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# Effect of some Auxins and Spraying with Boron and Zinc on Air Layering of Jojoba [*Simmondsia chinensis* (Link) Schneider] Plants

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## ABSTRACT

Two fields experiments were carried out during two successive seasons of 2012-2013 and 2013-2014 at the private Farm in Ismailia Governorate, Nursery and Laboratory of Vegt. and Flori. Department Fac. of Agri. Damietta University. This research aimed to study the effect of foliar some micro nutrients [Boron (B) 0.2 g/L or Zinc (Zn) 0.2 g/L] and study the effect of auxins treatment (Indole butyric acid (IBA) 4000 ppm or Naphthalene acetic acid (NAA) 2000 ppm) in addition control treatment (distilled water) on root formation in layering of jojoba plants. Obtained results revealed that jojoba plants treated with foliar nutrient Zn 0.2 g/L with layers which wounding and treated with IBA at 4000 ppm gave the greatest value of rooting percentage, vegetative growth and chemical constituents.

**Keywords:** Jojoba - *Simmondsia chinensis* – Boron – Zinc- IBA – NAA.

## INTRODUCTION

Jojoba [*Simmondsia chinensis* (Link) Schneider] belongs to Fam. *Simmondisaceae* is an evergreen dioeciously drought-tolerant perennial shrub. Its seeds contain about 50% oil. Jojoba plantations are established via seeds, seedlings, rooted cuttings, or plantlets from tissue culture. In general male plants more than female when. Being dioeciously, a seeded plantation of jojoba has genetic heterogeneity and low average yields (Benzioni, 1997). Vegetative propagation allow the establishing farms with the coveted ratio of male to female plants from pre-chosen eminent clones. It also creates uniformity, enhance yield, early bearing and reduced cost of production (Hogan & Palzkill, 1983). Attempts have been made to increase vegetative propagation of jojoba through air-layering (Reddy, 2003; Bashir *et al.*, 2005), grafting, stem cuttings and tissue culture. However jojoba is a hard of rooting, yet propagation through layers is used as asexual method with restricted success (Palzkill & Feldman, 1993).

Boron (B) plays paramount function in biochemical and physiological process like root development by cell division, sugar mobilization, formation of cell wall, carbohydrate metabolization, RNA, IAA and phenol (Camacho *et al.*, 2008). In this regard, foliar application with B enhanced vegetative growth of jojoba, yield and seed quality (Khattab *et al.*, 2019). Also, Zn is involved in several plants physiological functions like intervene in structural of enzymes and crebs cycle (Alloway, 2004), the establishing of chlorophyll and carbohydrates, transformation of starches to sugars. It is serious in the forming phenol, RNA and auxins by synthesis tryptophan that is precursor of IAA, that promote growth and stem elongation.

The importance of auxins in encourage the occasional root ability in layering has been successfully by increasing sugar availability at the site of primordial development and increasing cell division and cell elongation thus promote root length this led to increase survival layers of jojoba.

The aim to study the effect of foliar micro nutrients B or Zn and auxins treatments IBA and NAA on root formation in layering of jojoba plants.

## MATERIALS AND METHODS

Complete blocks randomized with in split plot design with three replicates (each of which consist of 10 layers) was done in 2012-2013 and 2013-2014 seasons. This experiments consist of 9 treatments that were the combinations between two of micronutrients (Boron or Zinc) in addition control The micronutrients were assigned in main plots, while sub plots were the application of auxins (control, Indole butyric acid or Naphthalene acetic acid).

Jojoba plants were sprayed with micronutrients (control, B as boric acid at 0.2 g/L or Zn as zinc sulfate at 0.2 g/L) five times (three times before layering the first one in beginning August and every three weeks later, while the last two spraying after layering).

After three foliar spraying with micronutrients at first of October the branches of jojoba were wounded and added auxins (control, IBA at 4000 ppm, NAA at 2000 ppm) with brush then left to dry and covered with wilt peat moss then plastic nets and clear poly ethylene plastic were covered and wrapped with wire.

After 75 days from layering at middle December layers were planted in pots (25 cm) filled with peat moss: perlite: vermiculite: sand (1:1:1:1) and kept under clear poly ethylene tunnel for two months.

