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Article

Effect of treatment with IBA and NAA on vegetative propagation of white mulberry (*Morus alba* L.)

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Abstract

Due to the many advantages of this method, Mulberry is propagated commercially by stem cuttings, such as faster growth and the preservation of cultivar traits from parent plants. Consequently, this study used artificial growth regulators such as IBA and NAA to increase the rooting ability to increase rooting capacity and success rates. The study was conducted in the greenhouse with the mist irrigation system and the cuttings were treated with 7 concentrations of Growth regulators (Control, 500 ppm, 1000 ppm IBA, 500 ppm IBA, 2000 ppm, 3000 ppm NAA and 4000 ppm IBA and planted on the same day. The data were collected after 90 days of the cutting being planted. Results revealed that all cutting treated with growth regulators had a positive effect on the studied characters. The maximum values of all studied traits were recorded when the cuttings were treated at 1000 IBA and 3000 ppm NAA. But the cuttings untreated with Growth regulators recorded the lowest values on the studied characters in both seasons.

Keywords: Growth regulator, *Morus alba* L. Propagation, Root number

1. Introduction

Mulberry plants can be multiplied using seeds, cuttings from softwood or deciduous trees, or both. Such trees can also be propagated using seeds or grafts. Further cutting is useful to obtain desired characteristics, such as the preservation of certain plant characteristics, rapid growth of numerous saplings, habitat adaptation, pest and disease resistance, and the ability to produce viable seeds. In other nations, various vegetative propagation techniques depend on the local environment and soil type (Gilman and Watson, 1994).

To determine a mulberry genotype's rooting ability, stem cuttings are the fastest, simplest, and most affordable procedure compared to grafting, especially in tropical areas (Susheelamma et al., 1990 and 1992 and Sujathama and Dandin, 1998). Auxin plays an essential role in the formation of adventitious roots by increasing root primordia initiation and growth via cell division, as well as promoting the hydrolysis of starch and the mobilization of sugars and nutrients to the cutting base. Auxin also engages in several interactions with other phytohormones, in addition to acting through linear pathways. (Hoermayer, *et al*., 2020 and Li, *et al*.,2020)

According to research by Rafeeq *et al*. (2020), the best treatment for propagating Morus alba by cuttings was IBA at 100 ppm. Additionally, it was discovered that applying 100 ppm of IBA concentration produced the best results for maximizing Morus Alba's characteristics and could be used for extensive propagation in nurseries.

Because it is difficult to form roots from cuttings, which are used in this study to produce plants, we have to use different growth regulator concentrations and collection times to get the greatest percentage of plants.

2. Materials and Methods

This study was carried out for two consecutive years (2020–2021) in experimental research at the El Kawamil Faculty of Agriculture at Sohag University. To investigate the impact of IBA and NAA on the vegetative propagation in white mulberry. The cuttings of white mulberry were collected from 20-year-old trees. Choose one-year-old mature shoots to prepare cuttings with a long length of 25 cm and a diameter of 10-12 mm.

The rooting media, sand, perlite, and pettmus at a ratio of (1:1:1) in 15 x 25 cm polyethylene bags. The cuttings' basal ends were dipped in 500, 1000 ppm, and 1500 ppm of solutions of IBA and 2000, 3000, and 4000 ppm of solutions of NAA respectively, along with control. The cuttings' basal ends were quickly dipped in solutions for 10 seconds. Additionally, the greenhouse was maintained at a temperature of 25 to 28 °C with a relative humidity of 80 to 90 %.

Experimental Work:

This study involved seven concentrations of Growth regulators.

T1) Control

T2) 500 ppm IBA.

T3) 1000 ppm IBA.

T4) 1500 ppm IBA.

T5) 2000 ppm NAA.

T6) 3000 ppm NAA.

T7) 4000 ppm NAA.

Each treatment was replicated three times, each replicate contained 7 cuttings.

Preparation of NAA and IBA application

Each concentration of IBA and NAA was prepared by dissolving of required growth regulator in 50 ml each of 100°/o ethanol in a 1-liter volumetric flask and finally, the volume was made up to 1 liter with distilled water.

