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Abstract - An experiment was conducted at the Horticultural garden of the Federal College of Agriculture Akure Ondo State Nigeria to investigate the effects of the types of stem cuttings and stem cutting lengths on the rooting and growth of *Duranta repens* in the nursery. Stem cuttings of the plant were subjected to different treatments; stem cutting types (softwood, semi hardwood and hardwood) and lengths (10 cm and 20 cm). The experiment was conducted under normal nursery conditions to determine the types of stem cutting and stem cutting lengths best for the rooting of the plant. The experimental design was a 3 x 2 factorial in complete randomized design (CRD) with four replications. The results revealed that the type and stem cutting length had effect on the rooting of *D. repens*. Percentage rooting was higher for hardwood cuttings irrespective of the length of cutting. Hardwood cutting of 20 cm length however, gave the best rooting followed by the semi hardwood of same length. Softwood cutting of length 10 cm and 20 cm gave the poorest result.

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Keywords : cutting length, rooting, nursery, duranta repens, ornamentals.

I. Introduction

Ornamental plants are very essential in environmental beautification and management, they make public parks and houses more conducive for relaxation and enjoyment (Day and Loveys, 1998). 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 (Armstrong, 2000). They offer a variety of noticeable effects: screening, cooling, enhancement of architectural lines, enframement of views, erosion management, sun and wind control, sound deadening, and horticultural focus (Hynes, 2002). It is generally accepted that most of perennial ornamental plants are multiplied and propagated by the use of vegetative propagation; cuttings, layering or grafting (Deng Xiong, 2000). 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.

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Duranta repens (yellow bush) belongs to the family Verbanaceae, it is a spreading, large, fast-growing, multi-stemmed shrub which matures with a height 1 to 3m. The full cluster of fragrant, pale blue flowers followed by bunches of golden- orange berries are often found on the plant simultaneously which makes it very attractive (Rowezak, 2001). It is a popular ornamental used for accent plants and hedges in tropical and subtropical parts of the world because of its profuse display of flowers and fruits (Pipattanawong, 2008).

It is well known that *Duranta repens* can either be propagated through seeds or stem cuttings (Robbins and Evans, 2006). However propagation by stem cuttings is the most popular and extensively used method of vegetative propagation. Stem cuttings are classified based on their maturity as softwood, semi-hardwood and hardwood (Hartmann *et. al*, 2002). These cuttings are important because of the ease by which plants grow from them although, some are more difficult to root than others hence this study was conducted to examine the type and length of stem cuttings that is most suitable for propagating *Duranta repens* in the nursery.

II. Materials and Methods

The experiment was conducted at the Horticultural garden of the Federal College of Agriculture Akure Ondo State Nigeria April-July 2002. The state lies between 4^1 30^0 and 6^1 40^0 east of the Greenwich meridian and latitudes 50^1 45^0 and 8^0 north of the equator. It is located in the rainforest zone with two distinct seasons. The mean annual rainfall and number of rainy days in year 2002 that the study was conducted were 1495.4mm and 110 days respectively. The mean daily maximum and minimum temperatures of the area in the year were 29^0C and 21^0C and the mean monthly maximum and minimum relative humidity were 83% and 65% (the Federal University of Technology Akure Meteorological Station 2002).

The nursery was made of wood stands and covered with bamboos in 10 cm by 10 cm spaces. Top soil from the top 0-15cm depth and sand (plastering grade) were collected from the Horticultural Garden of the College. The top soil and sand were sieved and mixed manually in the ratio 1:1, the container (polythene bags of size 20 cm by 12 cm) were filled with the rooting media and lightly firmed down so that the surface is just

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one inch below the container's top edge. The physical and chemical analyses of the soil and sand were determined following routine procedure described by the Department of Crop, Soil and pest management, the Federal University of Technology Akure (Laboratory Manual, 1998) and the result presented in table 1.

Stem cuttings 10 and 20cm length each from the softwood (obtained from soft, succulent new growth of the plant that has some flexibility but does not break when bent sharply with a gradation of leaf size oldest leaves are mature while newest leaves are still small), semi-hard (taken from partially mature wood, the wood is reasonably firm and the leaves of mature size) and hardwood cuttings (taken from dormant mature stems, the wood is firm and does not bend easily) were obtained from healthy, normal stem tip growth; very early in the morning when the plant is fully turgid with a sharp thin-bladed pocket knife (the cutting tool was dipped in a mixture of one part bleach and nine part water to prevent transmitting diseases from infected plant parts to healthy ones) making the cut just below a leaf. The hardwood cuttings of same lengths 10 cm and 20 cm were taken farther back on the stems (all the cuttings had equal number of nodes). The top of each cutting were cut just above a leaf bud and the bottom cut just below another one with the top cut slanted and the bottom cut square. All the leaves on the lower half of the cuttings were removed to reduce transpiration; the cuttings were then inserted to about half its length in the rooting media maintaining the vertical orientation of the stem (ensuring that the cuttings are not upside down). The cuttings were spaced adequately to allow all the leaves receive sunlight and then watered daily after planting, except when it rained and kept free of emerging opportunistic weed seedlings by regular handpicking throughout the duration of the experiment.