**Survival percentage:** $\frac{\text{No. of well established layers}}{\text{Total No. of planted layers}} \times 100$

**Data recorded:**

Before layering at middle December samples were taken to determine the following measurements:

**Rooting growth characters:**

**Rooting percentage:** $\frac{\text{No. of rooting layering}}{\text{No. of checked up layering}} \times 100$

- No. of roots.
- Root Length (cm).
- Root fresh weight (g).
- Root dry weight (g).

**Vegetative growth characters:** were taken at the end of experiment on middle February.

- No of leaves/ plant.
- Leaves fresh weight (g/plant).
- Leaves dry weight (g/plant).

**Chemical components:** After one month from layering at the base of layers.

**- Reducing sugars percentages:** according to the method of Krishnaveni *et al.* (1984).

**- Total phenol;** was determined according to Slinkard and Singleton (1977).

**Statistical analysis:**

ANOVA technique was used to analyzed data statistically according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

**Rooting growth parameters:**

Obtained results in Tables 1 and 2 illustrated that all rooting parameters *i.e.*, rooting percentage No. of root, root length, root fresh weight and root dry weight significantly affected by spraying with micro nutrients. The maximum values of the rooting growth parameters were obtained from spraying with Zn at 0.2 g/L followed by spraying with B at 0.2 g/L.

**Table 1. Effect of foliar application with micro nutrients, auxins and their combinations on root growth parameters of jojoba at 2012/2013 and 2013/2014 seasons.**

| Treatments | | Rooting percentage | | Number of roots/layers | | Root length (cm) / layers | |
|---|---|---|---|---|---|---|---|
| | | 12/13 | 13/14 | 12/13 | 13/14 | 12/13 | 13/14 |
| Foliar application with micronutrients (0.2g/l) | | | | | | | |
| Control | | 53.00 | 51.00 | 24.8 | 25.8 | 25.3 | 23.8 |
| Boron | | 62.00 | 58.00 | 31.6 | 31.4 | 27.2 | 27.3 |
| Zinc | | 61.00 | 62.00 | 36.2 | 38.2 | 29.8 | 30.1 |
| LSD at 5% | | 5.31 | 5.55 | 4.48 | 2.0 | 2.4 | 1.6 |
| Auxin type with (ppm) | | | | | | | |
| Control | | 38.00 | 34.00 | 9.22 | 9.2 | 13.6 | 13.3 |
| IBA 4000 | | 80.00 | 79.00 | 37.3 | 38.6 | 44.7 | 44.0 |
| NAA 2000 | | 58.00 | 58.00 | 46.2 | 47.6 | 24.0 | 23.9 |
| LSD at 5% | | 4.87 | 5.03 | 2.31 | 2.4 | 1.6 | 1.9 |
| Combination between micronutrient and auxin type | | | | | | | |
| | Control | 33.00 | 27.00 | 3.0 | 3.6 | 12.5 | 11.4 |
| Control | IBA 4000 | 72.00 | 69.00 | 31.6 | 33.3 | 42.3 | 40.2 |
| | NAA 2000 | 54.00 | 57.00 | 40.0 | 40.6 | 21.2 | 19.8 |
| | Control | 42.00 | 36.00 | 10.3 | 10.6 | 13.7 | 14.2 |
| Boron | IBA 4000 | 84.00 | 81.00 | 38.0 | 37.6 | 44.4 | 42.5 |
| | NAA 2000 | 60.00 | 57.00 | 46.6 | 46.0 | 23.5 | 25.4 |
| | Control | 39.00 | 39.00 | 14.3 | 13.3 | 14.5 | 14.4 |
| Zinc | IBA 4000 | 84.00 | 87.00 | 42.3 | 45.0 | 47.4 | 49.4 |
| | NAA 2000 | 60.00 | 60.00 | 52.0 | 56.3 | 27.4 | 26.4 |
| LSD at 5% | | 8.64 | 8.96 | 5.51 | 3.9 | 3.3 | 3.1 |

