EFFECT OF DIFFERENT NAA AND IBA CONCENTRATIONS ON ROOTING OF VEGETATIVE CUTTINGS OF TWO ROSE CULTIVARS

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Abstract: *Rose (Rosa sp) is one of the most used ornamental plants for decoration of parks and gardens, and as cut flower, all over the world, as well in Albania. The paper presents the effect of two different concentrations of NAA and IBA on rooting of vegetative cuttings of two cut flower rose cultivars. Study was conducted during 2009 in a flower greenhouse nursery in Kamëz, Tirana. A randomized complete block design (RCBD) with three replications and five variants per replication, with 100 cuttings (pots) per variant was used. Vegetative axillary cuttings 15 cm long were dipped for 20 seconds in 500 and 1000 ppm powders of Naphthalene Acetic Acid (NAA) and Indole-3-Butyric Acid (IBA), and were planted in individual pots filled with a mixture 50/50 potting soil and perlite. Survival (rooting) percentage (%), number of roots per cuttings, root length (cm), sprout length every ten days after rooting and at the end of vegetation (cm) were recorded. The data showed that use of different rooting hormones affected the recorded characters of both cultivars, and the different hormone concentrations affected them, as well. Compared to control (untreated cuttings), use of rooting hormones provided significantly higher values of recorded characters of both cultivars, and there were shown differences between cultivars, too. Maximal survival percentage was recorded by using IBA 500 ppm for both cultivars (91% and 89%, respectively), the maximal number of roots (50 and 47 roots) and the longest roots at the end of vegetation (31 and 28 cm) were recorded by using IBA 1000 ppm, but the strongest roots and healthier seedlings were developed by using IBA 500 ppm. At the same time, the use of rooting hormones has positively affected sprout length. The longest sprouts were developed by using IBA 500 ppm (66 and 62.3 cm, respectivley). The increase of NAA and IBA concentration from 500 ppm up to 1000 ppm provided shorter shoots. Use of IBA 500 ppm seems to be the most sustainable practices in terms of seedling production and nature preservation.*

Key words: *IBA, NAA, Rosa sp, rooting hormones, vegetative cuttings.*

INTRODUCTION

Rose (*Rosa sp*) is one of the most used ornamental plants for decoration of parks, gardens, welts, and as cut flower, all over the world, and in Albania, as well. In Tirana, Përmet, Shkodra, etc, rose is cultivated since hundreds years ago (VUKSANI GJ., 2004), but seedlings production is amateur till nowadays and most of rose seedlings used for bouquets are coming from Holland, Greece or Italy (SUSAJ L. & GJ JAKU, 2008). Rose is a shrub ornamental plant, originated from Near East and East Asia, which can be propagated through vegetative cuttings, grafting, grafting and rooting at the same time, layering of plants, and *in vitro* (LINDEN H., 2003; GIBELMAN R. (2002). Roses can be planted as single plants or in groups. Grafting over wild rootstocks, such as *Rosa canina inermis* and *Rosa motera,* and vegetative rooting of cuttings are two the most used propagation methods (BALAJ N. & GJ. VUKSANI, 2004; FUCHS M., 1994; RUTH K., 2003). In rose nurseries, in order to promote root initiation of vegetative cuttings there are used rooting hormones such are auxins, which were discovered in the 1930s by Dutch scientists. Auxins induce both growth of pre-existing roots and adventitious root formation, i.e., branching of the roots. In horticulture, auxins, especially NAA and IBA, are commonly applied to stimulate root initiation when rooting cuttings of plants. However, high

concentrations of auxin inhibit root elongation and instead enhance adventitious root formation (BELENDEZ K., 2008/a). Removal of the root tip can lead to inhibition of secondary root formation (HARTMAN A.H & F. T. DAVIES, 1990). Auxins regulate many physiological processes which include cell division, root initiation, apical dominance, leaf senescence, leaf and fruit abscission, fruit setting and vegetative growth, fruit ripening, and flowering (ALAN T., 2003). The most biologically active and the most practical auxins are Naphthalene Acetic Acid (NAA) and Indole-3-Butyric Acid (IBA) (BELENDEZ K., 2008/a). Auxins induce adventitious root development in cuttings used to propagate plants. Shoot cuttings of many plant species, when dipped or coated with small amounts of auxin, develop roots more quickly and in higher numbers. Most commercially available rooting powders take advantage of this effect (INTERCHEM, 2007; KHAN et al., 2006). Rooting hormones for plants are wonderful stuff, when used correctly, they dramatically increase the odds of success with propagation. It can be used on ornamental plants, as well as corms and bulbs. Rooting hormones work on a variety of cuttings, including new growth, brittle stems, woody stems, and others. They are also useful for grafting, and dramatically increase the success of grafted plants. After absorption of the cells, NAA and IAA cause a fairly rapid increase in the cell wall extensibility in coleoptiles and young stems (VANZILE J., 2001). FUCHS (1994) says that use of auxins positively affect rooting ability of rose cuttings of different cultivars and rootstocks.

