NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 54 Number 1, April 2023 Pg. 623-626
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Rooting and Seedling Growth of Weeping Fig (*Ficus benjamina* L.) as Affected by Type and Length of Stem Cutting

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Abstract
Weeping fig is an important ornamental plant widely used for indoor and outdoor beautification. Difficulty in weeping fig propagation remains a major bane for its mass production in ornamental plant and landscaping industries. Experimental trials were conducted in 2020 and 2021 at the Horticultural Garden of the Department of Horticulture, Federal University of Agriculture Abeokuta, Ogun State, Nigeria to investigate the effects of type and length of stem cuttings on the rooting and early growth of Weeping fig (*Ficus benjamina* L.) in the nursery. At the pre-nursery stage, stem cutting of weeping figs was assessed for rooting characteristics and vigorous seedlings were selected and transplanted into the nursery. Treatments consisted of cuttings obtained from different types of cuttings (soft-wood, semi-hardwood and hardwood) and cutting lengths of 10 and 20 cm. The experiment was a 3 x 2 factorial arranged in a Completely Randomized Design (CRD) replicated four times. Data collected on percentage rooted cuttings, number of roots/cutting, root length/cutting, percentage sprouted cuttings, seedling height, number of leaves/seedling, percentage seedling survival, and root fresh and dry weights were subjected to Analysis of Variance (ANOVA) using Genstat statistical software. Means of the treatments were separated using the Least Significant Difference (LSD) at a 5% probability level. In 2020, semi-hardwood had 42% rooted cuttings, when hardwood had 39% rooted cuttings, while softwood had 35.38% rooted cuttings. In 2021, semi-hardwood had 38% rooted cuttings; hardwood had 35% and softwood had 31% rooted cuttings. Stem cuttings of 20 cm length had a higher percentage of rooted cuttings of 41% and seedling survival percentage of 87% than stem cuttings of 10 cm length with 29% percentage rooted cuttings and 57%, seedling survival percentage. It was recommended that a 20 cm length of semi-hardwood cutting should be used for mass propagation and optimum seedling growth of *F. benjamina*.
Keywords:* *Cutting survival percentage, cutting length, rooting, nursery, and Ficus benjamina

Introduction

Ficus is an important ornamental plant comprising over 1000 species including weeping fig (*Ficus benjamina* L.). It is widely used as an ornamental foliage plant, bonsai, a potted plant or an urban tree. It is also utilized for animal feed and as a medicinal plant. Weeping fig cultivars available in cultivation differ in waviness or colour (variegation) of leaves, leaf-drop tendency and overall size (Di Beneditto *et al.,* 2019). Besides genotypic differences, environmental constraints and handling such as propagation techniques, cutting type, cutting length, growing container/media and low irradiance often affect Weeping fig propagation and growth at production in the nursery. Reduced rooting volume may represent a major growth-limiting factor in both the variegated and non-variegated species (Di Benedetto *et al*., 2020). Improper rooting and shoot development may affect the overall performance of the seedlings.

Danthu *et al.* (2002) noted that the most economical method of propagating Weeping fig is mass production through stem cuttings, in addition to the traditional air layering technique. Although vegetative propagation is a basic method for mass-scale production of cuttings, vegetative propagation of weeping fig has not been extensively studied (Danthu *et al.*, 2002). The three main types of stem cuttings are softwood, semi-hardwood and hardwood. These terms reflect the growth stage of the stock plant, which is one of the most important factors influencing whether or not cuttings will root or not (Okunlola and Akinpetide, 2016). The success of rooting stem cuttings also depends mainly on the techniques applied and the physiological state as well as the stage of the mother plant, the time of planting, the length of cuttings and the type of cuttings used. (Di Beneditto *et al*., 2018).

Joshee *et al*. (2002) reported that micro-propagation techniques require a more indigenous approach, mostly in Nigeria and Africa and similar areas where there are no stable electricity and adequate irrigation facilities, therefore, sustainable and simple propagation methods are suggested. The objective of this study was to determine the type and length of stem cutting of *Ficus benjamina* for optimum rooting ability and seedling growth.

