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# Evaluating the Multiplication of Kiwi (*A. deliciosa*) with the Cuttings Treated by Some Rooting Hormones

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**A B S T R A C T**

This research carried out at the experimental station in Peza (Tirana district) has sought to test the treatment of the lignified cuttings of kiwi, cv. Hayward, with rooting hormones. Several cuttings collected were stratified until the planting period. During February, cuttings were cut 15 – 20 cm long, with a diameter of 20 mm at the base. Six bathing treatments were applied: IBA 1000 ppm and 500 ppm, AIA 1000 ppm and 500 ppm as well as Control. IBA Gel was applied at the time of planting. The cuttings were planted in 500 cc containers with peat as a substrate, with a bottom temperature of 25ºC and air temperature 20ºC. Sprinkler irrigation was applied 1 minute every two days. After 50 days, we assessed the rooting percentage and quality. Data were analyzed in SAS/STAT. The results demonstrated that the use of both hormones AIB and AIA has improved rooting compared to control. The AIB solution 1000 ppm was responsible for an additional rooting of 24.1% and 20% compared to Control. In general, the bioregulators have promoted the differentiation of callus and root meristem. The amount of rooting was correlated to the dose and type of bioregulator, showing a pronounced variance in favor of 1000 ppm concentration.

## Introduction

Kiwi has been introduced in the last 15 years and actually covers about 30 hectare in all the country, with an intensive growing trend. The need of nursery plants is high and nurseries are facing technical problems. Thus, research has been carried out to optimize the propagation methods and improve the efficiency of production. The cost of production of micropropagated saplings is more or less high relative to other classical methods. Consequently, efforts are in progress to reduce part of the costs, therefore, producing saplings with acceptable cost levels, Bartolini *et al.,* (1988), Biasi *et al.,* (1990)**,** to improve the efficiency of the technique, i.e. the percentage of rooting and the quality of the root system Fabbri (1980), Safari *et al.,* (2012), especially using the *in vivo* technique. Furthermore, the use of IBA Gel on woody cuttings of kiwi has not been tested before in our country. Many authors have ascertained that low doses should have a long persistence period, Garillass *et al.,* (2001), Ghasemi *et al.,* (2013), Hartmann *et al.,* (2002), some others recommend the use of high doses for 10 seconds, Morini *et al.,* (1986), Nadafian *et al.,* (2013),

Kiwi can be multiplied by twigs or seeds; with green cuttings in July or mature wood at the beginning of spring. While some methods have a certain degree of success, the methods of green cuttings at the end of May – beginning of June has shown superiority Hashemabadi *et al.,* (2006), Razaghi *et al.,* (2010). In this context, we have conducted a study on the rooting ability of cv. Hayward in correlation with bioregulators under the conditions and capacities of our country, Stenfanic *et al.,* (2007).

## Materials and Methods

Mature shoots were collected in December from a kiwi orchard in Maknor, Tirana, which were then stratified in clean sand, without clay, until February. Before planting, shoots were cleaned several times with water, were dried and cut 15 – 20 cm long. The base was cut under the node and in the apical part with nodes. Cuttings were tied in batches of 20 cuttings. IBA (indole-3 butyric acid (C13H12NO2)) and AIA (indole-3-acetic acid ($C_{10}H_9NO_2$)) were laid in plastic containers. The basal part of the cuttings was dipped in a layer of 2 cm with a AIB and AIA solution, with a concentration of 1000 ppm and 500 ppm for 2 hours. The room was dusk and temperature $25^0$C. A control treatment was applied using only hydro-alcoholic solution.

Treatment with IBA Gel was carried out at the time of planting (IBA Gel 4000 ppm). Cuttings were planted in 500 cc containers with a sterile peat substrate. About 75% of the cutting was immersed in the substrate while the apical segment is outside in the air. The material was installed in a rooting bed, which base was kept at $18^o$C, with 15 – 16 hours of light and 6000 lux. Observations on establishment, rooting percentage, number of primary roots, and number of open buds were carried out 2 months after planting. Irrigation was applied every 2 days with 1- minute aspersion.

