67 c              | 26.45 c                     | 08.75 d                  | 19.17 c          | 01.85 c              | 0.53 b              | 15.00 b                | 25.39 d      |
| T4        | 25.83 d              | 17.69 b                     | 06.25 e                  | 15.17 a          | 02.39 bc             | 0.68 b              | 11.33 bc               | 42.62 c      |
| T5        | 27.67 d              | 25.65 c                     | 10.20 cd                 | 15.17 a          | 01.93 c              | 0.55 b              | 12.33 b                | 31.90 cd     |
| T6        | 42.67 c              | 37.18 b                     | 12.51 b                  | 20.00 c          | 02.90 b              | 0.82 b              | 15.67 b                | 49.21 b      |
| T7        | 55.83 b              | 41.99 b                     | 12.17 bc                 | 35.50 b          | 03.91 ab             | 1.12 a              | 19.00 a                | 58.17 b      |
| T8        | 70.00 a              | 74.90 a                     | 24.06 a                  | 41.17 a          | 05.26 a              | 1.50 a              | 22.84 a                | 84.32 a      |
| T9        | 15.67 e              | 14.43 e                     | 05.47 e                  | 08.00 bc         | 01.51 d              | 0.43 c              | 06.00 d                | 28.18 d      |
| T10       | 18.50 e              | 20.24 d                     | 06.31 e                  | 10.00 e          | 02.10 d              | 0.61 b              | 08.91 cd               | 40.86 c      |
| T11       | 10.33 f              | 07.73 f                     | 02.98 g                  | 06.50 e          | 01.09 d              | 0.32 c              | 04.00 b                | 19.46 e      |
| T12       | 24.50 d              | 27.41 c                     | 09.10 d                  | 14.67 d          | 02.39 b              | 0.68 b              | 10.38 c                | 42.20 c      |

* Columns values followed by the same letter did not differ significantly (P ≤ 0.05) according to Duncan’s multiple range tests.

4. Discussion

The stem cutting is influenced by several internal and external factors to success rooting formation [13]. As well, equally diverse exogenous factors can affect rooting parameters, for example; auxin applications can increase the rooting capacity of many plants [14; 15; 16; 17]. Therefore, auxin is widely used in propagation (generally IBA) [18].

The values stated in the Figure (1) display that the cuttings of White Mulberry *Morus alba* L. which collected on March 1st influenced more strongly the survival percentage 20.83%.

According to (Table 2) the differences between collection times in all other parameters were also significant, but values increased significantly in cutting collected on March 1st (T5) which were 27.67cm seedling height, 25.65g vegetative fresh weight, 10.20g vegetative dry weight, 15.17cm root length, 1.93g root fresh weight, 0.55g root dry weight, 12.33 leaves per plant and 31.90cm² leaf area. The lowest value were 15.67cm seedling height and 6 leaves per plant for cuttings collected on March 22nd (T9), while values were obtained 11.01g vegetative fresh weight, 4.28g vegetative dry weight, 8cm root length, 1.09g root fresh weight, 0.29g root dry weight and 16.18cm² leaf area from cuttings collected on February 8th (T1).

The results are agreed with that founded by [5] which discover that the seasonal timing of taken cuttings can play an important role in rooting. The best results reported by [19] that were reached with hard cuts, independent of the collection season or the environment of propagation.

The values in Figure (2) shown that the cuttings collected on February 8th Figure 2(a) and immersed in 1500ppm concentration of IBA for 30seconds; significantly increased to 50% as compared to control (16.67%), (33.33%) and (25%) for IBA 1000, 2000ppm respectively. Also on March 1st Figure 2(b); results were 20.83, 50.00, 66.67 and 58.33% while on March 22nd Figure 2(c) were achieve 12.5, 20.83 , 25.00 and 33.33% respectively for control, 1000, 1500 and 2000ppm of IBA.
Table (3) data are fluctuating between cutting collection times and IBA concentration. Results indicate that (T3) had superior values which on February 8th Table 3(a) 36.67, 26.45, 8.75, 19.17cm, 1.85, 0.53, 15 and 25.39 for cuttings height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g), leaves number per plant and leaf area cm$^2$ respectively. On March 1$^{st}$ Table 3(b); the advanced value were 70, 74.90, 24.06, 41.17, 5.26, 1.50, 22.84 and 84.32 for (T8).

