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Effects of growth hormones, rooting media and leaf size on juvenile stem cuttings of *Buchholzia coriacea* Engler

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Abstract. Effects of growth hormones, rooting media and leaf size on juvenile stem cuttings of *Buchholzia coriacea* were investigated. Two hundred and sixteen single node cuttings were obtained from two month old seedlings of *Buchholzia coriacea*. Half had their leaves reduced while the remaining retained their original leaf size. Cuttings were treated with indole butyric acid (IBA), naphthalene acetic acid (NAA) and a combination of the hormones (IBA/NAA) at 0, 50, 100 and 150 mg/l and planted in three rooting media-topsoil, riversand and sawdust giving a 3 x 4 x 3 x 2 factorial design. Cuttings were assessed for percentage survival, number of roots, length of longest root and total root length. ANOVA was carried out on the data collected and LSD at 5% probability level used to compare significantly different means. Survival percentage of 96.3% was recorded. The highest mean values of 3.8 cm and 12.5 cm in root length and total root length were recorded in topsoil. Control had the highest number of roots - 4.8. Leaf size had a highly significant effect on the rooting of the cuttings as whole leaf rooted better than half leaves. Single node cuttings of *Buchholzia coriacea* is amenable to cloning with or without auxin treatment.
Keywords *Buchholzia coriacea,* growth hormone, leaf size, macropropagation, rooting media.

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Introduction

Buchholzia coriacea, also known as wonderful kola or musk tree, is a member of the family Capparaceae. It is an understorey forest tree with large, glossy, leathery leaves and conspicuous creamy white flowers. The species extends from Cote d'Ivoire to Gabon in Africa. The seeds of *B. coriacea* are edible and have medicinal value. According to Adisa et al. (2010), the seeds are used traditionally for treating diabetes, hypertension, rheumatism, cold, cough and catarrh. The stem and bark of the tree exhibited a high concentration-de-

pendent antibacterial and antifungal activity when subjected to methanol extract (Ajaiyeoba et al. 2003, Ezekiel and Onyeoziri 2009). There are about 2-3 seeds in a fruit. They are blackish with a spicy taste. The leaves are large and ellipsoid between 15-25 cm long and 5-7.5 cm broad (Keay 1989). The utilisation of forest resources range from the provision of raw materials for the ever increasing industry to yielding poles and fuel wood for domestic consumption, regulation of water regime and climate, protection from desertification and satisfaction of recreational needs (Cunningham 1993). Within the forest zone, several woody plants of nutritional importance occur naturally. The fruits, seeds, leaves, twigs and occasionally flowers of these plants form common ingredients in a variety of traditional Nigerian dishes (Cunningham 1993). Attempts made to establish large plantations of some forest tree species have showed little or no success due to inadequate silvicultural knowledge about the mode of planting, soil type, suitable nutrient requirements, nursery techniques and early growth behaviour, that will guarantee effective seed germination. Delay in germination in the nursery is a serious constraint on the efficiency of nursery management. Hence, there is need for alternative sources of planting materials. Indeed, it has been reported that knowledge of reproductive biology is very limited for most tropical tree species (Bawa et al. 1990, National Research Council 1991).

During the time, is that detailed knowledge has been mainly restricted to temperate tree species of economic importance, whereas for most indigenous/non-timber species silvicultural knowledge has not advanced beyond the initial observation stage. Inevitably, many species under threat or loss of genetic diversity are those of least current economic importance for which knowledge is greatly restricted. Therefore, this study investigated the effect of growth hormones (IBA, NAA and IBA/NAA at 50, 100 and 150 mg/L) and rooting media (topsoil, sawdust and riversand) on whole leaf and half leaf cuttings of *B. coriacea*.