All the data from the observations were computerized in a PC and analysis of variance was conducted using JMP software, Jmp.Sas/ Stat (2008).

## Results and Discussion

The results of six treatments and their testing for the effect on rooting ability of kiwi cuttings has shown that the differences within treatments were smaller than between treatments, *P=0.05, lsd 1.79*, i.e. that the variables for each repetition are homogenous, statistically significant, with a standard deviation of 1.57 and frequency 0.98 to 2.19. In Table 3, the average rooting of treatments was 60.2%, with significant differences because the F Ratio has a value of 128.13 and is higher that the Prob. F >0.001, i.e. the results are reliable.

In Table 2 and 3, we have tested the differences between the average variables for each treatment was we found a high variability in the rooting percentage between treatments.

Furthermore, in Table 3, we found that the treatments with IBA 1000, 500 ppm and Gel IBA, have better stimulated the establishment and rooting ability, verified statistically using Tukey test, *lsd 1.79 HSD, P=0.05,* which demonstrates that there is a significant difference between the averages of each treatment. In Table 3 and 4, we can see that the best variant was IBA 1000 ppm, with a frequency of differences 24.1% to 3.01% and the highest differences found in the control (24.1%), while the lowest difference with IBA treatment of IBA 500 ppm and IB gel 4000 ppm, 3.1 and 7.3 % respectively.

In the 3rd diagram, we can notice that all treatments with bioregulators have positively influenced the rooting ability of kiwi cuttings, i.e. the changes between treatments (Control –

AIA – AIB) has increased the ability of the cuttings to differentiate roots, in the following order: IBA1000 ppm > IBA500 ppm > IBA Gel > AIA1000 ppm > AIA500ppm > Control.

The use of AIB 1000 ppm and AIB 500 ppm have a significant change against Control and explains the improved rooting ability. Only one concentration level of AIA has significantly improved the rooting compared to control, while AIA in a 500 ppm concentration did not changed significantly from Control. The analysis of performance shows that Control has a coefficient of –4.391 which demonstrates a non–economic effect which makes this treatment non usable relative to other treatments, Stenfanic *et al.*, (2007).

Using the analysis of variance, we found that the effect of Treatment (IBA, AIA, Control) on the rooting ability has been tested using the Coefficient of Determination ($R^2$) which demonstrates that AIB and AIA are close to unity (1), proving the effect of the these treatments while Control results close to zero (0), which demonstrates the lowest effect.

Regarding the rooting percentage from the application of bioregulators, $R^2$ coefficient is 0.87 which demonstrates the highest influence of hormonal factors. Thus, in this case, it can be demonstrated that the group of two hormones related to the rooting percentage and therefore the efficiency of the method, influences 87% of the values of (y), i.e. rooting percentage.

In the three cases analyzed, showing in Table 2, the value of tf > tk, 2.66 > 2, i.e. the hypothesis of Control treatment is not accepted and therefore, a 1000 ppm and IBA Gel 4000 ppm hormones concentration does not negatively influences the rooting ability by ascertaining their use efficiency.

In the correlative analysis of the independent variables in the scatter plot matrix, we have found that the point of interception (correlation coefficient showing the correlative relation between the cultivar and the percentage of rooting) is $r = 0.94$, which means that there is a 94 % positive relationship between variables and a very strong one.

In Table 3, the percentage of rooting with 1000 ppm and 500 ppm AIB, was respectively 24.1% and 21% higher compared to Control (no use of hormones). While, AIA 1000 ppm and 500 ppm have shown a significant difference against control, 7.2% and 0.00%, AIA 500 ppm does not significantly differ from Control and its effect on rooting is zero. The use of IBA gel 4000 ppm has shown close levels with AIB 500 ppm, resulting in 16.9% in disfavor of Control. The variation of the results related to the rooting percentage is due to the presence of hormone treatment which has improved the rooting ability of the plant material, has stimulated a better development of callus and parenchyma cells of the small roots, which were in much larger number compared to Control. Results on the higher number of differentiated roots relative to Control were found with the use of AIB 1000ppm. AIB and AIA has induced the production of a higher number of roots compared to Control, with a high average number of roots per cutting.