**Table 2. Effect of foliar application with micro nutrient, auxins and their combinations on plant growth parameters of at 2012/2013 and 2013/2014 seasons.**

| Treatments | | Root fresh weight (g)/ layers | | Root dry weight (g)/ layers | |
|---|---|---|---|---|---|
| | | 12/13 | 13/14 | 12/13 | 13/14 |
| Foliar application with micronutrients (0.2g/l) | | | | | |
| Control | | 0.421 | 0.416 | 0.135 | 0.135 |
| Boron | | 0.668 | 0.668 | 0.117 | 0.107 |
| Zinc | | 0.836 | 0.833 | 0.139 | 0.138 |
| LSD at 5% | | 0.030 | 0.064 | 0.017 | 0.010 |
| Auxin type with (ppm) | | | | | |
| Control | | 0.230 | 0.219 | 0.110 | 0.099 |
| IBA 4000 | | 0.943 | 0.933 | 0.157 | 0.158 |
| NAA 2000 | | 0.752 | 0.765 | 0.125 | 0.124 |
| LSD at 5% | | 0.071 | 0.044 | 0.016 | 0.018 |
| Combination between micronutrient and auxin type | | | | | |
| | Control | 0.137 | 0.126 | 0.218 | 0.209 |
| Control | IBA 4000 | 0.641 | 0.632 | 0.107 | 0.115 |
| | NAA 2000 | 0.484 | 0.489 | 0.080 | 0.081 |
| | Control | 0.234 | 0.221 | 0.058 | 0.036 |
| Boron | IBA 4000 | 0.961 | 0.901 | 0.159 | 0.150 |
| | NAA 2000 | 0.811 | 0.883 | 0.135 | 0.136 |
| | Control | 0.318 | 0.310 | 0.053 | 0.052 |
| zinc | IBA 4000 | 1.228 | 1.266 | 0.204 | 0.208 |
| | NAA 2000 | 0.961 | 0.924 | 0.160 | 0.154 |
| LSD at 5% | | 0.104 | 0.088 | 0.028 | 0.028 |

As for the impact of auxins type application on rooting growth parameters, results in the same tables reveal that auxins increased rooting growth parameters compared to control treatment. IBA at 4000 ppm gave the highest values of rooting percentage, root length, root fresh weight and root dry weight, while NAA at 2000 ppm treatment gave the No. of root/layer in both seasons.

The interaction effect between spraying with micro nutrients and auxins type application showed that the combination between spraying with Zn and application with IBA gave the highest values of rooting growth parameters except No. of roots.

**Vegetative growth parameters:**

With respect to the effect of spraying with micro nutrients, results listed in Table 3 showed that spraying with significantly affected on No. of leaves/layers, leaves fresh weight, leaves dry weight. Zn at 0.2 g/L gave superiority values of the vegetative growth parameters, followed by spraying with B at 0.2 g/L, while the lowest values were obtained from control treatment.

Results in the same Table exhibited that No. of leaves/layers, leaves fresh weight, leaves dry weigh of layers significantly increased as concerning to application with auxins compared to the control treatment. IBA at 4000 ppm gave the highest values of vegetative growth parameters.

**Table 3. Effect of foliar application with micro nutrient, auxins and their combinations on plant growth parameters of jojoba at 2012/2013 and 2013/ 2014 seasons**

