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Effect of Growth Promoting Substances on Selected Three Ornamental Plants

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Abstract

An experiment was conducted in the nursery, the department of Crop, Soil and Pest management the Federal University of Technology, Akure, on stimulation of rooting of three ornamentals; *Euphorbia milii, Adenium obesium, and Murraya paniculata*, (Christ thorn, Desert rose and Murraya respectively) using some rooting substances; Indole-3-butyric acid (IBA), Top soil, Coconut water and Tetracycline from July to September, 2013. The experiment was laid out in a Completely Randomized Design (CRD) and replicated four times. Data were collected on number of branches, the number of leaves per cutting, root weight, number of roots and length of roots. The results from the study showed that each of the treatment had significance ($P<0.05$) with respect to a specific plant. Tetracycline was found the best for rooting Christ thorn cuttings. Indole-3-Butyric Acid (IBA) was found the best for rooting Roses cuttings. Coconut water treatment was found the best for rooting Muraya cuttings. The different treatments produced significant variation while there was no significant variation among the three different plant cuttings, but in the interaction between the plant cuttings of the different treatments.

Keywords: Difficult-to-root plant; Root formation; Growth; Development

Introduction

Ornamental plants are essential object of environmental aesthetic beautification and management; they make up the component of urban green spaces, public parks and houses more for relaxation and enjoyment [1,2]. They are grown for the display of aesthetic features including flowers, leaves, scent and overall foliage texture- fruit, stem and bark. They are a valuable tool for the harmonious and practical resolution of many physical site problems, and they provide durable aesthetic satisfaction [3]. Generally, most perennial ornamental plants are multiplied and propagated through asexual means of reproduction such as cuttings, layering or grafting [4]. The cuttings from stems, leaves, roots or terminal buds were the commonly used techniques, due to their ability to retain the characters of the parent and also, for breeding seedless hybrid. Success of rooting ornamental plant cuttings depend on their growth responses, based on nutrient present with the aid of growth promoting substances before planting [5].

Euphorbia milii, Adenium obesium, and *Murraya paniculata* were known as 'difficult to root' ornamental plants, this difficulty led to research on propagating their stem cuttings in different growth promoting substances to observe their responses [6]. Studies have shown that physiological state of the mother plant, the prevailing environmental conditions in the nursery i.e., light, temperature and humidity play important role in rooting and developmental stages of cuttings.

According to McGregor [7] root promoting hormones like cytokinnins, gibberellins, ethylene, abscisic acid, brassinosteroids, jasmonic acids and auxins play major role in the success of rooting the cuttings. Synthetic growth treatments had these phytohormones naturally present in some plants, as active ingredients produced for commercial production. Formation of adventitious root ensure survival of the vegetative stage, this prompted several researchers to investigate the artificial means of initiating roots of stem cuttings, planted for optimum growth [8].

Although, in the production of nursery crops in containers, the selection and preparation of the medium is extremely important and could pay great dividends in terms of plant growth and quality. There is no universal or ideal rooting mix for cuttings [9] an appropriate propagation medium depends on the species, cutting type and propagation system [10]. To this end, different growth treatments and stem cuttings were explored to optimize the rooting of the ornamentals. Thus, the objective for this research was to determine the most effective growth treatment that would facilitate root development and promote rooting of each stem cutting and also to determine the best treatment that enhance vegetative growth in the stem cutting.

Materials and Methods

The experiment was stationed at the nursery of the department of Crop, Soil, and Pest management, Federal University of Technology, Akure with (7°16'N, 5°12'E) located in the rain forest vegetation zone of Nigeria between July and September 2013. The rainfall pattern of Akure is bimodal with a wet season of about seven months occurring during April to October/November and through February to March. The mean daily temperature ranges between 25°C and 37°C.

The materials used were stem cuttings of *Euphorbia milii, Adenium obesium,* and *Murraya paniculata*, (Christ thorn, Desert rose and Murraya respectively) collected from mother plant (stock plant) at Winpool garden, Exotic garden and Lucado horticultural garden within the state, also perforated plastic containers, Top soil, Tetracycline, IBA, Coconut water from matured green fruit and Distilled water. Stem cutting of apical plant cutting with leaf nodes for new root production, within range of 5 cm-10 cm of the different ornamental plants, was partly buried into the soil. Fertile top soil mixed with sandy soil in ratio

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1:1 was packed into plastic pots, for good aeration and good drainage, this was kept moist and not waterlogged, while the soil was slightly acidic with pH of 5.94. There was partial shade established to prevent cutting from dehydration, especially from hot afternoon sun which can burn off the foliage and therefore prevent diseases. 25 ml of fresh coconut water was added to 100 ml of distilled water, and each replicate of cuttings was treated with 25 parts per ml. 5 capsules equivalent of 5 g Tetracycline was dissolved in 100 ml of distilled water, and each replicate were treated with 25 parts per ml. IBA of 5 g was weighed and dissolved with 100 ml of distilled water, and each replicate was treated with 25 parts per ml. The fourth treatment was distilled water of 100 ml used to treat each replicate in 25 parts per ml as the control for the experiment.

