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Effects of Rooting Hormones on the Propagation of Bougainvillea from Cuttings

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ABSTRACT

An experiment on stimulation of rooting of six Bougainvillea species using three different rooting hormones was conducted at the horticultural nursery, department of crop soil and pest management of the Federal University of Technology Akure, between the months of March to June, 2013. The experiment was laid out in Completely Block Design (CRD) with three replicates. Data were collected on number of days to sprouting, plant height, stem girth, stem length, wet root weight, dry root weight, the number of leaves per cutting and length of longest roots and subjected to Analysis of variance (ANOVA) to determine the level of significance and Tukey Test was use to separate the means. The results showed that the Indole -3-butric acid and the coconut water had significant effect on the root emergence and root growth of *Bougainvillea Species* compare to the other hormone use and the hard wood cutting also has more influence on the rooting of the *Boungainvillea* flower than the semi –hard wood cutting had no roots. Therefore root initiation in cuttings of *Boungainvillea* could be enhanced when it is soaked with the indole -3-butric acid or coconut water for 5-10 minute and growth is also enhanced by propagation with the hard wood cutting.

Keywords: Difficult to root plants, plant growth regulator, stem cutting

INTRODUCTION

The floricultural crops i.e. ornamentals which are vegetatively propagated continue to increase in popularity because of its tremendous production, marketing and garden successes experienced by individuals and floriculturist (Cerveny and James, 2005). However, moderate and difficult-to-root plant species can prevent producers from realizing their full potential as propagators (Okunlola, 2013). Application of growth stimulator and rooting hormones are the keys to overcoming this challenge, which ultimately leads to an increase in product diversity (Kesari et al. 2010). Many ornamental plants have been said to reproduce under natural conditions by asexual means (Mohammed and Hamid, 2014). Asexual or vegetative propagation of plants is that form of plant propagation in which this new individual possesses exactly the same characteristics as the parent plant from which it was taken (Sandra and Mack, 2011; Gupta et al., 2002).

Bougainvilleas are primarily propagated by stem cuttings, but lack of competence to form adventitious roots by cuttings occurs routinely and is an obstacle for the vegetative propagation (Céline *et al*., 2006). But for the purpose of this research the bougainvillea has been selected based on its economic importance and good aesthetic value with also ranking high in its difficulty of root establishment (Céline *et al*., 2006; De Klerk *et al.*, 1999). Adventitious root formation is a key step in vegetative propagation of woody or horticultural species, and problems associated with rooting of cuttings frequently result in significant economic losses (De Klerk *et al.*, 1999; Mohammed and Hamid, 2014).

The hormone that aids the growth of adventitious roots is called auxin, however synthetic forms of auxins are available commercially in the form of Indolebutyric acid (IBA) and Napthalene Acetic acid (NAA). The use of cuttings from stems, leaves, roots or terminal buds are considered the most commonly applied technique due to its practicability and simplicity especially in a developing country like Nigeria (Okunlola, 2013). However, there seems to be a major problem in the propagation of some difficult to root plant in Nigeria as the availability, accessibility and cost of procuring rooting

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hormone tends to be a major concern especially for peasant growers. But the local people have devised a means of solving this problem by using other available alternative substances apart from IBA and NAA like coconut water, and tetracycline. Hence this study was conducted to examine the effects of rooting hormones on the propagation of *bougainvillea* from cuttings in the nursery.

MATERIALS & METHOD

The field experiment was carried out from the month of March to June at the departmental nursery at Obakekere campus of The Federal University of Technology, Akure. The experimental site was manually cleared and packed using simple farm tools. The sand filled nursery bags were brought and arrange, and a shade stand built with bamboo and palms to provide shade. Materials used were; stem cuttings Bougainvillea (96), collected from stock parent within Akure. Sand (top soil) obtained from the forest was packed and sterilized by heating with fire under the drum, the soil was poured for some hours and sieved again before filling bags, polythene bags, coconut water, tetracycline and IBA were also gotten.

The experiment was made of two factors; the experiment is made up of plant types which are the Hard and Semi hard cuttings of bougainvillea and dipping of cuttings in IBA, coconut water, tetracycline for the duration of ten minutes and no dipping for the control (no treatment application). There were two cuttings for each treatment and they are replicated 3 times.