2.1. Experimental Design

A completely randomized block design. Three replicates with 21 cuttings in each treatment replicates 7 cuttings, and a total of 147 cuttings were tested. and a single stem cutting was planted per pot.

2.2. Various measurements

Sampling for data on rooting and leaves After 90 days, the cuttings were carefully removed from the rooting medium; and the rooting percentage, the number of primary r, and the length of primary roots (cm) were recorded for each treatment. The number of branches, length of branches (cm), the diameter of branches (mm), and the average number of branches were calculated at each cutting.

2.3. Statistical Analysis

All the obtained data were tabulated and statistically analyzed according to Mead *et al*. (1993) and averages of treatments were compared by using the new L.S.D. test at 5% (according to Steel and Torrie, 1984).

3. Results

3.1. Rooting percentage

From Figure 1, it was observed that the rooting percentage was known to be impacted by various IBA and NAA concentrations. White mulberry (M. alba) cuttings treated with 1000 IBA and 3000 NAA (100.0%) showed the highest value of rooting percentage. The untreated cutting had the lowest percentage of rooting.

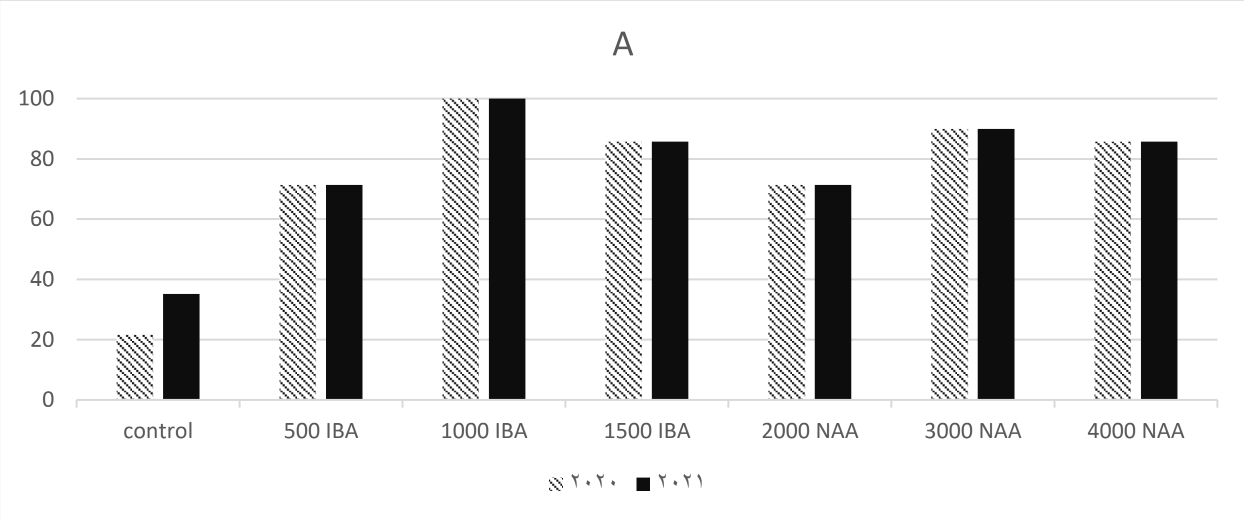

Figure 1. Effect of IBA and NAA applications on the hardwood cuttings on rooting percentage of White mulberry (M. alba).

3.2. Number of primary roots

The data in Table 1 make it clear that all treatments were significantly different from controls. The number of roots per cut was affected by different concentrations of IBA and NAA. In both seasons, cuttings treated with (1000 ppm IBA and 3000 ppm NAA) produced the highest number of roots per cut, while untreated cuttings of white mulberry (M. alba) produced the lowest number of roots per cut.

Table 1. Effects of IBA and NAA applications on the number of primary roots of white mulberry cuttings.