Materials and Methods

Trials were conducted at the Experimental Nursery of the Department of Horticulture, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria between May and November 2020 and 2021. The site is located on Latitude 7°15' N, Longitude 3°25' E and altitude 100 m above sea level with annual mean temperature ranging from 26.90 ^{0}C to 29.20 ^{0}C. The stem cuttings were sourced from randomly selected weeping fig trees (about 10 years old) within the Federal University of Agriculture, Abeokuta. The cuttings were defoliated of the leaves to two per cutting and trimmed to the required length (10 and 20 cm) by removing the terminal portions just above a bud. This was done very early in the morning when the plant was fully turgid with a sharp thin-bladed secateur (the cutting tool was dipped in a mixture of one part bleach mixed with nine parts water to prevent transmitting diseases from infected plant parts to healthy ones) Treatments consisted of two factors: (i) stem cutting (Hardwood(HW) (15 mm-16 mm girths, Semi-hardwood (SH) (5.7 mm-6 mm girth) and Softwood (SW) (2.7 mm- 3 mm girth); (ii) cutting length; (ii) stem cutting of 10 cm (2-3nodes) and 20 cm (3- 4 nodes). The experiment was a 3 x 2 factorial arranged in Completely Randomized Design (CRD) for both the pre-nursery and nursery phases. Six (6) treatment combinations were used and 480 plants made up the experimental unit. In the pre-nursery phase, each treatment contained 5 polyethene pots, replicated four times to have a total of 30 cuttings per treatment to give 180 plants. At the nursery phase, two plants were per treatment, with four replications arranged in double rows (1 m x 2 m spacing). Data were collected on: the percentage rooted cutting, number of roots per cutting, percentage sprouting (%), seedling height (cm) per seedling, seedling survival percentage/seedling, length of longest root (cm), root fresh and root dry weights (g/cutting). Data collected on rooting and growth parameters were subjected to Analysis of Variance (ANOVA) using GenStat discovery (12th edition) and significant treatment means were compared using the Least Significant Difference (LSD) at 5% probability ($p \leq 0.05$).

Results and Discussion

Percentage rooted cutting (%), number and length (cm) of roots

Semi-hardwood had 42% and 38% rooted cuttings, respectively in 2020 and 2021 (Table 1). Hardwood had 39 and 35% and softwood had 35.38 and 31%, in 2020 and 2021 respectively. Seedlings raised from semi-hardwood cuttings had the longest and more number of roots (5.29 cm; 9.22), compared with those raised from hardwood (4.48 cm; 5.12) and softwood cuttings (2.7 cm; 8.12), respectively. Stem cuttings 20 cm long proved superior to 10 cm long cuttings (Table 1). This could be a result of semi-hardwood cutting having more active buds or cells which in turn brought about favorable conditions for root initiation and higher rooting percentage. Higher nutrient reserve in the 20 cm cutting could also be responsible, as suggested by Veneklaas *et al*. (2002) that the plant part's age affects the success of rooting and older tissues have abundant carbohydrate food reserves. The present finding is however not in conformity with Reddy *et al.* (2008b) as reported by Di Beneditto *et al. (*2020a).

Percentage sprouted cutting (%)

Percentage (%) sprouting of weeping fig cutting during the 2020 and 2021 experiments showed that 20 cm cutting length obtained from semi-hardwood performed better than 10 cm long cuttings, but there were no significant differences when compared to other stem types (Table 2). This finding could be due to possession of more active buds and higher food reserve, leading to 20 cm cuttings recording more sprouts than 10 cm long cuttings (Table 2). It may also be associated with the level of cytokinin production and transport from roots since plant root apices are the main source of the hormone at a whole-plant level. This finding conforms with what Di Benedetto *et al*. (2018) reported by Di Benedetto *et al*. (2020a)

Seedling survival percentage (%)

The highest seedling survival percentage (87%) was observed in semi-hardwood compared with those raised from softwood cuttings (78%); the least in value was from hardwood (50%). Stem cuttings with a 20 cm length had a higher seedling survival percentage (86%) than stem cuttings with a 10 cm length (57%), respectively after transplanting (Table 3). This might have resulted from the development of an effective root system and an increase in the number and length of roots per cutting which might have influenced the uptake of water and nutrients. The present investigation conforms with the findings of Reddy *et al.* (2008a) in weeping fig.