While on March 22$^{nd}$ Table 3(c); greatest values for (T12) were 24.50, 27.41, 9.10, 14.67, 2.39, 0.68, 10.37 and 42.20 for cuttings height (cm), vegetative fresh weight (g), vegetative dry weight (g), root length (cm), root fresh weight (g), root dry weight (g), leaves number per plant and leaf area cm$^2$ respectively.

In figure (3); the average of seedling survival percentages ranged from 12.5 to 66.67%. The highest percentage occurred with interaction of cutting collection time on March 1$^{st}$ and IBA 1500ppm 66.67% (T7) and the lowest percentage obtained in 12.5% (T9).

These results are approved the notification of [20], that application of IBA in high concentration can prevent the stem cuttings, and agreed with [21], which they found that exogenous application of IBA had significant positive effect on the rooting and growth parameters of Tectona grandis cuttings.

[22; 23] denotes that the use of different hormonal concentrations of IBA induced significant differences in cuts rooting, because number of roots and root length indicate the cutting ability to assimilate nutrients, survive in the soil, have structural support, and develop buds to ensure the future CO$_2$ assimilation of the plant, these also indicate the acclimatization for future planting, which may increase survival efforts.

Rooting success of the various IBA concentrations was similar to the results of [24] and contrary to that reported by [19].

[25] reported that the process of adventitious root formation is influenced by a number of internal and external factors. Among the internal factors, the most important role is ascribed to phytohormones, especially the auxins. It is generally accepted that auxins have a certain role in the rooting initiation and therefore leads to control growth and development in plants, including lateral root initiation, root gravity response and other vegetative growth parameters such as seedling height (cm), vegetative fresh weight(g), vegetative dry weight (g), number of leaves per plant and leaf area (cm$^2$).

Many studies have shown that application of auxins results in increased initiation of lateral roots which its development is highly dependent on auxin transporting [26].

[27] explore that root lengths and ratings increased linearly with increasing hormone concentration, but mean class indicated that increasing the hormone level from 8000 to 10000ppm had no significant effect on root lengths.

[18] investigate that exogenous auxins play a major role in the fixing of rooting ability, whereas commercially most of the propagation is done by using IBA.

Result is in conformity with that obtained from the following studies which the effects of auxin group of hormones on rooting and plant development have been discussed.

[28] resolve the effectiveness of IAA and IBA in Malus pumila, Chukrasia velutina; [29] studied the action of IAA and IBA in Pisum sativum; [30] explore the effectiveness of IAA, IBA, and NAA in Malus. [31] investigate the influence of IBA in Prunus Africana; [32] studied the impact of IBA and NAA in both Robinia pseudoacacia and Grewia optiva.

[33] studied the effect of IBA in Holostemma ada-kodien; [26] researched the action of IAA, IBA, and NAA in Oryza sativa; [34] survey the impact of IAA and IBA in Rosa species; [35] examine the influence of IBA in Swietenia macrophylla [25] studied the effectiveness of IAA and IBA in Prunus spp. as well as IBA and NAA in Pseudotsuga menziesii at last [36] analyzed the effect of IAA and NAA in Centaurea tchihatchefii.
Finally, many of the treatments were results different survival percentage. While, a great deal of historical guidelines for propagation of woody plants by cutting on selection rooting hormone treatments, the environment factors such as the amount of light, type of the rooting medium and relative humidity should also be considered, which make a notable effects directly on rooting time and rooting percentage and so affect on the other seedlings parameters wholly.

5. Conclusion
The study found that cuttings of fruitless cultivar of white mulberry Morus alba L. should be collected on March 1st (early March) and immersed in 2000ppm concentration of IBA solution for 30seconds directly before planting; to propagate and obtaining special quality of seedling height (cm), root length (cm), number of leaves per plant and leaf area cm² and cuttings valuable quantity percentage.

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