| Treatments | | Leaves No. /Layers | | Leaves fresh weight (g)/ Layers | | Leaves dry weight (g)/ Layers | |
|---|---|---|---|---|---|---|---|
| | | 12/13 | 13/14 | 12/13 | 13/14 | 12/13 | 13/14 |
| Foliar application with micronutrients (0.2g/l) | | | | | | | |
| Control | | 49.66 | 48.77 | 16.60 | 15.15 | 5.54 | 5.05 |
| Boron | | 63.55 | 61.66 | 21.18 | 20.55 | 7.06 | 6.85 |
| Zinc | | 64.77 | 64.00 | 21.66 | 21.33 | 7.22 | 7.11 |
| LSD at 5% | | 3.47 | 4.08 | 1.32 | 2.66 | 0.45 | 0.89 |
| Auxin type with (ppm) | | | | | | | |
| Control | | 56.66 | 56.33 | 18.88 | 18.75 | 6.30 | 6.25 |
| IBA 4000 | | 61.67 | 59.77 | 20.60 | 19.93 | 6.87 | 6.65 |
| NAA 2000 | | 59.66 | 58.33 | 19.96 | 18.34 | 6.66 | 6.12 |
| LSD at 5% | | 3.74 | 3.48 | 1.24 | 1.79 | 0.409 | 0.60 |
| Combination between micronutrient and auxin type | | | | | | | |
| | Control | 49.66 | 47.66 | 16.56 | 15.86 | 5.52 | 5.30 |
| Control | IBA 4000 | 50.66 | 52.00 | 17.03 | 17.34 | 5.68 | 5.78 |
| | NAA 2000 | 48.66 | 46.66 | 16.20 | 12.24 | 5.40 | 4.08 |
| | Control | 60.33 | 59.33 | 20.10 | 19.77 | 6.71 | 6.59 |
| Boron | IBA 4000 | 64.00 | 62.66 | 22.10 | 20.90 | 7.37 | 6.97 |
| | NAA 2000 | 66.33 | 63.00 | 21.36 | 21.00 | 7.12 | 7.00 |
| | Control | 63.00 | 62.00 | 20.00 | 20.63 | 6.67 | 6.88 |
| Zinc | IBA 4000 | 60.00 | 64.66 | 22.66 | 21.56 | 7.56 | 7.19 |
| | NAA 2000 | 66.33 | 65.33 | 22.33 | 21.80 | 7.44 | 7.27 |
| LSD at 5% | | 6.30 | 6.35 | 2.18 | 3.65 | 0.73 | 1.22 |

As for the interaction effect between spraying with micro nutrients and application with auxins, results in the same Table revealed that the combination between spraying with Zn at 0.2 g/L plus NAA at 2000 ppm gave the highest values of vegetative growth parameters except the second season of leaves fresh and dry weight.

**Survival percentage and chemical contents:**

It is evident from results listed in Table 4 that using spraying with micro nutrients for jojoba plants significantly

increased survival percentage of layers and chemical contents *i.e.* reducing sugar, and total phenol. In this regard, spraying with Zn 0.2 g/L gave the preferable values of this parameters.

**Table 4. Effect of foliar application with micro nutrient, auxins and their combinations on survival percentage of jojoba layers and chemical contents during the two seasons of 2012/2013 and 2013/2014**

| Treatments | | Survival percentage | | Reducing sugar | | Total Phenol | |
|---|---|---|---|---|---|---|---|
| | | 12/13 | 13/14 | 12/13 | 13/14 | 12/13 | 13/14 |
| Foliar application with micronutrients (0.2g/l) | | | | | | | |
| Control | | 47.53 | 45.90 | 1.40 | 1.42 | 0.91 | 0.92 |
| Boron | | 55.80 | 52.20 | 1.65 | 1.64 | 0.82 | 0.81 |
| Zinc | | 55.80 | 55.80 | 1.71 | 1.72 | 0.80 | 0.78 |
| LSD at 5% | | 6.12 | 4.99 | 0.04 | 0.07 | 0.04 | 0.02 |
| Auxin type with (ppm) | | | | | | | |
| Control | | 35.10 | 30.60 | 1.29 | 1.32 | 0.90 | 0.90 |
| IBA 4000 | | 71.83 | 71.10 | 1.79 | 1.78 | 0.80 | 0.79 |
| NAA 2000 | | 52.20 | 52.20 | 1.68 | 1.68 | 0.83 | 0.82 |
| LSD at 5% | | 3.92 | 4.52 | 0.06 | 0.04 | 0.04 | 0.05 |
| Combination between micronutrient and auxin type | | | | | | | |
| Control | Control | 29.70 | 24.30 | 1.15 | 1.19 | 0.91 | 0.94 |
| | IBA 4000 | 64.30 | 62.10 | 1.60 | 1.58 | 0.90 | 0.90 |
| | NAA 2000 | 48.60 | 51.30 | 1.45 | 1.47 | 0.94 | 0.91 |
| Boron | Control | 37.80 | 32.40 | 1.33 | 1.36 | 0.92 | 0.92 |
| | IBA 4000 | 75.60 | 72.90 | 1.86 | 1.82 | 0.77 | 0.75 |
| | NAA 2000 | 54.00 | 51.30 | 1.77 | 1.74 | 0.76 | 0.76 |
| Zinc | Control | 37.80 | 35.10 | 1.39 | 1.40 | 0.87 | 0.83 |
| | IBA 4000 | 75.60 | 78.30 | 1.92 | 1.95 | 0.72 | 0.72 |
| | NAA 2000 | 54.00 | 54.00 | 1.82 | 1.82 | 0.80 | 0.77 |
| LSD at 5% | | 8.19 | 8.07 | 0.10 | 0.09 | 0.06 | 0.07 |

Results illustrated in the same table revealed that survival percentage of layers and chemical contents significantly enhanced with auxins applications compared to control treatment. IBA at 4000 ppm gave the best results of mentioned characters.