Root dry and fresh weight (g)

There was no significant difference in the effects of cutting type on root fresh and dry weight, but the length of cutting was significantly effective (Table 3). Interaction effects of type and length of stem cuttings were only significant ($p \leq 0.05$) on seedling survival percentage, root fresh and dry weights. Semi-hardwood cutting of weeping fig at 20 cm length had optimum rooting characteristics and seedling growth (Table 3).

Conclusion

The study demonstrated that semi-hardwood stem cuttings of weeping fig plants, particularly those 20 cm in length, exhibited superior performance in terms of rooting, sprouting, and seedling survival compared to hardwood and softwood cuttings. The success of rooting and seedling growth was likely influenced by the presence of active buds, higher nutrient reserves, and potentially elevated levels of cytokinins in the semi-hardwood cuttings. These findings underscore the importance of selecting the appropriate cutting type and length to optimize the propagation and establishment of weeping fig plants. Further research could delve into the specific physiological mechanisms underlying the observed differences in rooting and seedling performance among different cutting types and lengths.

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Table 1: Effects of type and length of stem cutting on percentage rooted cutting, number and length of roots of weeping fig at the pre-nursery stage in 2020 and 2021

Treatment	Percentage rooted cutting (%)		Number of roots		Length of longest root (cm)	
	2020	2021	2020	2021	2020	2021
Type of Cutting (T)						
Hardwood	38.53	35.03	4.5	5.12	4.09	4.56
Semi-hardwood	41.72	38.12	7.53	9.22	5.69	7.22
Softwood	35.38	30.88	6.41	8.06	4.28	5.25
LSD(p<0.05)	NS	NS	NS	NS	NS	NS
Length of Cutting (L)						
10 cm	28.42	28.62	4.62	6.17	2.98	4.15
20 cm	48.67	41.02	7.67	8.77	6.4	7.21
LSD (p<0.05)	13.29	12.98	NS	NS	3.04	3.37
Interaction						
T x L	NS	NS	NS	NS	NS	NS

NS – Not significant

Table 2: Effect of types and length of cuttings on Percentage sprouting of Weeping fig Seedlings at a pre-nursery stage in 2020 and 2021

	2020				2021			
	Weeks After Planting							
Treatment	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Type of Cutting (T)								
Hardwood	1.16	23.53	25.06	38.53	0.91	18.16	25.19	35.03
Semi-hardwood	1.25	23.47	27.09	41.72	1.16	22.16	29.59	38.12
Softwood	1.06	20.38	16.59	35.38	1.06	21.34	25.38	30.88
LSD (p<0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Length of Cutting (L)								
10 cm	0.85	14.67	18.54	28.42	0.85	17.56	21.48	28.62
20 cm	1.46	26.25	31.29	48.67	1.23	23.54	30.54	41.02
LSD(p<0.05)	0.4	6.82	12.17	13.29	0.39	6.98	NS	12.98
Interaction								
T x L	NS	NS	*	NS	*	NS	NS	NS

NS – Not significant

Table 3: Root fresh weight, root dry weight, seedling survival, number of roots and length of longest root of weeping fig as affected by type and length of cuttings after Transplanting into the nursery

Treatments	Root fresh weight (g)		Root dry weight (g)		Percentage survival (%)			Number of roots	
	Week After Transplanting								
	4	6	4	8	8	12	16	16	16
Type of Cutting (T)									
Hardwood	0.28	0.22	0.13	0.1	30.47	25.2	50.00	1.83	5.72
Semi-hardwood	0.42	0.15	0.2	0.07	62.5	37.5	87.5	2.51	2.29
Softwood	0.63	0.15	0.28	0.07	57.03	23.44	78.91	1.83	4.48
LSD (p<0.05)	0.19	NS	0.1	NS	15.05	12.28	11.49	NS	2.76
Length of Cutting(L)									
10 cm	0.33	0.08	0.18	0.03	36.98	23.96	57.29	2.23	3.76
20 cm	0.56	0.27	0.23	0.13	63.02	33.33	86.98	1.88	4.56
LSD (P<0.05)	0.19	0.12	NS	0.06	15.05	NS	11.49	NS	NS
Interaction									
T x L	NS	NS	NS	NS	*	*	*	NS	NS

*WAP – Weeks After Planting; * - Significant; NS – Not significant*