The treatments were prepared as follow:

- Treatment 1: 10gm/L of IBA
- Treatment 2: 10gm/L of Tetracycline
- Treatment 3: 100ml of coconut water
- Control: Nothing was applied

Planting was done manually immediately after filling the nursery bag with sieved top soil. A hole of 2-3 cm deep was made into the soil and the cuttings were put into it making sure 2-3 stem node are above the soil.

Method of data collection

Data collected were; length of longest root (cm) using metre rule; number of days to sprouting by counting; number of leaves per cutting (by counting); plant height (cm) using metre rule; Stem girth size (cm) using vernier calliper; Root fresh and dry weight (g) were measured using electronic sensitive scale.

All parameters were subjected to Analysis of Variance (ANOVA) to determine the level of significance of the treatments on the different cuttings of the bougainvillea plant.

RESULTS

Effect of wood cuttings on stem girth *of Bougainvillea spectabilis*

The effects of wood cuttings of the stem girth of *Bougainvillea spectabilis* at 1, 2, 3 and 4 weeks were significant ($p<0.05$). At week 1, Orange (hard wood) and both White (hard wood) and White (semi-hard wood) had the highest and lowest stem girth of 0.66cm, 0.07cm and 0.07cm respectively. At week 2, both Red (hard wood) and Orange (hard wood) and Double colour (semi-hard wood) had the highest and lowest stem girth of 0.70cm, 0.68cm and 0.28cm respectively. At week 3, Red (hard wood) and White (semi-hard wood) had the highest and lowest stem girth of 0.88cm and 0.42cm respectively. There was no significant difference in the mean separation of Purple (semi-hard wood), Double colour (semi-hard wood), Red (hard wood) and Pink (hard wood) as they have stem girth of 0.72cm, 0.72cm, 0.71cm and 0.69cm respectively. At week 4, Purple (hard wood) and both White (hard wood), Pink (semi-hard wood), Red (semi-hard wood), Pink (hard wood), Double color (semi-hard wood) and Orange (semi-hard wood) had the highest and lowest stem girth of 0.54cm, 0.52cm, 0.48cm, 0.48cm, 0.47cm and 0.46cm respectively. The result is as shown on Table 1.

Table1. *Effect of wood cuttings on stem girth of Bougainvillea spectabilis*

Treatment	Stem girth at 1 week	Stem girth at 2 weeks	Stem girth at 3 weeks	Stem girth at 4 weeks
Pink (hard wood)	0.36±.14bcd	0.52±.24abcd	0.69±.36abc	0.48±.05d
Red (hard wood)	0.50±.05b	0.70±.81a	0.88±.06a	0.66±.05bcd
Double color (hard wood)	0.39±.04bc	0.49±.71bcde	0.60±.46bc	0.67±.04bcd
Orange (hard wood)	0.66±.04a	0.68±.21a	0.79±.05ab	0.87±.76ab
White (hard wood)	0.07±.05e	0.37±.02cdef	0.49±.02de	0.54±.88d
Purple (hard wood)	0.35±.24bcd	0.65±.02ab	0.84±.53ab	0.92±.43a
Pink (semi-hard wood)	0.24±.52cd	0.36±.63cdef	0.46±.71de	0.52±.57d
Red (semi-hard wood)	0.29±.08cd	0.60±.41ab	0.71±.83abc	0.48±.94d
Double color (semi-hard wood)	0.21±.43de	0.28±.08f	0.72±.07abc	0.47±.25d
Orange (semi-hard wood)	0.33±.09cd	0.33±.09def	0.49±.30de	0.46±.31d
White (semi-hard wood)	0.07±.07e	0.32±.01ef	0.42±.25e	0.52±.86d
Purple (semi-hard wood)	0.36±.04bc	0.55±.32abc	0.72±.01abc	0.78±.80abc

Effect of wood cuttings on leaf number of *Bougainvillea spectabilis*

The effects of wood cuttings of the leaf number of *Bougainvillea spectabilis* at 1, 2, 3 and 4 weeks were significant ($p<0.05$). At week 1, Orange (hard wood), Red (hard wood) and Orange (semi-hard wood) had the highest number of leaves of 4.80, 4.48 and 4.26 at week 1, while White (semi-hard wood) had the lowest number of leaves of 0.64 at week 1. At week 2, Purple (hard wood) and White (semi-hard wood) had the highest and lowest number of leaves of 8.48 and 3.02 respectively. At week 3, Purple (hard wood) and White (hard wood) had the highest and lowest number of leaves of 14.29 and 4.56 respectively. At week 4, Purple (hard wood) and Pink (semi-hard wood) had the highest and lowest number of leaves of 14.04 and 5.39 respectively. However, the mean separation of all the treatments did not show significant difference expect for Purple (hard wood) and Purple (semi-hard wood). The result is as shown on Table 2.

