Effect of Indole-3-Butyric Acid (IBA) 3000 ppm on Rooting Ability and Vegetative Growth of the Vegetative Cuttings of Kiwifruit

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Abstract

The paper presents the effect of Indole-3-Butyric Acid (IBA) 3000 ppm on rooting ability of the vegetative cuttings of kiwifruit, planted in three different planting periods. The study was conducted during three consecutive years, 2010-2012, in a controlled atmosphere greenhouse in Lezha, using three different vegetative cuttings: hardwood cuttings, green cuttings and semi-hardwood cuttings. A randomized complete block design (RCBD) with 2 variants (control – no IBA and IBA 3000 ppm) and three replications, with a plot size of 100 cuttings for each variant in each replication, was used. Cuttings were taken from healthy mother plants of 8-10 years old, cultivar "Hayward". Hardwood cuttings, planted in March 5, were taken in January 20-30 and were stored in sand under blackness conditions, while green cuttings, planted in June, and semi-hard cuttings, planted in August, were taken on the 5th day of the respective month, and were planted immediately. Vegetative cuttings of kiwifruit were planted on a perlite supporter, with basal heating in March and without heating in the other periods. Results showed that IBA 3000 ppm significantly affected rooting ability of kiwifruit vegetative cuttings for all planting periods. The highest rooting percentage and the highest quality seedlings were achieved using hardwood cuttings, taken in January 20-30 and planted in March 5, by 80% rooted cuttings and 44% first quality seedlings.

KEYWORDS: cuttings, indol-3-butyric acid, kiwifruit, propagation, rooting ability.

INTRODUCTION

The kiwifruit *(Actinidia deliciosa* C. F. Liang & A. R. Ferguson), often shortened to *kiwi* in many parts of the world, is the edible berry of a woody vine in the genus Actinidia (Stirk, 2005). Kiwifruit is native to southern China, where it is declared a National Fruit of China, and other species of the genus *Actinidia* are native to India, Japan, and southeastern Siberia. The genus *Actinidia* contains around 60 species. The skin of the fruit can vary in size, shape, hairiness, and color. The flesh can also vary in color, juiciness, texture, and taste. Some fruits are unpalatable, while others taste considerably better than the majority of the commercial varieties (Ferguson, 1999). The most common kiwifruit is the Fuzzy Kiwifruit and comes from the species *A. deliciosa*. Other species have fruits that are commonly eaten; some examples are Golden Kiwifruit (*A. chinensis*), Chinese Egg Gooseberry (*A. coriacea*), Baby Kiwifruit (*A. arguta*), Arctic Kiwifruit (A. *kolomikta*), Red Kiwifruit (*A. melanandra*), Silver Vine (*A. polygama*), Purple Kiwifruit (*A. purpurea*) (Ferguson, 1999). Although, kiwifruit was known and used 2000-3000 years ago, it was brought

in Europe, including Mediterranean countries, around 1980s (Gjeloshi, 2007). Currently, Italy, New Zealand, Chile, Greece, France, Japan and the United States are among the leading commercial producers of kiwifruit (Wilkinson, 2008; Huang & Ferguson, 2001; Huang & Ferguson, 2003; FAO, 2011).