As it can be seen in Table 3, the average number of roots resulted higher with the application of AIB for the three different trainings compared to Control for lsd.2.11 or, numerically, 11.3 and 10.8 roots, or 4 roots more than Control. The average number of roots per cutting is higher compared to Control. Compared to the average number of roots, 9.46 roots /cutting, there is a high variability between IBA and Control but also between IBA and AIA, from 2.4 to 1.1 roots.

The Std. Dev 1.029, amplitude 0.65 to 1.47, with significant differences because tF > Tt.

Regarding data the root length shown in Table 3, the average is 8.02 cm with an amplitude Std. Dev 0.48 (0.20 – 0.88), which demonstrates that there is a lack of variance or very small variance. Variants being tested following Means Comparisons with the best using Hsu's MCB Alpha 0.05 did not show differences in root size, therefore, demonstrating that bioregulators used did not had an effect on the biometric growth of the roots.

Acclimatization of the rooted material has required a further elaboration of the physical –chemical aspects to optimize the photosynthetic capacity and other conditions of the culture.

The low rhizogenic capacity of cv. Hayward in Control has induced the development of a less differentiated root system.

The use of cut node segments has identically improved the proliferation o the material and after planting and further development, it was possible to use it for further propagation cycles (Mist). Thus, this method enabled to provide a large number of rooted plantlets within a relatively short period of time, 50-60 days.

**Table.2** Analysis of variance for rooting ability, N0 roots and G.R1 cv. Hayward, propagated with woody cuttings without leaves

| Source of variation | DF | Sum of Squares | Mean Square | F Ratio | Prob > F |
|---|---|---|---|---|---|
| **Treatment - % Rooting** | 5 | 1693.9044 | 338.781 | 128.1373 | <.0001* |
| Error | 12 | 31.7267 | 2.644 | | |
| C. Total | 17 | 1725.6311 | | | |
| **Treatment- $N^0$roots** | 5 | 39.626667 | 7.92533 | 6.7770 | 0.0032* |
| Error | 12 | 14.033333 | 1.16944 | | |
| C. Total | 17 | 53.660000 | | | |
| **Treatment-G.R1** | 5 | 2.7494444 | 0.549889 | 1.9145 | 0.1654 |
| Error | 12 | 3.4466667 | 0.287222 | | |
| C. Total | 17 | 6.1961111 | | | |

**Table3** Data on the rooting percentage, N0 roots and G.R1 cv. Hayward, propagated with woody cuttings without leaves

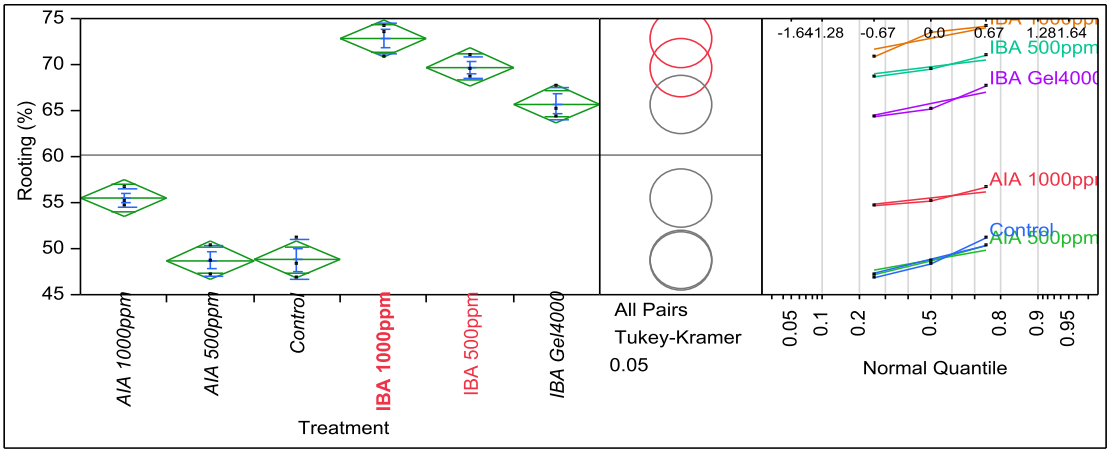
| Treatment / Indices | Percentage of rooting | Root System | |
|---|---|---|---|
| | | $NR^1$ | Length $R^1$ |
| Control | 48.8±2.19 d | 7.3±0.66 c | 7.33±0.55 a |
| IBA 1000ppm | 72.8±1.70 a | 11.3±0.86 a | 8.50±0.88 a |
| IBA 500ppm | 69.7±1.16 ab | 10.8±1.41 ab | 8.06±0.20 a |
| AIA 1000ppm | 56.0±0.98 c | 8.9±1.10 abc | 8.20±0.45 a |
| AIA 500ppm | 48.7±1.65 d | 7.9±0.65 bc | 7.73±0,20 a |
| IBA Gel4000 | 65.7±1.76 b | 10.3±1.47 abc | 8.33±0.57 a |