Treatments	2020	2021
Control	1.26	0.61
500 IBA	2.14	2.28
1000 IBA	8.14	8.88
1500 IBA	3.57	2.28
2000 NAA	5.28	6.85
3000 NAA	5.5	3.22
4000 NAA	3.42	

3.3. The length of primary roots

Table 2 clearly shows that applying different concentrations of IBA and NAA to cuts of white mulberry trees significantly increased the length of primary roots per cut compared to non-application. Significant differences in the length of primary roots per cut were observed among all concentrations. Treatment with IBA 1000 ppm resulted in the greatest average length of primary roots (6.92 and 5.27 cm), followed by treatment with NAA 3000 (4.71 and 6.48 cm). However, the recorded minimum length of primary roots (0.77 and 1.63 cm) was observed in the control treatment. The same trend was observed during the 2020 and 2021 seasons.

Table 2. Effects of IBA and NAA applications on the length of primary roots of white Mulberry cuttings.

Treatments	2020	2021
Control	0.77	1.63
500 IBA	1.64	3.46
1000 IBA	6.92	5.27
1500 IBA	3.07	1.79
2000 NAA	2.07	2.43
3000 NAA	4.71	6.48
4000 NAA	3.50	4.87
New LSD 5%	0.6	0.4

3.4. Number of branches

Table 3 shows that treating the cut of white mulberry with different concentrations of IBA and NAA increased the number of branches per cut significantly more than non-application. Significant differences in the average number of branches per cut were observed among all concentrations. Treatment of cuttings with IBA 1000 ppm recorded the highest number of branches (6.07 and 5.07) followed by cuttings treated with NAA 3000 ppm (3.85 and 4.35) in two seasons. However, the minimum number of branches (1.35 and 1.35) was observed in the control treatment The same trend was observed during the 2020 and 2021 seasons

Table 3. Effects of IBA and NAA applications on the number of branches of white mulberry cuttings.

Treatments	2020	2021
Control	1.35	1.35
500 IBA	2.00	2.85
1000 IBA	6.07	5.07
1500 IBA	2.57	2.28
2000 NAA	1.78	2.21
3000 NAA	3.85	4.35
4000 NAA	2.71	4.14
New LSD 5%	0.4	0.4

3.5. The length of branches

Data in Table 4 concerning the effect of IBA and NAA concentrations clearly show that treating cuttings with IBA and NAA of all concentrations increased the branch length more than untreated cutting. The treatment of cuttings with IBA 1000 ppm recorded maximum branch length (6.61 and 8.35 cm), followed by 3000 ppm NAA (4.77 and 8.28 cm). But, the minimum branch length (1.0 and 1.0 cm) was recorded with control, in the 2020 and 2021 seasons.

Table 4. Effects of IBA and NAA applications on the length of branches of white mulberry cuttings.

Treatments	2020	2021
Control	0.64	0.64
500 IBA	1.62	3.21
1000 IBA	6.61	8.35
1500 IBA	3.08	3.78
2000 NAA	1.94	3.85
3000 NAA	4.77	8.28
4000 NAA	3.58	4.28
New LSD 5%	0.6	0.6

3.6. Diameter of branches

The data in Table 5 clearly show that treating cuttings with IBA and NAA of all concentrations improves branch diameter more than an untreated cutting. The treatment of cuttings with IBA 1000 ppm recorded maximum branch diameter (25.71 and 22.42 ml), followed by 3000 ppm NAA (24.28 and 16.21 ml). However, in the two study seasons, the control had the smallest average branch diameter in comparison to all treatments

Table 5. Effects of IBA and NAA applications on the diameter of branches of white mulberry cuttings.

Treatments	2020	2021
Control	1.26	1.26
500 IBA	10.00	16.85
1000 IBA	25.71	22.42
1500 IBA	12.85	12.28
2000 NAA	12.14	12.42
3000 NAA	24.28	16.21
4000 NAA	13.57	10.64
New LSD 5%	1.00	1.10

3.7. The number of leaves.

Data in Table 6 concerning the effect of IBA and NAA concentrations clearly show that the cuttings treated with 1000 PPM IBA recorded a maximum Number of leaves (12.71 and 14.28) significantly superior to the rest of the treatments and control, followed by the cuttings treated with 2000 ppm NAA (16.50 and 12.42). But the control recorded a minimum Number of leaves (1.35 and 1.35) respectively in the two study seasons.