Kiwifruit is a dioecious plant, with separate male and female plants. Almost all kiwifruit in commerce belong to a few cultivars of Fuzzy Kiwi (*Actinidia deliciosa*): "Hayward", "Blake", and "Saanichton 12" (Stirk, 2005). They have a fuzzy, dull brown skin, and bright green flesh. The familiar cultivar "Hayward" was developed by Hayward Wright in Avondale, New Zealand around 1924, with a fibrous, dull greenish-brown skin and bright green or golden flesh without rows or tiny, black, edible seeds. The fruit has a soft texture and a sweet, but unique, flavor (Ferguson, 1999). "Hayward" was initially grown in domestic gardens, but commercial planting began in the 1940s. The most common male pollinators for this variety are "Chico" and "Mattua". Kiwifruit chlorophyll, after its release from protein complexes, absorbs energy and transforms to extremely powerful antioxidants, which play an important antioxidant protection for the plant and human body (Müller *et al*., 2007). Kiwifruit can be grown in most temperate climates with adequate summer heat. Kiwifruit is commercially grown on sturdy support structures, as it can produce several tons per hectare, more than the rather weak vines can support. Kiwifruit is a perennial plant (over 40-45 years). These are generally equipped with a watering system for irrigation and frost protection in the spring. First fruits can be yielded after 3-4 years, and kiwi fruits can be preserved and consumed all over the year. In Albania, kiwifruit is not well-known and its domestic cultivation started in 1994, in Lezha, and, after 2002, began commercial planting by some farmers in Divjakë (Lushnjë), Velipojë (Shkodër), Llakatund (Vlorë), Tiranë, Elbasan, etc., showing high fruit quantity and quality, under plain Mediterranean climate conditions (Gjeloshi, 2007). Since thea area under cultivation is increasing year-by-year, there is a need for high quality seedling production and new kiwi orchard construction. Seedling production of kiwifruit can be using traditional methods and cuttings rooting in greenhouses. Any living vegetative plant tissue, cambium, epidermis, parenchyma of the bark, etc., can form roots if there are fulfilled appropriate environmental conditions and if there is a certain level of hormonal contents (growth regulators) (Hartman & Kester, 1990). The high hormone concentrations provoke the cambium and pericycle cell division from where the process of root formation starts. Roots originated from vegetative plant's parts under the hormone effect are similar to roots formed naturally (Hartman & Kester, 1990). For cuttings rooting acceleration can be used growth regulators such are Indole-3-Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) (Rama, 2010). A higher concentration of the rooting hormones is used for woody and lignified parts as well as for those that hardly root, while very high concentrations of the rooting hormone inhibit the rooting process (Rama, 2010).

Susaj *et al*., (2011) and Lekaj *et al*. (2011) have shown that the use different NAA concentration affected significantly the rooting percentage of the vegetative cuttings of thuya "Emeraud", as well as the seedling quantity. Some early workers (Bhattacharya *et al*., 1978) have reported that indole-3-butyric acid (IBA) and gibberelic acid (GA3) enhanced the formation of roots on the stem cuttings of *Abelmoschus esculentus* Moench.

MATERIALS AND METHODS

The study was conducted during three consecutive years, 2010-2012, in a 5000 m^2 controlled atmosphere greenhouse in Lezha, under ownership of Gjovalin Gjeloshi, using two IBA treatments (control – no IBA was used and IBA 300 ppm) and three different vegetative cuttings, taken in three different periods: in January, with hardwood cuttings, in June, with greenwood cuttings, and in August, with semi-hardwood cuttings. Cuttings were taken from healthy mother plants of 8-10 years old, cultivar "Hayward". Hardwood cuttings, planted in March 5, were taken in January 20-30 and were stored in sand under blackness conditions, while green cuttings, planted in June, and semi-hard cuttings, planted in August, were taken on the 5th day of the respective month, and were planted immediately. Cuttings were taken from the middle part of the vine in a length of 10-12 cm (or 4-5 buds) and a diameter of 7-10 mm. Vegetative cuttings were planted in a greenhouse, equipped with an automatic fog system, on a perlite supporter, with basal heating in March and without heating in the other planting periods. The air temperature in greenhouse was kept of 22-26^{o}C, basal perlite temperature 17-18^{o}C, and air humidity 90-95%. Each year and each planting period, two variants were used:

V1 = control, no IBA was used

V2 = IBA 3000 ppm

Pre-prepared IBA 3000 ppm solution was poured into a Petri dish, and the bottoms of the vegetative cuttings were dipped for few seconds. After the treatment with IBA, the kiwifruit vegetative cuttings were placed for rooting on a perlite supporter with basal heating. There were used 100 vegetative cuttings for each variant in each replication, planted in distances 10 cm x 5 cm, planting 200 vegetative cuttings per m^2. Planting of the vegetative cuttings for rooting was carried out at the same period for three consecutive years. Twenty days after planting, there were observed the formation of root nodules and callus ring at the end of vegetative cuttings, and twenty days later, consisting of 40 days after planting, there were counted rooted seedlings (rooted cuttings), and was evaluated the rooting percentage for each variant, while the root length was measured 60 days after planting, and vine length was measured 80 days after planting. Differences between cuttings taking periods were testified using statistical tests [LSD (95%) and ANOVA test] (Papakroni, 2001).