Materials and methods

Seeds of *B. coriacea* were collected from south western Nigeria and used to raise seedlings in the greenhouse of the Department of Forest Resources Management, University of Ibadan, Nigeria (Table 1). The University of Ibadan campus is located north of Ibadan along Oyo road at approximately latitude 7°28'N and longitude 3°52'E. It is at an altitude of 277 m above sea level. The climate is the West Africa monsoon with dry and wet seasons. The dry season is usually from November through March and is characterized by dry cold wind of harmattan. The wet season usually starts

Table 1 Selected seed sources of *B. coriacea* in south western Nigeria

S/N	Selected sources	Identification		Location		Rainfall (mm)	FAO soil type
		Country	State	Latitude	Longitude		
1	Erifun	Nigeria	Ogun	6°93'	3°46'	1488	Dystric nitosols
2	Olukosi	Nigeria	Ogun	7°46'	3°03'	1174	Lithosols
3	Ore Forest Reserve	Nigeria	Ondo	6°74'	4°86'	1749	Ferric luvisols
4	Ogbere	Nigeria	Ogun	6°73'	4°15'	1687	Dystric regosols
5	Ago-Owu Forest Reserve	Nigeria	Osun	7°24'	4°33'	1466	Ferric luvisols
6	Omo Forest Reserve	Nigeria	Ogun	6°35'	4°05'	2180	Ferric luvisols
7	Eleiyele	Nigeria	Oyo	7°51'	3°56'	1253	Ferric luvisols

from April to October, with occasional strong winds and thunderstorms. Annual rainfall is about 1300 mm while mean annual temperature ranges between a maximum of 34°C and a minimum of 22°C.

Two months after germination, single node leafy stem cuttings were obtained from fifty four (54) uniformly growing seedlings. A total of two hundred and sixteen (216) leafy stem cuttings were obtained from the seedlings. One hundred and eight (108) stem cuttings had each of their leaves reduced to half the original leaf size while the remaining one hundred and eight stem cuttings retained their original leaf. The cuttings were treated with indole butyric acid (IBA), naphthalene acetic acid (NAA) and a combination of the hormones (IBA/NAA) at different concentrations of 0, 50, 100 and 150 mg/l using the quick dip method (Oni 1987). The hormones were prepared and the single node cuttings dipped into the hormones and immediately transferred to the rooting media. There were twelve (12) cuttings/auxin concentration. The cuttings were planted in three (3) different rooting media namely topsoil, alluvial riversand and thoroughly decomposed sawdust and arranged in a 3 x 4 x 3 x 2 factorial design on the bench in the green house under a high humidity propagator. Watering was done twice daily with a knapsack sprayer. The cuttings were assessed for the following parameters after 60 days: percentage survival which was determined as the number of living plants per total cutting planted per treatment; number of new roots formed per cutting, length of longest root per cutting and total root length per cutting. Analysis of variance (ANOVA) was carried out on the data collected for the different parameters and least significant difference (LSD) at 5% probability level was used to compare the significantly different means using STATISTICA software package.

Results

Percentage survival of cuttings

Percentage survival of the cuttings of *Buchholzia coriacea* showed substantial variations among the leaf size and hormone concentrations; and rooting media and hormone concentration ($p < 0.05$). From ANOVA, interactions between leaf size and concentration of hormones were observed to have significant effect on seedlings' survival percentage. The highest survival percentage with a mean value of 97.2% was obtained among whole leaf size while half leaf size had 93.5% (Table 2). Hormones at 150 mg/l concentration had the highest mean value of 98.1% for survival percentage, hormones at 100mg/l concentration had 96.3%, the control (no hormones) had 94.4% while hormones at 50 mg/l concentration re-

Table 2 Effect of leaf size and concentration of hormones on the number of roots, root length, total root length and percentage survival of juvenile stem cuttings

Treatments	Number of roots	Root length (cm)	Total root length (cm)	Percentage survival (%)
Leaf size				
Whole leaf	4.9[a]	3.3[a]	13.5[a]	97.2[a]
Half leaf	2.6[b]	2.5[b]	5.9[b]	93.5[b]
Concentration of hormones				
Control	4.8[a]	3.4[a]	13.2[a]	94.4[a]
50 mg/l	3.0[b]	2.3[b]	7.8[b]	92.6[b]
100 mg/l	3.0[b]	2.4[b]	6.6[b]	96.3[c]
150 mg/l	4.0[a]	3.3[a]	11.2[a]	98.1[c]

Note: For each experimental factor, any two numbers from the same column followed by the same letter are not significantly different at $p = 0.05$ level (ANOVA test).

corded the least, 92.6%.