Table 6. Effects of IBA and NAA applications on the number of leaves of white mulberry cuttings.

Treatments	2020	2021
Control	1.35	1.35
500 IBA	6.35	14.14
1000 IBA	12.71	14.28
1500 IBA	8.85	7.28
2000 NAA	6.42	12.28
3000 NAA	16.50	12.42
4000 NAA	9.28	11.07
New LSD 5%	1.00	1.50

4. Discussion

Treatment of cuttings at 3000 ppm NAA, and 1000 ppm IBA, were all significantly more effective than the other treatments, including power. The explanation for the increase in the number of roots per cutting treated with NAA and IBA is most likely due to their accumulation at the base of the cutting where conditions are ideal for root initiation and growth. (Hartmann *et al* (1997). The reason for recording the longest root may be the action of auxin activity, which may have triggered the hydrolysis and translocation of sugars and nitrogenous compounds towards the base of cuttings and led to rapid cell division and cell elongation under favorable conditions. Another cause can be related to the treated cuttings' early root development and increased use of their stored food resources. (Ghatnatti, 1997).

These results agree with those obtained by (Shanmugavelu 1975, Konarli *et al*. 1977 and Isa *et al*. 1993).

Cuttings treated with 1000 ppm IBA registered the most branches, whereas cuttings treated with 3000 ppm NAA reported the most branches of any of the treatments, including control.

Accumulation of nutrients at the base of the cutting to a level suitable for root initiation and development may be the reason for the increased branch number per cutting due to treating the cuttings with NAA and IBA. These results agree with the findings of (Shanmugavelu 1975, Konarli *et al*. 1977 and Isa *et al.* 1993).

The largest number of leaves per cutting was produced by 3000 ppm NAA and 1000 ppm IBA, in addition, all concentrations of IBA and NAA increase the number of leaves. A stronger root system, which absorbs more nutrients and moisture than cuttings with a modest root system, may explain the increased number of leaves (Sandhu et al., 1991). The results are consistent with those of Fotedar *et al*. (1991), who reported similar results for a variety of berry cultivars treated with IBA at 1000 ppm.

5. Conclusions

In this study, the best treatment for vegetative propagation of White mulberry hardwood cuttings was treated White mulberry cuttings with NAA at 3000 ppm or IBA at 1000 ppm was beneficial for imparting maximal rooting, root, and shoot characteristics

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مقال

الملخص العربي

تأثير المعاملة اندول حمض الخليل والنفثلين اسيتك اسيد على الاكثار الخضري للتوت الابيض

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يتم إكثار التوت في مصر باستخدام زراعة الأنسجة نظرًا لصعوبة إنشاء الجذور على العقل بسبب مشكلة قلة منظمات النمو داخل العقل، إلا أن هذه العملية مكلفة ماديا للغاية وتستغرق وقتًا طويلاً. استخدمنا تركيزات متنوعة من منظمات النمو لحث العقل على التجذر في هذه الدراسة، وهي تقنية منخفضة التكلفة تنتج نباتات كثيفة وكثيره في فترة زمنية قصيرة. أجريت التجربة في صوبه مزوده بنظام الري بالرش، وتم جمع العقل وزرعها في نفس اليوم بعد معاملتها بالتركيزات المختلفة من منظمات النمو. تم جمع النتائج بعد ثلاثة أشهر من زرع النباتات. أظهرت النتائج أن العقل التي تمت معاملتها بتركيزات مختلفة من الاندول بيوتيريك اسيد والنفتالين اسيتك اسيد إلى تحسين نسبة نجاحها. كانت أعلى قيم للقياسات التي تم أخذها عند معاملة العقل ب 1000 جزء في المليون من محلول الاندول بيوتيريك اسيد أو 3000 جزء في المليون من نفتالين استيك أسد. بينما أعطت العقل الغير معاملة بمنظمات النمو اقل القيم في جميع الصفات المدروسة.

الكلمات الأساسية: التوت الأبيض، الإكثار، عدد الجذور، منظمات النمو.