The soil analysis was done using the procedure in the csp laboratory manual booklet. Soil pH was determined. Magnesium was determined with an atomic absorption spectrophotometer. Exchange acidity was determined by Cabonoglu et al. [11] titration method. Soil organic C was determined by the procedure of Walkley and Black using the dichromate wet oxidation method, total N was determined by micro-Kjeldahl digestion method, available P was determined by Bray- 1 extraction followed by molybdenum blue colorimetry. Exchangeable K, Ca and Mg were extracted using 1.0 N ammonium acetate. Thereafter, K was determined using flame photometer and Ca and Mg were determined using the EDTA titration method while sodium (Na) was determined by flame emission photometry. Particle size distribution was determined with a hydrometer.

The experiment was arranged in a completely randomized design (CRD) with four replicates. The data obtained were subjected to analysis of variance (ANOVA) and treatment mean were compared using Duncan's multiple range test (DMRT) at p=0.05 probability level [12]. And every 4 weeks after planting, data on plant height, stem girth, leaf length and number of leaf were taken to assess plant growth from each treatment per replicate. The ornamental plants were harvested after 12 weeks. Yield parameters such as root number, root length, leaf area and net dry weight were recorded. Soil nutrient present were also determined in relation to the initial and present nutrient content.

Soil analysis	Initial reading before planting
Sodium (C mol/kg)	29.80
Phosphorus (mg/kg)	0.45
Nitrogen (%)	4.60
Potassium (C mol/kg)	39.70
Magnesium (C mol/kg)	8.20
Calcium (C mol/kg)	45.8
Organic matter (%)	26.8
pH	5.94

Table 1: Soil chemical analysis before planting and treatment with growth substances.

Results

Initial soil analysis before the experiment showed the nutrient contents of the soil which contains higher percentage of organic matter, phosphorus, nitrogen and potassium and other nutrients in adequate proportions as shown in Table 1. However there were significant differences in the effects of each treatment on the nutrients contents of the soil with coconut water having higher significance and the control showing no significant difference (Table 2). The Table 3 showed the effect of different growth treatment on leaves number of different ornamental plants, Significant ($p<0.05$) differences were not observed between the plants cuttings used for the experiment. However, it was observed that the plants treated with coconut water had the highest number of leaves followed by Tetracycline, and IBA while the control had the lowest. Table 4 showed the response of ornamental plants within the twelve weeks of planting to number of leaves sprouting. Significant ($p<0.05$) differences were observed during the 4th and 12th week of the experiment. However, the Murraya plant had the highest number of leaves (Table 5), followed by Christ thorn while Roses had the lowest number of leaves.

The combine effect of different growing media and different ornamental species on leaves number were also analyzed as significant ($p<0.05$) differences were observed during the 1st and 3rd month of the experiment. However, Murraya plant grown with coconut water had the highest number of leaves while the Roses grown in the control experiment had the lowest number of leaves. The response of the ornamental plants to different growth treatment through number of branches per plant as evaluated in Table 6 Significant ($p<0.05$) differences were not observed throughout the months of the experiment. However, it was observed that the plants treated with Tetracycline and IBA had highest no of branches while the control had the least. Table 7 showed the response of different ornamental plant to different growth treatment on number of branches. Significant ($p<0.05$) differences were

Treatments	Species	N	P	K	Ca	Mg	Na	OM	pH
Tetracycline	Murraya	1.60a	0.15a	25.40a	14.40a	5.00a	13.50a	11.70a	6.39a
	Christ thorn	3.20b	0.07b	27.40a	14.00a	5.60a	13.40a	12.50a	6.15a
	Roses	3.50b	0.13a	29.40a	34.80b	4.00a	15.20b	14.10a	5.87a
Coconut water	Murraya	2.30a	0.14a	21.60a	43.40b	4.60a	9.50a	10.10a	6.49a
	Christ thorn	2.70ab	0.12a	26.60b	21.00a	4.60a	12.50c	11.40a	6.25a
	Roses	3.00b	0.09a	24.20b	38.60b	5.40b	11.60b	13.20a	4.87b
IBA	Murraya	3.10c	0.10a	22.80b	20.70a	4.80a	10.60a	11.70a	6.69a
	Christ thorn	1.80a	0.10a	25.00b	24.30b	5.80b	12.30a	12.60a	6.25a
	Roses	2.50b	0.14a	15.00a	44.00c	5.20b	15.00a	13.10a	5.37a
Control	Murraya	2.90a	0.09a	27.00a	4.10a	4.10a	14.60b	11.60a	6.79a
	Christ thorn	2.50a	0.12a	20.40b	4.80a	4.80a	9.20a	12.60a	6.55a
	Roses	2.20a	0.24b	27.20a	5.40a	5.40a	13.90b	13.10a	5.77a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range tests.