Table2. *Effect of wood cuttings on number of leaves of Bougainvillea spectabilis*

Treatment	Leaf number at 1 week	Leaf number at 2 weeks	Leaf number at 3 weeks	Leaf number at 4 weeks
Pink (hard wood)	3.94±.34ab	5.02±.64cdef	8.37±.51bc	5.61±.84b
Red (hard wood)	4.48±.44a	7.48±.43ab	7.91±.52bc	7.56±.83b
Double color (hard wood)	3.32±.37ab	3.45±.73efg	6.02±.43cde	7.94±.76b
Orange (hard wood)	4.80±.32a	5.48±.49cd	7.10±.54cd	7.69±.88b
White (hard wood)	0.64±.84d	3.07±.43fg	4.53±.57e	8.04±.98b
Purple (hard wood)	3.45±.54ab	8.48±.42a	14.29±.58a	14.04±.72a
Pink (semi-hard wood)	2.47±.63bc	3.29±.38defg	4.60±.52de	5.39±.89b
Red (semi-hard wood)	3.70±.36ab	5.53±.75bc	6.32±.82cde	5.99±.56b
Double color (semi-hard wood)	1.51±.74cd	2.94±.26g	4.89±.53de	7.77±.75b
Orange (semi-hard wood)	4.26±.32a	5.32±.86cde	7.91±.55bc	6.34±.97b
White (semi-hard wood)	0.64±.36d	3.02±.41g	6.56±.59cde	8.15±.44b
Purple (semi-hard wood)	3.43±.34ab	6.80±.41abc	9.97±.52b	12.37±.42a

Effect of wood cuttings on wet root weight, dry root weight and root length of *Bougainvillea spectabilis*

The effect of wood cuttings of the wet root weight of *Bougainvillea spectabilis* was significant ($p<0.05$). Wet root weight was highest for Purple (hard wood) and lowest for Double color (semi-hard wood). There was no significant difference between Pink (semi-hard wood), Pink (hard wood) and Orange (hard wood) has they have wet root weight of 7.13g, 7.30g and 7.35g respectively. Also, there was no significant difference between Orange (semi-hard wood), White (semi-hard wood) and Purple (semi-hard wood) they have wet root weight of 5.16g, 5.46g and 5.43g respectively. The result is as shown on Table 3.

The effect of wood cuttings of the dry root weight of *Bougainvillea spectabilis* was significant ($p<0.05$). Dry root weight was highest for Pink (hard wood) and lowest for both White (semi-hard wood) and Double color (hard wood) has they have dry root weight of 0.92g, 0.33g and 0.33g respectively. There was no significant difference between Red (hard wood), Orange (hard wood), Purple (hard wood) and Purple (semi-hard wood) has they have dry root weight of 0.57g, 0.60g, 0.70g and 0.54g respectively. The result is as shown on Table 3.

The effect of wood cuttings of the root length of *Bougainvillea spectabilis* was significant ($p<0.05$). Root length was highest for Red (semi-hard wood) and Double color (semi-hard wood) as they have 16.33cm and 5.74cm root length respectively. The result is as shown on Table 3.

