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Research Article

Propagating Stem Cuttings of Selected Shrubs and Tree Species Using Indo-3-Butyric Acid Dips

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Abstract

The use of cuttings from stems, leaves, roots or terminal buds is a common technique for plant propagation being practicable and simple. This study assessed the establishment of selected stem cuttings with and without rooting hormone. It was also to determine the part of stem most suitable for propagating selected shrubs and trees cuttings. The experiment was conducted from mid-July to mid-October 2016 at the Department of Agronomy, University of Ibadan, Ibadan. Stem cuttings were sourced within the University environs. Some 720 stem cuttings were cut with secateurs from selected growing shrubs and trees. Stems were cut into: tip, middle and hardwood parts each 20 - 25 cm long for each shrub and tree. Cuttings were treated with indole-3- butyric acid (IBA) at 0, 100, 300, 500 ppm and planted in washed river sand laid out in a completely randomized design with a 3 × 20 × 4 × 3 factorial arrangement. Data collected on five variables were subjected to analysis of variance ANOVA and significant means separated using Duncan New Multiple Range Test (DNMRT). Hormone treatment of stem cuttings had influence on the survival of plant species. Stem cuttings treated with 300ppm IBA gave the highest number of cuttings that rooted (32.41%) followed by those treated with 500 ppm (31.48%). The highest rooting was in *Acalypha rhomboidea, Codium* spp., and *Jatropha curcas* at 37.38%, 34.92% and 30.50%, respectively. The stem cuttings of *Mangifera indica, Anacardium occidentalis, Bougainvillea, Thuja standishii, Psidium guajava, Ocimum gratissimum, Citrus sinensis* and *Vitis vinifera* established poorly indicating their low rooting potentials, in particular, the responses to stem parts and levels of IBA vary among plant species. In all, IBA treatment influences propagation of stem cutting depends on the tree or shrub species.

Keywords: *Stem Cuttings; Establishment; Indole-3-Butyric Acid; Hormone; Shrubs; Tree Species*

Introduction

Vegetative propagation through the use of cuttings from stems, leaves, roots or terminal buds is a common technique for plant propagation being practicable and simple as practiced in Nigeria [1]. Technologies reported and practiced for decades by researchers and horticulturalists include stem cuttings, layering, grafting and recently cell tissue and organ culture [2].

Plant hormones (a group of naturally occurring, organic substances) are used to influence physiological processes at low concentrations measured in parts per million (ppm). In plant propagation, cuttings are dipped into a rooting hormone to stimulate root development [3]. Hormones stimulate root development, control plant height in greenhouse investigation and increase sizes of fruits also. Plant hormones are usually applied to understand and manipulate plants for specific purposes [4].

Kristiansen., *et al*. [5] reported that the establishment and growth rate of a stem cutting depends on many factors, including seasonal conditions, variation in ages of cuttings, stem portion and diameter, growing media, moisture level, nutrient status and environmental

conditions. Research on vegetative propagation treated stem cuttings with auxin (rooting hormones) such as indole-butyric acid (IBA) and naphthalene-acetic acid (NAA) [6-10]. Auxins are widely used to treat stem cutting of various woody plants. Generally, a quick-dip in IBA and NAA hormones has been used mostly to propagate plants using any stem cutting [11]. IBA is the best synthetic auxin for general use because it is not toxic to plants over a wide range of concentrations [12].

In Nigeria, diverse shrubs and trees play a crucial role in its economy. Kunjani., *et al*. [13] reported that rural people rely on plant resources for their domestic and primary health care needs. They collect the useful plants and their parts from various habitats such as forest, scrubs, and grass lands, cultivated field, wetlands and river banks. Economic shrubs and trees are indispensable in the nation's growth and development by its capacity to provide citizens with food, clothing, shelter, medicine, industrial raw materials as well as for aesthetic purposes.