RESULTS AND DISCUSSIONS

Effect of IBA 3000 ppm on rooting ability of different vegetative cuttings, planted in different periods of the year

Use of Indole-3-Butyric Acid 3000 ppm significantly affected rooting percentage of the kiwifruit vegetative cuttings, planted in three different planting periods. The increase of rooting ability because of IBA 3000 ppm using was from 2.0 to 2.67 times higher than untreated variants for the same planting period. The highest value of rooting percentage was achieved in the first planting period (March 5), using hardwood cuttings (HC), by 80%, followed by the third planting period August 5, using semi-hardwood cuttings, by 56%, and the second planting period June 5, using green cuttings, by 54%. There were not observed significant differences between green cuttings and semi-hardwood cuttings for both untreated and treated variants (Table 1). Observed results were similar to Susaj *et al*., (2011) and Lekaj *et al*. (2011) with vegetative cuttings of thuya "Emeraud".

Table 1. Effect of IBA 3000 ppm on rooting percentage of different vegetative cuttings, planted in different periods of the year (mean values, different letters indicate significant difference at $p<0.05$).

Variants	Planted cuttings	March 5 – HC		June 5 - GC		August 5 - SHC	
		Rooted cuttings	%	Rooted cuttings	%	Rooted cuttings	%
V1 Control (no IBA)	300	90^{bA}	30	72^{bB}	24	84^{bB}	28
V2 (IBA 3000 ppm)	300	240^{aA}	80	162^{aB}	54	168^{aB}	56

Effect of IBA 3000 ppm on seedlings (rooted cuttings) vine development of different vegetative cuttings, planted in different periods of the year

There was observed that IBA 3000 ppm affected significantly seedlings (rooted cuttings - RC) vine development (vine length – VL) (cm), in three planting periods. In the first planting period, March 5, using hardwood cuttings (HC), for 62.5% of the seedlings was measured a vine length of 6-10 cm and for 27.5% of the seedlings was measured a vine length over 10 cm. There were not observed significant differences between green cuttings and semi-hardwood cuttings for both untreated and treated variants (Table 2).

Table 2. Effect of IBA 3000 ppm on vine development (vine length) of different vegetative cuttings, planted in different periods of the year (mean values, different letters indicate significant difference at $p<0.05$).

Variants	March 5 – HC				June 5 – GC				August 5 – SHC			
	RC	Vine length (cm)			RC	Vine length (cm)			RC	Vine length (cm)		
		≤ 6	6-10	>10		≤ 6	6-10	>10		≤ 6	6-10	>10
V1	90	90^{aA}	-		72	72^{aB}	-	-	84	84^{aB}	-	
V2	240	24^{bE}	150^{A}	66^{C}	162	48^{bA}	84^{B}	30^{cE}	168	50^{bD}	86^{B}	32^{cE}

Effect of IBA 3000 ppm on seedlings root development (root length – RL) of different vegetative cuttings, planted in different periods of the year

There was observed that IBA 3000 ppm affected significantly seedlings (rooted cuttings) root development (root length – RL, cm), in three planting periods. The highest quality seedlings were achieved, in the first planting period (March 5), using hardwood cuttings (HC), were for 50.83% of the seedlings was measured a root length over 7 cm. There were not observed significant differences between green cuttings and semi-hardwood cuttings for both untreated and treated variants (Table 3).

Table 3. Mean values of the root development (root length) of different vegetative cuttings, planted in different periods of the year, (different letters indicate significant difference at $p<0.05$).

Variants	March 5 – HC			June 5 - GC			August 5 - SHC		
	RC	Root length (cm)		RC	Root length (cm)		RC	Root length (cm)	
		≤7 cm	>7 cm		≤7 cm	>7cm		≤7 cm	>7cm
Control (no IBA)	90	90^{b}	-	72	72^{B}	-	84	84^{b}	
IBA 3000 ppm	240	108^{aB}	122^{A}	162	102^{aB}	60^{C}	168	104^{aB}	64^{C}

CONCLUSIONS

Use of Indol-3-Butyric Acid 3000 ppm showed to have a significant effect on rooting of different vegetative cuttings of kiwifruit, taken in different periods of the year. Hardwood cuttings, taken in January 20-30 and planted in March 5, treated with IBA 3000 ppm, rooted 24% and 26% more than semi-hardwood cuttings, planted in August, and greenwood cuttings, planted in June. Use of IBA 3000 showed a significant positive effect on rooting percentage of vegetative cuttings and produced seedling quantity and quality of kiwifruit in all planting periods. More than 51% of seedlings produced by hardwood cuttings were of first quality, while for other vegetative cuttings, semi-hardwood and green cuttings, first quality were 38% and 37%.

For best quality kiwifruit seedlings, we recommend the use IBA 3000 ppm and of as planting period the beginning of March, using hardwood cuttings.

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