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Evaluations of Indole Butyric Acid (IBA) for Stenting Propagation of Cut Rose at Bahir Dar conditions, Noth-western of Ethiopia

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Abstract
Many of reproducers of ornamental plants use auxin to root cuttings of the plants..Their effects are however influenced by environmental conditions, types of plants, the rooting media and the concentrations used. This research was therefore mainly conducted to evaluate the effects of IBA concentrations *viz* 0ppm, 1000ppm, 1500ppm, 2000ppm, 2500ppm, and 3000ppm on growth and development of stenting-propagated roses under the environmental conditions of Bahir Dar which is not yet reported in Ethiopia. Natal Break and Acpinc varieties were used as rootstock and scion respectively. Stenting-propagated rose cuttings were treated with quick dip method in solutions containing the respective IBA-concentrations. After air drying, six stem cuttings were planted in pots (90x150mm) that were filled with coco peat as rooting medium. The experiment was laid down in completely randomized design with four replications in the propagation house of Tana Flora PLC. The results revealed that treating of the cuttings with IBA promoted the growth and development of both root and shoot system of stenting-propagated rose cuttings. The performance of rose cuttings treated with 1500 ppm of IBA was however the best in all growth parameters which can be recommended for the study area.
Keywords: auxin, hormone, rose cuttings, rooting, plant height, fresh weight

INTRODUCTION

The development of the floriculture industry especially roses production and its export in Ethiopia has experienced unique and unexpected high speed in the last decade. In 2008, the land under flower cultivation was only 922 ha, and it has increased to over 1,442 ha in 2012. In the same period of time the export earnings from floriculture increased from US $ 111.7 to over US $ 212 million by exporting 1,021 to 2,102millions of flower stems. Hence, Ethiopia is currently become the second largest flower exporter in Africa next to Kenya. Besides, thousands of jobs have been created in and around these flower farms (Ministry of Trade & Industry (MoTI), 2014).

Moreover, the number of commercial horticultural farms is increasing from year to year which produce especially floricultural crops for export market. According to MoTI (2014), about 84 farms are producing different horticultural crops including cut flowers, herbs and vegetables in more than 1400 ha of greenhouses. Most of the farms which produce especially floricultural crops are concentrated around Addis Ababa at 100 kilo meter radius. However, nowadays floriculture farms are also established in other big cities like Bahir Dar located about 560 km northwestern of Addis Ababa. Despite of encouraging achievements observed in the floriculture industry of the country in recent time, it is still low compared to the existing potentials of the country for floriculture.

Among the ornamental plants roses are the dominant cut flowers which accounts more than 80% of the cut flowers produced in Ethiopia. The remaining 20% of the cut flowers is covered by chrysanthemums, poinsettia and geranium, and bouquet fillers primarily Hypericum,Carnation, Gypsophila, Allium and Carthamus (Van der *et al*,2011).

Roses are conventionally propagated by cutting, budding, grafting and layering methods. Grafting and cutting are indeed the common propagation methods used in commercial rose production (Izadi *et al,*2014). The Netherland Scientists have developed a technology for quick propagation of roses whereby cuttings of rootstock and grafting of the scion cuttings are performed in one action where wild rose varieties such as *Rosa caninainermis* and *Rosa motera* are widely used as rootstock (Balaj,etal,2004, Fuchs,1994). Such a new technique of rose propagation is known as stenting (Belendez,2008, Van De et.al,1982).With this method of rose propagation, formation of the graft union and root initiation and development from cuttings are occurred simultaneously. According to the authors, the technology is best performed in controlled propagation structure like greenhouses using continuous misting operations. The production of planting materials is thus possible in four to six weeks and of flowers within only four months. Therefore, stenting can be performed all year round (Izadi *et al,*2014, Nazari,2009,and Belendez,2008). The success of the technology however depends upon many factors including types of cuttings, age and portion of the branch, growing media, moisture level, nutrient status and temperature (Izadi *et al,*2014, Park et.al,2015and Dole etal,2006). Provision of optimal growing conditions including the concentration of plant growth promoting hormones are paramount important for the establishment and growth of the cuttings used for vegetative propagation.