Table 2: Effect of the treatments on soil nutrient after planting the stem cuttings.

Treatments	4	8	12
	Weeks after planting		
Tetracycline	4.79a	5.75a	6.96a
Coconut water	4.88a	5.58a	7.04a
IBA	4.54a	5.38a	6.63a
Control	4.38a	5.00a	6.04a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 3: Response of stem cuttings on number of leaves to treatments for 12 weeks.

Treatments	4	8	12
	weeks after planting		
Murraya	5.25b	6.25b	7.38a
Christ thorn	4.94b	5.88ab	6.54a
Roses	4.56ab	5.19ab	5.56a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 4: Stem cuttings by treatment interaction effect on number of leaves for 12 weeks.

Treatments	Species	1	2	3
		Months after planting		
Tetracycline	Murraya	5.25ab	6.75a	7.45ab
	Christ thorn	4.50ab	5.75a	6.75ab
	Roses	4.00ab	5.25a	5.75ab
coconut water	Murraya	6.50b	7.50a	9.50b
	Christ thorn	4.75ab	6.00a	7.50ab
	Roses	3.75ab	4.00a	5.40ab
IBA	Murraya	4.75ab	5.75a	7.75ab
	Christ thorn	5.25ab	5.75a	7.00ab
	Roses	5.50ab	6.00a	7.50ab
Control	Murraya	4.50ab	5.00a	7.50ab
	Christ thorn	5.25ab	6.00a	6.50ab
	Roses	5.00ab	5.50a	5.00a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 5: Effect of the treatments on number of leaves of each stem cutting.

Treatments	1	2	3
	Months after planting		
Tetracycline	2.13a	2.79a	3.68a
Coconut water	2.29a	2.92a	3.47a
IBA	2.33a	2.67a	3.67a
Control	2.17	2.65a	3.25a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 6: Response of stem cuttings on number of branches to treatments for 12 weeks.

Treatments	1	2	3
	Months after planting		
Murraya	2.38a	2.88a	3.46a
Christ thorn	2.06a	2.56a	3.23a
Roses	2.31a	2.94a	3.34a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 7: Stem cuttings by treatment interaction effect on number of branches for 12 weeks.

not observed throughout the 12 weeks of the experiment. However, Muraya plant had the highest no of branches followed by Roses while Christ thorn had the lowest.

The combine effect of different growth treatment and different ornamental species on number of branches (Table 8) revealed significant ($p<0.05$) differences were observed during the 2nd and 3rd months of the experiment. However, Murraya plant grown with Tetracycline had the highest number of branches while the Christ thorn grown in the control experiment had the lowest. Treatment with coconut water and Murraya cuttings in coconut water and tetracycline had the highest number of roots and root net dry weight respectively at 12 WAP (Tables 9 and 10). The combine effect of treatments on length of roots for Murraya and Christ thorn cuttings showed a significant increase ($P<0.05$) Murraya cuttings had the longest roots over Christ thorn and rose (Table 11).

Discussion

In this study coconut water has proven effective as an efficient growth stimulant for the propagation of difficult to root plant. The research work of Khayyat et al. [13] in which soil nutrient was studied, after treatment with Coconut water to evaluate the potential of soil to sustain growth and the retained nutrient in plant, It was observed that

Treatments	Species	1	2	3
		Months after planting		
Tetracycline	Murraya	2.25a	3.00ab	3.75ab
	Christ thorn	1.75a	2.75ab	3.75ab
	Roses	1.75a	2.75ab	3.50ab
coconut water	Murraya	2.50a	2.90ab	3.25ab
	Christ thorn	2.25a	2.25ab	3.50ab
	Roses	2.75a	3.50b	4.10b
IBA	Murraya	2.50a	2.75ab	3.75ab
	Christ thorn	2.25a	2.50ab	3.75ab
	Roses	2.50a	2.75ab	3.15ab
Control	Murraya	2.25a	2.75ab	3.25ab
	Christ thorn	2.00a	2.75ab	3.50ab
	Roses	2.25a	2.75ab	3.75ab

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 8: Effect of the treatments on number of branches of each stem cutting.