HARTMAN A.H & F. T. DAVIES (1990) have demonstrated that hormone concentration has a direct action on root formation process, while VANZILE (2001) suggests that vegetative cuttings of roses must be put into water few hours before treating with powder rooting hormones, such as NAA and IAA because cuttings with good turgor have higher rooting percentage and shoot growth rate (GOODY J., 1993).

BELENDEZ (2008/b) says that she has successfully taken and rooted rose cuttings with both new and old wood. It is important to let the new stems sufficiently mature. The new wood is usually mature enough after the stem has just finished blooming. If you don't let the stem mature enough, then it usually becomes limp and will die before you can get it to root. Rose cuttings that do not root die 3-4 days after planting and we can differentiate them by black color at their endpoint because of tissue oxidation. The time of taking cuttings is an important factor which affects rooting percentage and the quality of rose morphological features. Certain times of the year are more beneficial for taking rose cuttings. The milder weather of late winter and early spring is ideal for greenhouses (BELENDEZ K., 2008/a).

Length of vegetative cuttings affects rooting quality parameters. Best results are obtained using 15-20 cm cuttings with 4-5 buds and internodes (BELENDEZ K., 2008/b; KHAN et al., 2006).

MATERIAL AND METHODS

Study was conducted during 2009 in a flower greenhouse (nursery), property of F. Shahini, in Kamëz, Tirana. A randomized complete block design (RCBD) with three replications and five variants (different hormones and concentrations) per replication, with 100 cuttings (pots) per variant was used. Studied variants were: V_1 – control (cuttings not treated with rooting hormones), V_2 – cuttings treated with NAA 500 ppm, V_3 - cuttings treated with NAA 1000 ppm, V_4 - cuttings treated with IBA 500 ppm, and V_5 - cuttings treated with IBA 1000 ppm.

There were used two rose cultivars, Christopher Columbus and Vay Vicend. Vegetative axillary cuttings were taken from tested healthy mother plants, 15-20 cm in length, and were planted immediately, during January 10-15. Cuttings were dipped for few seconds in 500 and 1000 ppm powders of Naphthalene Acetic Acid (NAA) and Indole-3-Butyric Acid (IBA), according to variants, slightly higher than the planting depth, the excess powder was

shaked off by lightly tapping the cuttings against the edge of the pot, and were planted in individual pots filled with a mixture 50/50 potting soil and perlite. This is a very light blend that encourages the roots to grow quickly (BELENDEZ K., 2008/b).

The bottom end of cuttings were 2-5 cm near a node, under the first bud, the upper cut was 2 cm over last bud, on the opposite side. From cuttings were removed all leaves and flowers. To prevent crushing the rose stem there were used sharp cutters. Rose cuttings were labeled with their proper name. Cuttings were planted to root in the flower greenhouse at 18-23^{o}C, moist at all times, with a good air circulation and sunlight. In the bottom ends of the rose cuttings scrape off some of the stem with a knife to induce rooting. After all the stems are stuck into the soil (pot), the soil around all the cuttings was lightly tamp down, and there were inserted plastic labels in each pot with the name of the rose variety and the date of the cutting (Fig. 1).

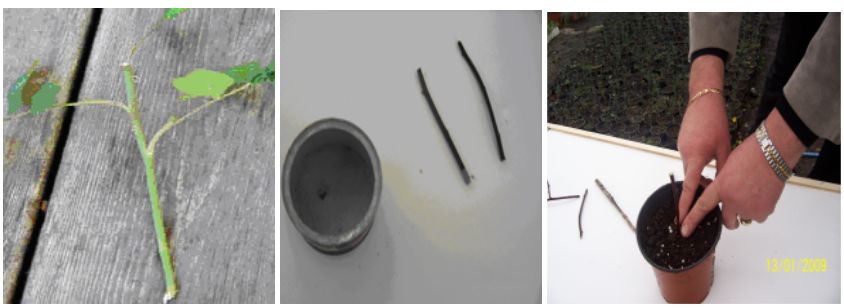

Figure 1. Prepared cuttings, hormone powder and planting in individual pots

After that, pots were placed under controlled climatic conditions and pots soil was completely irrigated. Rooting of the cuttings occurs four to eight weeks, after cuttings planting, depending on the weather and the rose variety (Belendez K., 2008/a), but under controlled environmental conditions, it is can occur at any time. After complete rooting, 80 days after planting, the other practices are the same for both variants and cultivars (except prior hormone treatment).