Concerning to the combination effect between raying with micro nutrients and auxins applications, results in the same Table showed that the using spraying with Zn plus application with IBA gave superiority of survival percentage of layers and chemical contents, followed by spraying with B plus application with IBA.

**Discussion**

The enhancement effect on all parameters allied with Zn may be due to prevent Zn shortage in plants as sandy soils poor with micronutreints and its function of building up IAA which increase cell division (El-Tohamy and El-Greadly, 2007) and influence on meristematic growth that increase plant growth with increasing chlorophyll foundation (Abd El-Hady and Shehata, 2019) by effect on enzymatic function then enhance synthesis of carbohydrates and protein. These findings are in agreement with (Pirzad *et al.* 2013) on anise, Atteya *et al.* (2018) on jojoba and Rossi *et al.* (2019) on coffee.

The promotive effect of B may be due to its role of cell wall formation and stability, servicing of structural and functional integrity of biological membranes, mobilization of sugar and energy into plant growing parts, the importance of B for plant growth came from its role in cell division, biological regulation that include enzyme and hormone system Ganie *et al.* (2013) and enhance the length and No. of root hairs Fontes *et al.* (2016). These observation are in harmony with the reports of Clemente *et al.* (2018) on coffee and Khattab *et al.* (2019) on jojoba.

The increments of jojoba growth and survival percentage by application of auxins (IBA and NAA) addition may be due to its role for incidental root formation of root primordial and medium support to it by enhance the cambial growth and decrease damages through callus formation (Gehlot *et al.*, 2014) and increase cell division and cell elongation thus promote root length. Also, induces encourage metabolism of enzymes, carbohydrates, and proteins, thus changes in the rooting zone may inhibit or promote regeneration of incidental roots, at most during cell division (Komatsu *et al.* 2011). These results are in harmony with those obtained by Reddy (2003), Sayed *et al.* (2010) and Eed and Burgoyne (2014) on jojoba

## CONCLUSION

The results obtained in this study show that jojoba plants treated with foliar nutrient Zn 0.2 g/L with layers which wounding and treated with IBA at 4000 ppm enhanced survival percentage, jojoba vegetative and rooting growth.

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## تأثير بعض الاوكسينات والرش بالزنك والبورون على اكثار نبات الجوجوبا بالترقيد الهوائى

**السيد عطيه حامد البرعى**

**قسم الخضر والزينة- كلية الزراعة – جامعة دمياط - مصر**

تم إجراء تجربتان حقليتان خلال الموسمين 2013/2012 و 2014/2013 فى مزرعة خاصة بمحافظة الاسماعيلية ومعمل ومشتل قسم الخضر والزينة بكلية الزراعة جامعة دمياط لدراسة تأثير الرش ببعض العناصر الصغرى [الزنك (0.2 جم/لتر) و البورون (0.2 جم/لتر)] مع دراسة تأثير المعاملة بالاوكسينات المختلفة (الاندول بيوتريك اسيد 4000جزء فى المليون و نفثالين استيك اسيد 2000جزء فى المليون) بالإضافة إلى معاملة المقارنة (الماء المقطر) على تكوين الجذور عن طريق الترقيد الهوائى لنبات الجوجوبا. أوضحت النتائج التى تم الحصول عليها أن معاملة نباتات الجوجوبا بالرش الورقى بالزنك (0.2 جم/لتر) مع معاملة التراقيد بالإندول بيوتريك أسيد 4000 جزء فى المليون أعطت أعلى نسبة مئوية للتجذير وصفات النمو الخضرى و المحتوى الكيماوى (من السكريات والفينولات).