Table3. *Effect of wood cuttings on wet root weight, dry root weight and root length of Bougainvillea spectabilis*

Treatment	Wet root weight (g)	Dry root weight (g)	Root length (cm)
Pink (hard wood)	7.30±.62abc	0.92±.39a	8.25±.43def
Red (hard wood)	6.11±.34bcd	0.57±.19abc	12.30±.51b
Double color (hard wood)	4.00±.55de	0.33±.09c	7.28±.71ef
Orange (hard wood)	7.35±.58abc	0.60±.49abc	11.30±.41bcd
White (hard wood)	3.84±.52de	0.38±.07bc	7.63±.75ef
Purple (hard wood)	8.95±.58a	0.70±.09abc	11.79±.77bc
Pink (semi-hard wood)	7.13±.98abc	0.38±.04bc	8.43±.76cdef
Red (semi-hard wood)	7.86±.52ab	0.73±.54ab	16.33±66a
Double color (semi-hard wood)	3.30±.52e	0.41±.55bc	5.74±.68f
Orange (semi-hard wood)	5.16±.45cde	0.49±.45bc	11.44±.61bcd
White (semi-hard wood)	5.46±.33cde	0.33±.22c	6.71±.71ef
Purple (semi-hard wood)	5.43±.64cde	0.54±.24abc	9.14±.78bcde

Effect of rooting hormone on stem girth of *Bougainvillea spectabilis*

The effects of rooting hormone of the stem girth of *Bougainvillea spectabilis* at 1, 2, 3 and 4 weeks were significant ($p<0.05$). At week 1, coconut water and control has the highest and lowest stem girth of 0.48cm and 0.12cm respectively. There was no significant difference in the mean separation of rooting hormone and tetracycline on stem girth at week 1. At week 2, coconut water and control has the highest and lowest stem girth of 0.67cm and 0.30cm. There was no significant difference in the mean separation of rooting hormone and tetracycline on stem girth at week 2. At week 3, coconut water and control has the highest and lowest stem girth of 0.84cm and 0.48cm. There was no significant difference in the mean separation of rooting hormone and tetracycline on stem girth at week 3. At week 4, coconut water and control has the highest and lowest stem girth of 0.83cm and 0.25cm. The result is as shown on Table 4.

Table4.*Effect of rooting hormone on stem girth of Bougainvillea spectabilis*

Treatment	Stem girth at 1 week	Stem girth at 2 weeks	Stem girth at 3 weeks	Stem girth at 4 weeks
Rooting hormone	0.36±.02b	0.52±.03b	0.66±.04b	0.66±.03b
Coconut water	0.48±.04a	0.67±.05a	0.84±.06a	0.83±.06a
Tetracycline	0.31±.02b	0.47±.02b	0.63±.03b	0.72±.03ab
Control	0.12±.02c	0.30±.02c	0.48±.02c	0.42±.02c

Effect of rooting hormone on leaf number of *Bougainvillea spectabilis*

The effects of rooting hormone on number of leaves of *Bougainvillea spectabilis* at 1, 2, 3 and 4 weeks were significant ($p<0.05$). At week 1, coconut water and control has the highest and lowest leaf number of 4.45 and 1.29 respectively. There was no significant difference in the mean separation of rooting hormone and tetracycline on stem girth at week 1. At week 2, coconut water and control has the highest and lowest leaf number of 6.54 and 3.86 respectively. At week 3, coconut water and control has the highest and lowest leaf number of 9.29 and 5.90 respectively. At week 4, coconut water and control has the highest and lowest leaf number of 10.37 and 4.92 respectively. There was no significant difference in the mean separation of coconut water, rooting hormone and tetracycline on stem girth at week 4. The result is as shown on Table 5.

Table5. *Effect of rooting hormone on number of leaves of Bougainvillea spectabilis*

Treatment	Leaf number at 1 week	Leaf number at 2 weeks	Leaf number at 3 weeks	Leaf number at 4 weeks
Rooting hormone	3.60±.22ab	5.09±.29ab	6.91±.37bc	7.94±.54a
Coconut water	4.45±.37a	6.54±.47a	9.29±.62a	10.37±.90a
Tetracycline	2.88±.17b	4.52±.21b	7.40±.28ab	9.10±.40a
Control	1.29±.14c	3.81±.19c	5.90±.24c	4.92±.35b

Effect of rooting hormone on wet root weight, dry root weight and root length of *Bougainvillea spectabilis*

The effect of rooting hormone on wet root weight of *Bougainvillea spectabilis* was significant ($p<0.05$). The highest and lowest wet root weights were observed in coconut water (7.04g) and control (3.48g) respectively. There was no significant difference in the mean separation of coconut water, rooting hormone and tetracycline on wet root weight. The result is as shown on Table 6.