Cuttings rooting percentage (%), number of roots per cuttings, root length (cm), sprout length after rooting and at the end of vegetation (cm) were evaluated and recorded periodically, every ten days, starting from 30 to 80 days. Cuttings rooting percentage (%), number of roots per cuttings, root length (cm), and sprout length after rooting, were measured in a randomly chosen sample of 10 seedlings. The last measurement of sprout length was carried out 150 days after planting of the seedlings in the field, or 240 days after cuttings planting in the nursery, at the end of the vegetation period. The obtained results by the use of rooting hormones were compared to control and between them finding the effect of NAA and IBA concentration on seedlings features. Obtained data were subjected to ANOVA conducted by MSTAT-C (PAPAKRONI H., 2001). The significance of differences among mean values was tested by LSD test.

RESULTS AND DISCUSSIONS

Effect of rooting hormone concentration on rooting percentage of cuttings

The first verification of cuttings was carried out at the third day after planting and in continuous looking for oxidised cuttings, while the last control was carried out 80 days after planting, on April 1-10. Use of rooting hormones was essential on quality enhancing of rose

seedlings. Cuttings rooting percentage (%) was affected by the used rooting hormone and its concentration. Control (no hormone treatment) recorded the lowest rooting percentage, 51% and 46%, for Christopher Columbus and Vay Vicend, respectively, while the highest rooting percentage was obtained in V_4 (IBA 500 ppm) for both rose cultivars, 91% and 89%, respectively (Table 1).

Compare to control, there is a significant difference of rooting percentage, from 24 to 40%, for V_1 NAA 500 ppm and V_3 500 ppm, respectively, but differences between cultivars were not significant. The highest rooting percentage of rose cuttings was obtained by using IBA 500 ppm, to both cultivars.

Table 1

Mean values of rooting percentage, according to variants and cultivars (different letters indicate significant difference at P<0.05)

Variants	Treatments	C. Colombo	***V. Vicend***
V_1	Control, no treatment	51 cd	46 d
V_2	NAA 500 ppm	75 c	71 c
V_3	NAA 1000 ppm	83 bc	82 bc
V_4	IBA 500 ppm	91 a	89 ab
V_5	IBA 1000 ppm	88 ab	89 ab

The increase of NAA concentration from 500 ppm to 1000 ppm was followed by a significant increase of rooting percentage, while the increase of IBA concentration from 500 ppm to 1000 ppm did not show any significant difference on rooting percentage for both cultivars. Obtained data were similar to KHAN et al. (2006) for tomato seedlings, SUSAJ et al. (2011) for *Thuya occidentalis* "Emeraud", etc.

Effect of rooting hormone concentration on the number of roots per cuttings

Counting of the number of roots per cuttings and mean root length was carried out 80 days after planting (April 1-10) using 10 chosen randomly seedlings per variant per replication. Seedlings were cleaned by pot dressing and roots were accounted and measured. Treated cuttings showed high values of the root number per seedling (cuttings) compare to control for both cultivars. IBA concentration 1000 ppm showed the highest root number, but roots are weaker than under effect of IBA 500 ppm. Christopher Colombus showed higher rooting ability compare to Vay Vicend (Table 2).

There were obtained longer roots by treatment of rose cuttings with IBA 1000 ppm for both cultivars, but thiker and helthier roots were obtained using IBA 500 ppm. Treatment with IBA was more effective than NAA for the same concentration (Table 2 and 3).