The experiment was laid out in a complete randomized design (CRD) with four replications, the treatments were; cutting types (softwood, semihardwood and hardwood) and cutting length (10 cm and 20 cm).

Data collection started at three week after planting (WAP) and continued till 12 WAP when the experiment was terminated, the following parameters were measured: number of leaves, roots and sprouts (branches) were obtained by counting, length of sprouts were measured using meter rule. To measure the root length, the cuttings were uprooted by gentle digging and washed after taking the readings the cuttings were replanted in the container. The leaf area were measured using an automatic leaf area meter (Delta-T WinDIAS 3 Version 3.1v 2009 Delta-T Devices Ltd).

The data collected were subjected to analysis of variance (ANOVA).

III. Results and Discussion

Table 1 : Chemical properties of the growth media

Media type	P_H in H_2O 1:2	O/C (%)	O/M (%)	N (%)	P (mg/kg)	K^+	Na^+	Ca^{2+}	Mg^+
							(CMol/Kg)		
Sand	4.09	0.42	0.72	0.06	6.98	0.07	0.05	0.80	0.50
Topsoil	6.75	4.38	7.57	0.57	26.14	0.58	0.44	3.90	2.60
Sand +Topsoil	5.42	2.94	5.01	0.37	13.07	0.29	0.24	2.38	1.57

Table 2 : physical properties of sand and soil

Particle size %	Soil	Sand
Sand	78.0	93.0
Silt	12.0	6.0
Clay	10	1.0
Textural class	Sandy loam	Sand

Table 3 : Water capacity (%) and Percent air-porosity of the different media

Media type	Water holding capacity (%)	Percent air-porosity (%)
Sand	37.24	63.07
Topsoil	106.80	44.00
Sand+ Topsoil	147.06	45.04

Table 4 : Mean Percentage sprouting at 3 WAP

Type of cutting	Length	
	10cm	20cm
Softwood	16.7	29.2
Semi hardwood	16.7	33.3
Hardwood	33.3	33.3
Total	56.7	95.8

Table 5 : Mean number of leaves

Type of cutting	Length	
	10 cm	20 cm
S oftwood	9.5	13.0
Semi hardwood	12.8	19.7
Hardwood	13.3	25.8
Total	35.6	58.5

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Figure 1 : Mean number of sprouts due to cutting types and lengths of the woods

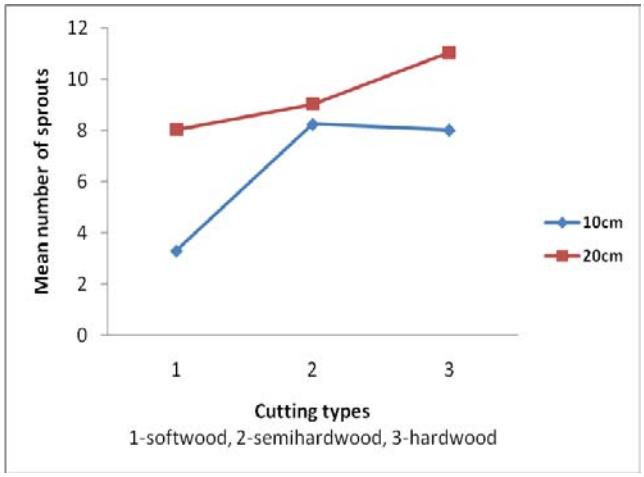
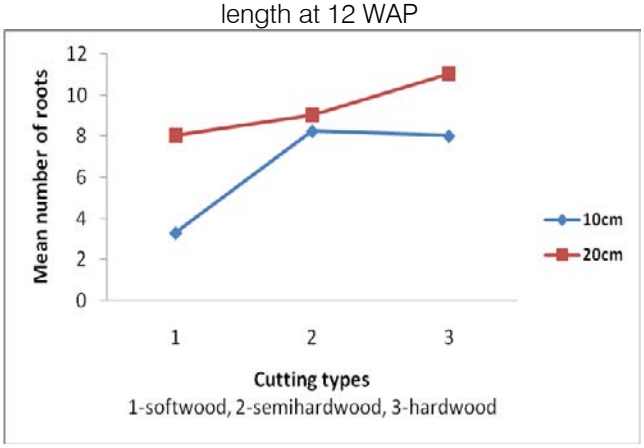