Growth promoting hormones like auxins are nowadys used commercially in the propagation industry for rooting of many ornamental plants including roses (Martin, 2012, Abu-Zahra *et al*., 2012) since they influence the growth and development of plant cells. Among the auxins, Indole Butyric acid (IBA) and Naphtalin Acetic acid (NAA) are typically used for rooting of cuttings of the majority of plant species including roses. Their effect however depends on the concentration applied and the age of cuttings (Henrique, 2006, Ly *et al*., 2013; Ibrahim, *et al*., 2015). The concentrations of these auxins recommended by the manufacturers are quite general and not specific to roses and it may also differ with environmental conditions (Akhta et.al,2002, Hartmann et.al, 1990). Hence, investigating the optimal concentration of IBA under specific environmental conditions for specific crop is necessary. The present study was therefore mainly conducted to evaluate the effects of different concentrations of IBA on stem cutting for growth and development of stenting-propagated roses in Bahir Dar, Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in the propagation house of Tana Flora PLC in Bahir Dar, north western Ethiopia from December 2013 to January 2014.The study area has an altitude of 1850 meter above sea level and located at 11.71^{O} N latitude and 37.30^{O} E longitude. The average annual rainfall of the study area is about 1250mm, and the minimum and maximum temperatures are about 10.5^{0}C and 27^{0}C, respectively.

The propagation house was equipped with necessary misting facility which is arranged to mist intermittently for 30 seconds at every five minutes interval between 9:00 am and 6:00 pm depending on daily temperature. The average temperature and relative humidity in the propagation house were 35^{O}C and 85%, respectively. The light intensity in the propagation house was adjusted automatically to 50% (diffused light). The house was also provided with good air circulation through automated side and open top vents.

Experimental Materials

In this experiment, rose varieties of Natal Break and Acpinc were used as rootstock and scion, respectively which are commonly used in Ethiopia. While hardwood cuttings of the variety having two to three leaves were used as a scion, rootstocks of six cm long having similar age and diameter with that of the rootstock were used in the experiment. Both the rootstock and the scion were taken from healthy branches of the respective mother plants as described by Belendez,2008.As a source of IBA, Hormande brand water soluble Hortus imported from the Netherlands was used. Coco peat produced from waste products of coconut palm (*Cocos nucifera*) imported from Israel was used as propagation medium which was filled in plastic pots with the size of 90x150 mm

Propagation procedure

The scions were prepared and grafted on rootstock cuttings using with simple whip grafting (splice grafting) method as described by Younis, A., 2005. Accordingly, the top cut of the rootstocks and the bottom end cut of the scions were cut at angle of 45^{O} so as to fit the cut surfaces of one partner exactly with that of the other to facilitate the joining process. For best cambial contact of scion and rootstock, the two plant parts were fixed with clipper. The bottom ends of grafted cuttings were then wounded by making vertical cuts using clean and sharp knife to facilitate root induction.

Experimental Treatments and Design

Six concentrations of IBA such 0, 1000, 1500, 2000, 2500, and 3000ppm were prepared by weighing the respective quantity of IBA and by dissolving it in water. The application of IBA was done by dipping the basal portion of grafted stem cuttings in the respective hormone concentrations at to the depth of 2cm for five seconds, whereas the control cuttings were dipped in water without IBA. After drying of the treated portion, six uniform-sized and treated stem cuttings of rose were planted in plastic pots which were previously filled with coco peat as rooting medium. To neutralize the pH value of coco peat, 2 kg calcium nitrate ($CaNO_3$) was added. Treatments (pots) were laid in completely randomized design (CRD) with four replications on propagation bench.

Management of Experimental Plants

For successful rooting, stem cuttings of plants including roses should be kept moist throughout the experiment [22]. Therefore, they were misted for 30 seconds at five minutes interval between 9 am and 6 pm depending on the daily temperature. The propagation house was ventilated through side and top ventilators.Whenever the temperature rose above 35°C, the side and top ventilators were left open to maintain the temperature and relative humidity of the propagation house.

After 35 days, all seedlings were transferred to hardening room and watering was provided three times a day by showering without misting. During hardening process, shade net put over the top of cuttings in the greenhouse was removed from 10:00 am up to 5:00 pm to expose seedlings to full sunlight. After 5:00 pm, shade net was placed again on the top of the seedlings. The required macro-and micro-nutrients were supplied through irrigation water.

Data Collection and Analysis

Various growth parameters of stem cuttings of rose were evaluated after 45 days of planting. For that purpose, seedlings were carefully uprooted and media particles adhered to roots were removed with great care by hand and the following parameters were recorded.

Root number: roots emerged from four randomly selected seedlings were counted and the average values were taken for further analysis.

Root length (cm): The length of the longest root was measured from the point of emergency to the tip using linear meter and the average length taken from four randomly selected sample seedlings was taken for further analysis.

Root fresh weight (g/plant): The fresh weights of emerged roots of four randomly selected sample seedlings were measured using electrical sensitive balance and the average values were were used for analysis.

Root dry weight (g/plant)*:* The roots of four randomly selected sample seedlings were dried in oven for 24 hours at 60^0C and weighed using electrical sensitive balance. The average values were then taken for further analysis.

Length of the shoots (cm): The lengths of newly grown shoots of four randomly selected sample seedlings were measured from the point of emergency to the tip using linear meter and the average lengths were taken.