Treatments	Root no	Root length	Leaf area	Net dry weight
Tetracycline	8.00a	14.32a	13.54a	4.23a
Coconut water	8.23a	14.35a	13.54a	4.55a
IBA	7.50a	13.77a	12.15a	4.27a
Control	7.00a	11.30a	11.52a	3.88a

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 9: Response of root cuttings to different treatments for 12 weeks.

	Root no	Root length	Leaf area	Net dry weight
Murraya	8.25ab	15.30bc	7.75ab	5.20b
Christ thorn	7.00a	6.33a	15.20bc	3.35a
Roses	5.50a	13.03bc	12.23ab	5.41b

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 10: Root cuttings by treatment interaction on parameters taken for 12 weeks.

Treatments	Species	Root no	Root length	Leaf area	Net dry weight (%)
Tetracycline	Murraya	16.00a	21.00bc	12.20ab	5.20a
	Christ thorn	10.00ab	7.00a	16.80d	3.30ab
	Roses	9.00a	19.00c-e	14.40ab	6.12bc
Coconut water	Murraya	17.00cd	16.50c-e	12.50ab	5.90c
	Christ thorn	11.00ab	6.00a	15.00cd	3.10ab
	Roses	7.00a	13.20bc	14.00ab	5.70bc
IBA	Murraya	12.00ab	18.90ab	10.50ab	4.50ab
	Christ thorn	8.00a	7.00a	10.40ab	3.12a
	Roses	6.00a	11.00bc	12.50ab	6.90bc
Control	Murraya	12.00ab	10.20bc	11.80ab	3.70a
	Christ thorn	10.00bc	12.30a	10.60ab	3.00ab
	Roses	6.00a	8.90ab	10.00ab	4.90b

Mean in same column followed by the same letter (s) are not significantly different ($p \leq 0.05$) by Duncan's multiple range test.

Table 11: Effect of the treatments on parameters taken for each root cutting.

Myo- inositol present in coconut has mechanism for sodium uptake, which plays a major role in the transition of ice plant from non-tolerance of soil salinity to successful adaptation of the ice plant to salinity stress, this result into sprouting and survival of the plant. Furthermore, this study of responses of different ornamental plants to growth promoting substances has shown relevant results by data analysis obtained. The results of the soil analysis of initial and after planting with treatments, the mineral nutrient absorbed by the root hairs determined their rate of sprouting and survival through Plant height, number of branches, number of leaves, number of roots, root length, leaf area and dry net weight as represented by the data. Different treatments produced significant variation while there was no significant variation among the three different plant cuttings, but in the interaction between the plant cuttings of the different treatments.

It was observed from results that maximum sprouting of Murraya was seen by treating the cuttings with Coconut water, which was enhanced by the extensive root hairs of the taproot to absorb water and needed nutrient. Also, this was due to the fact that Cytokinin present in Coconut water encourages cell division and growth. From Tables 9-11 [14] more plant root length, number and net dry weight was recorded by Roses treated with Indole-3-butyric acid, which was related with the rooting length of the lateral root induced by IBA to absorb needed nutrient, and also Auxin derivative in IBA promotes apical growth [15]. Cuttings treated with coconut water significantly increase shoot length, shoot girth, number of leaves, wet root weight, dry root weight and root length. Asma et al. [2] performed an experiment on *In vitro* propagation of kiwifruit (*Actinidia deliciosa*) using coconut water. During the study, it was observed that the 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. This enhanced root formation ultimately resulted in the high survival rate (>95%) of the grown plants.

Results from this experiment have proven that tetracycline is an efficient growth stimulator for Christ thorn as it also has added advantages in inhibiting pathogenic invasion. From recent researches, it was known that Tetracycline prevents and overpowers disease pathogens by moving through all parts of the plant, activating the immune system, thereby all other systems especially the branches are stimulated for optimum performance, even with the short adventitious root [16]. Cuttings treated with Tetracycline, Coconut water and IBA induced maximum sprouting and plant growth. Plant cuttings in the replicates within the twelve weeks of experiment had no significant differences. The treatment worked for different physiological characters independently, growers can choose based on result analyzed for desired treatment. Tetracycline was found the best for rooting Christ thorn cuttings. Indole-3-Butyric Acid (IBA) was found the best for rooting Roses cuttings [17].

Conclusion

Cuttings treated with Tetracycline, Coconut water and IBA induced maximum sprouting and plant growth. Tetracycline was found the best for rooting Christ thorn cuttings. Indole-3-Butyric Acid (IBA) was found the best for rooting Roses cuttings. Coconut water treatment was found the best for rooting Murraya. Tetracycline treatment helped the ornamental plants to fight pathogenic invasion, because all the plants with the treatment remain healthy throughout period of experiment, though Roses had slow growth development compared to others.

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