Figure 2 : Mean number of roots due to cutting type and length at 12 WAP



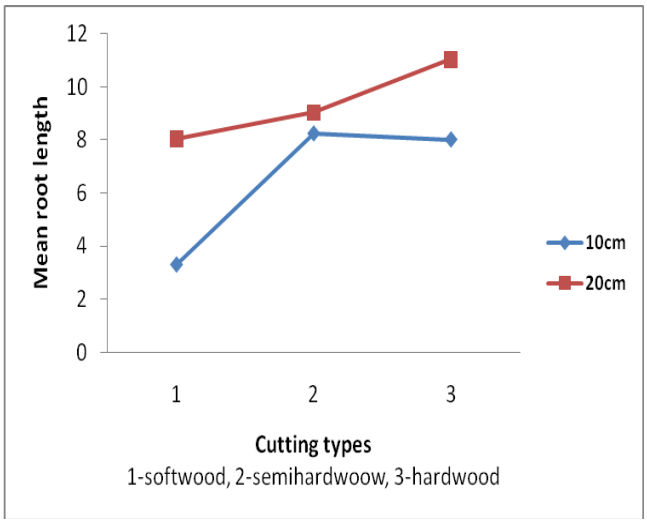


Figure 3 : Mean root length due to cutting type and length

Table 6 : Mean sprout length and leaf area due to cutting type and length of the wood

Type of cuttings	Sprout Length		Leaf Area (cm^2)	
	10cm	20cm	10cm	20cm
Softwood	6.3	12.5	4.7	5.6
Semi	5.8	13.5	3.4	8.8
Hardwood	4.8	13.0	6.6	10.6

The result from the study indicated that there were increases in the mean percent sprouting for all the cutting types (softwood, semi hard and hardwood cuttings at 20cm length) though the highest mean percentage sprouting was recorded in the semi hardwood and hardwood cuttings at 20 cm length. This support the findings of Khan et al. 2006 that the less mature a plant, generally the easier it is to root a cutting from it, also the less mature the growth stage of a plant for example the softwood the more easily it can lose water, dry out and die. In addition, Day and Loveys, 1998; Dole and Wilkins, 1999 also stated that the success of rooting of woody stem cuttings in the majority of ornamental plants depends on the physiological stage of the mother plant. Also rooting varies with the type of cutting, the species rooted and the environmental conditions.

The semi hard and hardwood cuttings of 10 cm and 20 cm length had higher number of leaves however, at 20 cm; the highest number of leaves was recorded for the hardwood cutting. The same trends was observed for the average sprout length at 12WAP the average sprout length at 20 cm were highest for all the stem cutting lengths.

The experiment was conducted during the rainy season which supports high humidity thereby reducing the heat load on the cuttings hence permitting the utilization of high light conditions to increase photosynthesis (Hartmann *et. al*, 1990; Acquaah, 2005). Leaves are the primary photosynthetic organ which captures sunlight for the process of photosynthesis towards the growth and subsequent development of the plant (Stancato et al. 2003). It is important to maintain high humidity levels while rooting vegetative stem cuttings in order to reduce water loss due to transpiration (Scianna, 2004). For average leaf area semi hardwood and hardwood cuttings at 20 cm performed better result from the study conducted by Singh, 1980 revealed that leaf area was found to be directly related to rooting.

The average numbers of roots were higher in the 20 cm length for all the stem cutting types. Result for the average root length showed that hardwood cuttings at 20 cm stem cutting length performed better than the softwood and semi hardwood however at 10cm the root length of the semi hardwood and hardwood cuttings were comparable. Root lengths for the 10 cm softwood cuttings were poor. Janick, 1986 reported that an

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important component of the capacity for a stem to root is the nutritional status of the plant. The vigorous rooting of the hardwood enabled the cuttings to absorb more nutrients and produce more leaves, Reuveni and Raviv, 1981; Karaguzel, 1997 also, the presence of leaves on cuttings exerts a strong stimulating influence on root initiation, leaves and buds are also known to be powerful auxin sources (Edmond et al, 1994).

IV. Conclusion

The result obtained from the study revealed that *D. repens* will not root easily when propagated with softwood cuttings. The semi hard and hardwood cuttings however showed good response at 20 cm length. It is therefore recommended that *D. repens* can be propagated using semi hard and hardwood cuttings of 20 cm stem cutting length.

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