Shoot fresh weight (g/plant): The fresh weights of newly grown shoots of four randomly selected sample seedlings were measured by using electrical sensitive balance and the average weights were taken for further analysis.

Shoot dry weight (g/plant): The dry weights of newly grown shoots of four randomly selected sample seedlings were dried in oven for 24 hours at 60^0C and weighed using electrical sensitive balance. The average values were then taken for further analysis.

Leaf number: The newly grown leaves from four randomly selected sample seedlings were counted and the average leaf numbers were taken.

The collected data were subjected to analysis of variance (ANOVA) using SAS software computer program version 9.0. Mean comparison was performed using Least Significant Difference Test (LSD) at1% or 5% significant level.

RESULTS AND DISCUSSION

The growth of the aboveground parts of stenting-propagated rose seedlings are affected by all IBA concentrations used in this study (Table 1 & Figure 1). Both the fresh and dry weights of as well as the height and leaf number of rose cuttings were highly significantly affected by the IBA concentrations compared to the untreated control. However, the highest aboveground growth parameters such as SFW (2.35 g), SDW (0.81 g), SL (18.12 cm) and LN (65.75) were obtained from rose cuttings treated with 1500ppm of IBA. The performance of untreated rose cuttings was least in all aboveground growth parameters observed in this study. Rose cuttings treated with 1500ppm of IBA were about 108.0% longer and produced about 209.2%, 440.0% and 78.3% more SFW, SDW and LN, respectively, compared to the untreated control (Figure 1).

Similarly, the underground parts of the rose cuttings were also highly significantly influenced by the IBA concentrations used in this study (Table 2). The highest RFW (0.85 g), RDW (0.29 g), number (64.56) and length (13.5 cm) of the roots of the cuttings were observed in stenting-propagated rose seedlings which were supplied by 1500ppm of IBA hormone. The RFW, RDW, RN and RL of rose cuttings treated with the IBA concentration of 1500ppm were more by 254.2%, 1350%, 109.6% and 131.2%, respectively, compared to the control cuttings (Figure 2).

Growth promoting hormones affect the growth and development of plants. These effects can be used in the progagation industry of various crop plants including roses (Hartmann, 1990). Their performance is however influenced among others by the types and concentrations used as decribed by various researchers (Dole and Gibson, 2006; Belendez, 2008; Abu-Zahra *et al*., 2012; Martin, 2012; Ly *et al*., 2013; Ibrahim, *et al*., 2015).

Among auxins, IBA is the most common hormone used in the propagation industry of floricultural crops like roses. As indicated in this study the concentration ranges from 1000 to 3000 ppm has a positive effect on the growth and development of both above-and underground parameters of stenting- propagated rose cuttings. However the best shoot and root growth performance of cuttings were obtained when rose cuttings were treated with 1500 ppm of IBA. These results are in aggrement with the findings of Susaj *et al*. (2012) and Younis (2005) where they found a concentration of 1500ppm of IBA gave the best result in the propagation of rose plants by cutting. The results are also in agreement with the findings of Ramtin *et al.* (2011) on poinsettia where longer roots, high number of bracts, cyathium, and leaves and big bract were observed when cuttings were treated with 1500 ppm of IBA.

The results of this study clearly showed that treating stenting-propagated rose cuttings with 1500ppm of IBA increased the rooting capacity and thus the growth and development of rose cuttings under the environmental conditions of the study area. The untreated stem cuttings have shown the least root and shoot performance. Further researchs on the effects of IBA on rose cuttings using different growth media is recommended.

Above all,bsed on the result of the experiment it could be conclude in such away that the application of IBA hormone on hard wood stem cuttings significantly affect rooting capacity and shoot characters of stenting-propagated rose. Among tested IBA concentrations, stem cuttings that received 1500ppm of IBA were ascribed with better rooting capacity and shoot system under the environmental conditions of the study area. The untreated stem cuttings have shown the least root and shoot performance. From the results of this research findings pre-treating of rosestem cutting (hard wood) with 1500ppm of IBA improved the rooting capacity, growth and development of stenting-propagated roses. Further research on the effects of IBA on rose hardwood cuttings and using different growth media at different session is also recommended.