The influence of the cutting position on the stem is sometimes referred to as the influence of topophysis [2]. For many years rooting ability has been known to vary between cuttings from different parts of the same plant, especially in woody species (Leakey and Mohammed, 1985) and this has correlation with the structure of the stem [14] or difference in chemical composition of the plant along the stem [14,15]. When the stem matures and gets older a continuous sclerenchyma ring between the phloem and cortex, exterior to the point of origin of adventitious roots occurs, and this hampers the root development [14].

Stem cuttings from most tree species hardly root simply by planting cuttings in substrates. Stem cuttings propagation without the use of hormone is a common practice by many farmers and garden owners but sometimes without the assurance of getting 100% success which would eventually lead to input and time loss, extra cost of labor and energy redeployment. Rooting hormone is mostly used to ensure 100% propagation work. Indole butyric acid is an auxin commonly used to promote the formation of roots in plants [16]. Raising plants from stem cuttings (asexual reproduction) reduces the time it takes plants to reach maturity compared to planting seeds (sexual reproduction).

Objective of the Study

The objectives of this study were to: i) determine the establishment of selected shrubs and trees cuttings to different concentration of Indole-3-butyric acid and ii) determine the stem parts suitable for propagating selected shrubs and trees.

Materials and Methods

Experimental site: The experiment was from mid-July to mid October 2016 at the Department of Agronomy, University of Ibadan, Ibadan [latitude 7°28'N, longitude 3°52'E, 228m above sea level and mean annual rainfall of 1289.2 mm] [17].

Experimental materials: The materials used were: selected shrubs and trees stem cuttings, indole-3-Butyric acid, bowl, sharp knife, pure water sachets (12.5 cm×15 cm), washed river sand, and secateur.

Source of planting materials: Stem cuttings were sourced within the University of Ibadan and its environs from established shrubs and trees. Stems were cut using a secateur to prevent crushing of the stem, give smooth surface, and prevent microbial infection. The young tip, intermediate and hard woody stem parts of 20 - 25 cm length of each shrub and tree were propagated.

Potting medium: All 720 poly pots were filled with washed river sand.

Preparation of the hortus IBA soluble salts: Indole-3-Butyric acid was dissolved in distilled water and adjusted to four different level of concentration of 0, 100, 300, and 500 ppm.

Application of rooting hormone: Quick dip method was used by dipping the basal 2 - 3 c m part of each stem cuttings into the IBA solution for about 3 seconds and sown into the potting mixture.

Experimental design: The experiment was laid out in a completely randomized design with a 3 replicates ×20 species×4×3 stem parts factorial structure [18].

Data collection: Data was collected on daily basis until week eight after planting and terminated. The data was collected on number of sprout, number of leaves, number of roots length of roots, and rooting percentage.

Data analysis: The mean values of data collected on all parameters were subjected to Analysis of Variance (ANOVA) using Genstat. The Duncan New Multiple Range Test (DNMRT) was used to compare means.

Results and Discussion

Soil analysis for experimental plot

Pre-planting soil analysis for physical and chemical properties of the soil had: pH 6.7, 0.96 g/kg organic carbon, 0.11 g/kg total N, 3.99 mg/kg P, 1.00 g/kg Ca, 0.44 g/kg Mg, 0.73 g/kg K, 5.56 g/kg Mn, 8.41 g/kg Fe, 0.071 g/kg Cu, 0.91 g/kg Zn, acidity 0.3 cmol/kg and a sandy textural class.

Effect of IBA on survival percentage of selected plant species

Treatment of stem cuttings influenced survival of plant species. Stem cuttings treated with 300 ppm IBA gave the highest survival (32.41%) followed by those treated with 500 ppm (31.48%). The lowest percentage was from untreated stem cuttings (control) (28.70%). Survival across the treatments was below 50%.