**Table.4** Data on the level of differences between treatments on the rooting ability of woody cuttings of cv. Hayward of Kiwi

| Level | - Level | Difference | Std Err Dif | Lower CL | Upper CL | p-Value |
|---|---|---|---|---|---|---|
| IBA 1000ppm | AIA 500ppm | 24.10000 | 1.327627 | 19.6407 | 28.55932 | <.0001* |
| IBA 1000ppm | Control | 24.03333 | 1.327627 | 19.5740 | 28.49265 | <.0001* |
| IBA 500ppm | AIA 500ppm | 21.00000 | 1.327627 | 16.5407 | 25.45932 | <.0001* |
| IBA 500ppm | Control | 20.93333 | 1.327627 | 16.4740 | 25.39265 | <.0001* |
| IBA 1000ppm | AIA 1000ppm | 17.33333 | 1.327627 | 12.8740 | 21.79265 | <.0001* |
| IBA Gel4000 | AIA 500ppm | 17.00000 | 1.327627 | 12.5407 | 21.45932 | <.0001* |
| IBA Gel4000 | Control | 16.93333 | 1.327627 | 12.4740 | 21.39265 | <.0001* |
| IBA 500ppm | AIA 1000ppm | 14.23333 | 1.327627 | 9.7740 | 18.69265 | <.0001* |
| IBA Gel4000 | AIA 1000ppm | 10.23333 | 1.327627 | 5.7740 | 14.69265 | <.0001* |
| IBA 1000ppm | IBA Gel4000 | 7.10000 | 1.327627 | 2.6407 | 11.55932 | 0.0019* |
| AIA 1000ppm | AIA 500ppm | 6.76667 | 1.327627 | 2.3073 | 11.22598 | 0.0028* |
| AIA 1000ppm | Control | 6.70000 | 1.327627 | 2.2407 | 11.15932 | 0.0030* |
| IBA 500ppm | IBA Gel4000 | 4.00000 | 1.327627 | -0.4593 | 8.45932 | 0.0887 |
| IBA 1000ppm | IBA 500ppm | 3.10000 | 1.327627 | -1.3593 | 7.55932 | 0.2526 |
| Control | AIA 500ppm | 0.06667 | 1.327627 | -4.3927 | 4.52598 | 1.0000 |

**Fig.1** The Kiwi cuttings 1 month, 1.5 months and 2 months after the hormone treatment

**Fig.2** Analysis of Rooting by Treatment for testing the variability analyzed all pairs tukey-kramer lsd 1.79 HSD, P=0.05




In conclusion, annual woody cuttings of kiwi were treated with rooting hormones to improve the rooting ability and the number of roots. AIB solution has improved by 20% the

rooting ability compared to other treatments and constitutes a premise for increasing the efficiency of the method. Besides the influence on rhizogenesis, the stimulants have increased the number of roots because each cutting had more roots when hormone treatments were applied compared to Control. Kiwi can be propagated not only by seed but also using green cuttings and mature wood collected in the beginning of the spring. The nursery plants produced as such does not represent any genetic modifications relative to mother trees and is appropriate to be reproduced.

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