Table 2

Mean root number and mean root length (cm), according to variants and cultivars (different letters indicate significant difference at P<0.05)

Variants	Treatments	Mean root number		***Mean root length (cm)***	
		C. Colombus	V. Vicend	C. Colombus	V. Vicend
V_1	Control	13 de	11 e	15 cd	12 d
V_2	NAA 500 ppm	29 cd	24 d	21 bc	18 c
V_3	NAA 1000 ppm	34 bc	27 c	23 bc	20 c
V_4	IBA 500 ppm	42 b	36 bc	26 b	22 bc
V_5	IBA 1000 ppm	50 a	47 ab	31 a	28 ab

Table 3

Mean root length (cm) every ten days, according to variants and cultivars

Variants	Christopher Colombus						Vay Vicend					
	Days after planting						Days after planting					
	30	40	50	60	70	80	30	40	50	60	70	80
V_1	0.7	1.5	3	7	10	15	0.5	1.1	2	5	8	12
V_2	1.8	2.7	6	12	16	21	1.5	2	5	11	14	18
V_3	1.9	2.9	7	13	18	23	2	3.5	7	13	17	20
V_4	2.2	3	7	15	19	26	2	3	6	12	16	22
V_5	2.8	6	10	17	23	31	3	5	8	13	20	28

Effect of hormone treatment and concentration on sprout length (cm)

The sprout length is very important for cut flowers and for roses, as well. Sprout (stem) length and plant height, in general, do affect positively on the number of flowers per plant and flower quality. The state of root system, roots number, roots length and their water and nutrient absorption capability do affect directly the sprout length (BELENDEZ K., 2008/b).

The sprout length was measured every ten days, starting form 30 days after planting, at the same time with the measurement of the root length, using 10 chosen randomly seedlings per variant per replication. The last measurement in the nursery was carried out 80 days after planting (April 1-10), while the last measurement was carried out in the field, at the end of the vegetation period. The sprout measurement 80 days and 240 days after cuttings planting showed that from treated seedlings were obtained higher values compare to control, for both cultivars. IBA concentration 500 ppm showed the highest length values (34.2 and 66 cm, and 32.6 and 63.2 cm, for C. Colombus and Vay Vicend, respectively). IBA treatment was more effective than NAA for the same concentration. Treated cuttings with IBA 500 ppm showed helthier seedlings, with more roots and longer sprouts compare to the other treatments for both cultivars. Christopher Colombus formed helthier and longer sprouts compare to Vay Vicend, maybe it is variety characteristics (Table 4). Taking into consideration the nature preservation and the environmental pollution, and seedling qualities, IBA concentration of 500 ppm (RAMA P., 2010), seems to be more effective than NAA of both concentrations and IBA 1000 ppm.

Table 4

Mean sprout length (cm) every ten days and at the end of the vegetation period, according to variants and cultivars

Variants	Christopher Colombus							Vay Vicend						
	Days after planting							Days after planting						
	30	40	50	60	70	80	240	30	40	50	60	70	80	240
V_1	2	4.1	6.2	9.3	13.7	16.9	51.3	1.2	3.1	5.4	9.3	12.6	16.1	46.1
V_2	2.5	5.3	8.4	12.7	17.4	22.5	57.1	1.5	3.6	6.3	11.5	14.7	18.2	54
V_3	3.1	6.2	8.7	17.5	19.6	26.3	59.3	2.2	4.3	8.2	15.1	18.2	26.5	55.7
V_4	5.3	9.5	13.7	21.3	29.5	34.2	66	4.3	8.2	12.5	19.2	27.8	32.6	62.3
V_5	4.1	8.3	11.4	19.1	25.2	29.1	63.1	2.5	6.1	11.4	18.2	24.3	31.1	59.2

a) b) c) d)

Figure 2. a) Rooted cuttings 80 days after planting in the nursery; b) newly formed roots; c) C. Colombus seedlings, and d) Vay Vicend seedlings at the end of the vegetation period

CONCLUSIONS

The use of rooting hormones (auxins) does affect the seedlings quality of rose cultivars originated from axillary vegetative cuttings.

Treated vegetative cuttings show higher rooting percentage, root number, root length, and sprout length, compare to control (untreated cuttings).

Maximal rooting percentage was recorded by using IBA 500 ppm for both cultivars (91% and 89%, respectively), the maximal number of roots (50 and 47 roots) and the longest roots at the end of vegetation (31 and 28 cm) were recorded by using IBA 1000 ppm, but the strongest roots and healthier seedlings were developed by using IBA 500 ppm.

Christopher Colombus showed higher rooting ability compare to Vay Vicend for the same rooting hormone and concentration, maybe because of variety characteristics.

Taking into consideration the nature preservation, environmental pollution, and seedling quality, IBA concentration of 500 ppm, seems to be more effective than NAA of both concentrations and IBA 1000 ppm.

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