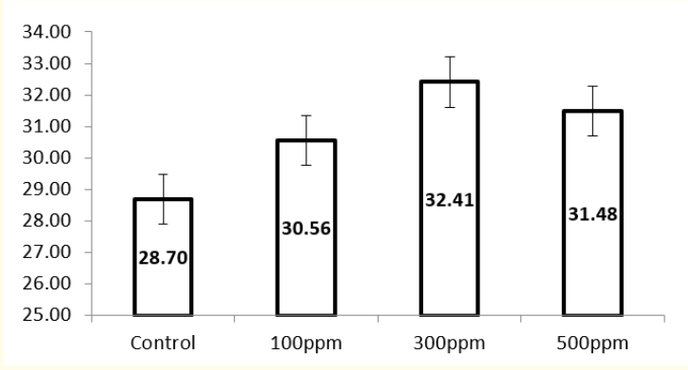

Figure 1: *Effect of IBA on survival percentage of selected plant species.*

Sprouting and rooting were highest for *Acalypha rhomboidea* (37.38%), *Codium spp* (34.92%) and *Jatropha curcas* (30.50%). *Caesalpinia pulcherrima, Artocarpus altilis, Vitis vinifera, Mangifera indica, Anacardium occidentalis, Theobroma cacao, Dillenia indica* and *Persea americana* sprouted poorest in this study.

Species	Sprout %	Leave No	Root No	Root Length	Root %
Moringa oleifera	52.78	6.58	4.40	5.56	38.89
Vernonia amygdaline	44.44	5.70	20.08	5.44	44.44
Jatropha curcas	69.44	6.24	15.80	4.68	47.22
Bougainvillea	19.44	2.25	1.50	1.19	5.56
Tecoma stans	47.22	4.06	1.63	1.49	5.56
Ixora coccinea	52.78	4.22	6.31	2.22	55.56
Codium ssp	58.33	7.56	38.87	3.40	58.33
Acalypha rhomboidea	75.00	9.07	28.06	2.86	63.89
Ocimum gratissimum	22.22	4.25	1.00	0.49	5.56
Citrus sinensis	19.44	-	2.75	2.14	11.11
Thuja standishii	27.78	11.13	-	-	-

Psidium guajava	8.33	0.50	-	-	-
Caesalpinia pulcherrima	-	-	-	-	-
Artocarpus altilis	-	-	-	-	-
Vitis vinifera	5.56	-	-	-	-
Mangifera indica	5.56	-	-	-	-
Anacardium occidentalis	5.56	-	-	-	-
Theobroma cacao	-	-	-	-	-
Dillenia indica	-	-	-	-	-
Persea americana	2.78	-	-	-	-
Mean	32.29	3.85	7.52	1.84	21.01
Sd	24.68	3.64	11.88	2.02	25.09
CV	0.76	0.95	1.58	1.10	1.19

Table 1: *Effect of IBA pre-treatment on establishment of selected plant species.*

Figure 2: *Effect of hormone pre-treatment on rooting of economic plant species.*

Vegetative propagation by stem cuttings is a useful method for growing plants with desired characteristics. The findings of this research in which plant species like *Mangifera indica*, *Anacardium occidentalis*, *Bougainvillea, Thuja standishii, Psidium guajava, Ocimum gratissimum, Citrus sinensis* and *Vitis vinifera were poorly established* is in agreement with that of Guo., *et al*. (2009) who discussed that there are great differences in the rooting potential among plant species, in particular, the responses to different types and concentrations of auxins which vary among plant species. Auxins are widely applied in stem cutting of various woody plants. Generally, quick-dipping in IBA is one of the used mostly used auxin to propagate plants by any stem cutting as reported by Dhillon., *et al* [11]. In the current study, hormone pre-treatment enhanced the establishment of different plant species. However, not all the plant species responded to the hormone used as seen in plant species like *Theobroma cacao, Dillenia indica, Caesalpinia pulcherrima* and *Artocarpus altilis* where no result was recorded throughout the study.

Conclusion

It was clearly revealed that the response of plant to hormone pre-treatment is plant dependent as other factors in other research could also play its role in plant establishment. Treatment of stem cuttings with higher concentration sometime would not give the best result. For plants whose survival was not based on hormone treatment imply such plant could be massively propagated without the use of hormone.

It is recommended that minimal concentration of hormone should be used by farmers to safe cost because the use of hormone is not the only factor for successful vegetative propagation.

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