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Table 1: Aboveground growth parameters of stenting-propagated of rose cuttings as influenced by IBA concentrations

IBA concentration	Aboveground growth parameters			
	SFW (g/plant)	SDW (g/plant)	SL (cm)	LN (No/plant)
0ppm	0.76c	0.15c	8.71e	36.87d
1000ppm	1.55b	0.50b	11.00d	55.5b
1500ppm	2.35a	0.81a	18.12a	65.75a
2000ppm	1.87ab	0.49b	14.12b	57.31b
2500ppm	1.46b	0.48b	12.25c	54.25b
3000ppm	1.38b	0.36b	10.56d	46.56c
CV (%)	23.67	24.05	5.56	5.05
SE±	0.30	0.045	0.32	1.25
P-value	<0.0004	<0.0001	<0.0001	<0.0001

SFW = Shoot fresh weight; SDW = shoot dry weight; SL = Shoot length; LN = Leaf number; CV = coefficient of variance; SE = Standard deviation; P = probability; Means with the same letter/s in columen are similar

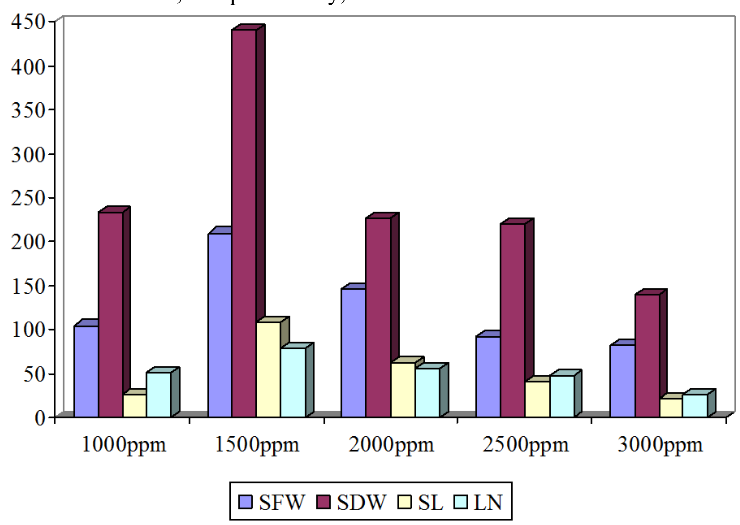

Figure 1: Percentage increament in abovegrownd growth parameters of stenting-propagated rose cuttings due to IBA application, SFW = Shoot fresh weight; SDW = shoot dry weight; SL = Shoot length; LN = Leaf number

Table 2: Underground growth parameters of stenting-propagated of rose cuttings as influenced by IBA concentrations

IBA concentration	Underground growth parameters			
	RFW (g/plant)	RDW (g/plant)	RN (No/plant)	RL (cm)
0ppm	0.24c	0.02c	30.80b	5.84b
1000ppm	0.32bc	0.11b	57.56a	8.62b
1500ppm	0.85a	0.29a	64.56a	13.50a
2000ppm	0.39bc	0.14b	54.43a	8.50b
2500ppm	0.37bc	0.12b	34.06b	6.62bc
3000ppm	0.41b	0.14b	41.50b	7.25bc
CV (%)	22.43	27.59	18.31	16.38
SE±	0.04	0.04	3.54	0.63
P-value	<0.0001	<0.0001	<0.0001	<0.0001

RFW = Root fresh weight; RDW = root dry weight; RN = root number; RL = root length; CV = coefficient of variance; SE = Standard deviation; P = probability; Means with the same letter/s in column are similar

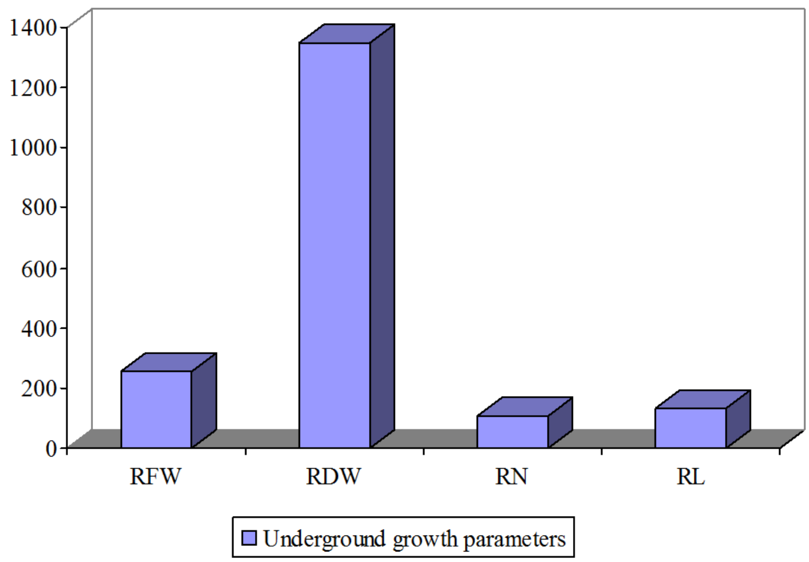

Figure 2: Increment in underground growth parameters of stenting-propagated rose cuttings due to application of 1500ppm IBA in comparison with control, RFW = Root fresh weight; RDW = root dry weight; RN = root number; RL = root length