The effect of rooting hormone on dry root weight of *Bougainvillea spectabilis* was significant ($p<0.05$). The highest and lowest dry root weight was observed in coconut water (0.83g) and control (0.23g) respectively. There was no significant difference in the mean separation of rooting hormone and tetracycline on dry root weight. The result is as shown on Table 6.

The effect of rooting hormone on root length of *Bougainvillea spectabilis* was significant ($p<0.05$). The highest and lowest root length was observed in coconut water (12.05cm) and control (6.88cm) respectively. The result is as shown on Table 6.

Table6. Effect of rooting hormone on wet root weight, dry root weight and root weight of *Bougainvillea spectabilis*

Treatment	Wet root weight (g)	Dry root weight (g)	Root length (cm)
Rooting hormone	6.88±.35a	0.50±.06b	9.77±.47b
Coconut water	7.04±.57a	0.83±.10a	12.05±.78a
Tetracycline	6.56±.26a	0.56±.04b	10.08±.35ab
Control	3.48±.22b	0.23±.04c	6.88±.30c

DISCUSSION

The use of cuttings for Bougainvillea propagation was carried out in this study using hard wood and semi hard wood cuttings. The effects of using different stem cutting materials were significant for stem length at 1, 2, 3 and 4 weeks, stem girth 1, 2, 3 and 4 weeks, number of leaves 1, 2, 3 and 4 weeks, root length, wet and dry root weight. From reviews it is said that bougainvilleas are primarily propagated by stem cuttings, but lack of competence to form adventitious roots by cuttings which poses an obstacle for its vegetative propagation (Céline *et al.,* 2006).

However, the performance of the cuttings varies from one another with different parameters considered during the course of this study. Purple (hard wood) cutting had the highest stem length (10.37cm), stem girth (0.92cm) and leaf number (14.04) at week 4. Purple (hard wood) cutting also had the highest wet root weight (8.95g). This correlates with its ability to possess good vegetative growth. Adventitious root formation is a key step in vegetative propagation of woody or horticultural species, and problems associated with rooting of cuttings frequently result in significant economic losses (De Klerk *et al.,* 1999). Dry root weight on the other hand was recorded for Pink (hard wood). More so, the longest root was observed in Red (semi-hard wood).

Vegetative propagation of Bougainvillea by stem cuttings has been found to be very effective because of its simplicity and practicability in our developing countries. However the rooting rate of success is very low and varies from species to species. Due to limited rates of success in sprouting and rooting, many researchers tried various auxins for initiation of rooting in cuttings of various horticultural crops as reported by (Sherer *et al.*, 1985; Leaky *et al.*, 1982).

It is well known that the success of rooting of the woody stem cuttings, in the majority of ornamental plants and fruit trees depends mainly on the physiological stage of the mother plant [Day and Loveys, 1998], the time of planting of the cutting [Hartmann and Loreti, 1995; Darwesh, 2000] and the type of growth regulators used [Rowezak, 2001].

In this study, cuttings treated with coconut significantly increase shoot length, shoot girth, number of leaves, wet root weight, dry root weight and root length. Asma*et al.*, 2008 in their study reports that root induction was highly effected by the length of shoots and an appropriate length was pre-requisite for the efficient root formation. The use of coconut water also indirectly effected In vitro roots induction since during shoot multiplication; the addition of coconut water to the culture media resulted in maximum shoot length (7.2 ± 0.16) and hence facilitating the efficient root formation. Gupta *et al.*, (2002) reported that treatment of Bougainvillea cuttings with 1000 ppm IBA gave maximum rooting (100%) with higher number of roots in soaking method but its availability and cost of procuring it by the peasant gardeners made it of utmost importance to study and look for local and accessible alternatives which brought about the usage of coconut water and tetracycline. Panwar et al. [1994] observed the best rooting in hard wood cuttings of Bougainvillea treated with IBA 2000 ppm.

CONCLUSION

Rooting characteristics of cuttings of Bougainvillea was enhanced when soaked in coconut water and IBA while the uncontrolled and tetracycline soaked has no significant on the rooting ability of the cutting. Hard cutting used for propagation of Bougainvillea performed better in development better in development in comparison with the semi-hard cutting of the plant.

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