In the interaction of rooting media and hormone concentration, it was observed that 100% survival percentage of cuttings were recorded in cuttings planted in topsoil and hormones at 100 and 150 mg/l concentration; sawdust with hormones at zero and 150 mg/l concentration and riversand with hormones at zero concentration. Topsoil with hormones at zero concentration had the least mean of 83.3%. Interaction between cuttings with full leaf size and hormones at 150 mg/l concentration had 100% survival percentage while the least mean of 92.6% was observed in cuttings with half leaf size and hormones at 50 mg/l concentration (Table 3).

Number of roots

Leaf size and hormone concentration had significant effect on the number of roots produced ($p < 0.05$). The rooting medium and the type of hormone did not have any significant effect on the number of roots produced by the cuttings. The interaction between rooting media and concentration of hormones had significant effect on the rooting of the cuttings. Whole leaf size had higher mean value of 4.9 for number of roots while half leaf size had 2.6 indicating a highly significant difference in the number of roots produced by both sizes (Table 2). The control (no hormone) and 150 mg/l were observed to significantly affect the number of roots produced by the cuttings. The control had the highest mean value of 4.8 for number of roots followed by 150 mg/l concentration with 4.0, while 50 and 100 mg/l concentration of hormone had 3.0 each. The interaction between rooting media and hormone concentration showed that Sawdust x zero concentration had the highest number of roots of 7.3 (Table 3). Both zero concentration of hormone and topsoil rooting medium; and sawdust rooting medium plus 150 mg/l concentration of hormone had 4.3 while river sand x 50 mg/l had the least mean value of 2.5. For number of roots, there were highly significant differences among the control with sawdust as the rooting medium and all other interactions between rooting medium and hormone concentration.

Root length and total root length

Rooting media, leaf size and concentration of hormones had significant effects on root development ($p < 0.05$). There was no significant

Table 3 Effect of rooting media and hormone concentration on the number of roots, total root length and percentage survival of juvenile stem cuttings

Rooting medium/ hormone concentration	Number of roots	Total root length	Percentage survival
Topsoil x Control	4.3[a]	14.2[a]	83.3[a]
Topsoil x 50 mg/l	3.6[b]	12.1[a]	94.4[b]
Topsoil x 100 mg/l	3.1[b]	9.6[b]	100.0[c]
Topsoil x 150 mg/l	3.6[b]	14.1[a]	100.0[c]
Sawdust x Control	7.3[d]	20.7[c]	100.0[c]
Sawdust x 50 mg/l	2.9[c]	7.4[d]	94.4[b]
Sawdust x 100 mg/l	2.8[c]	5.3[d]	94.4[b]
Sawdust x 150 mg/l	4.3[a]	12.3[a]	100.0[c]
Riversand x Control	2.8[c]	4.7[d]	100.0[c]
Riversand x 50 mg/l	2.5[d]	3.9[e]	88.9[b]
Riversand x 100 mg/l	3.2[b]	4.9[d]	94.4[b]
Riversand x 150 mg/l	4.2[a]	7.2[d]	94.4[b]

Note: Any two numbers from the same column followed by the same letter are not significantly different at $p = 0.05$ level (ANOVA test).

Table 4 Effect of rooting media on root length and total root length of juvenile stem cuttings of *Buchhol zia coriacea*

Rooting medium	Root length (cm)	Total root length (cm)
Topsoil	3.8[a]	12.5[a]
Sawdust	3.4[a]	11.4[a]
Riversand	1.4[b]	5.2[b]

Note: Any two numbers from the same column followed by the same letter are not signifi cantly different at $p = 0.05$ level (ANOVA test)

difference ($p < 0.05$) in the type of hormone used and the various interactions of all the factors on the development of roots. Whole leaf size had the higher mean value of 3.3 cm for root length while half leaf size had 2.5 cm (Table 2). Topsoil had the highest value of 3.8 cm for root length while riversand had the least, 1.4 cm (Table 4). The control experiment (zero concentration of hormone) had the highest mean value of 3.4 cm for root length. One hundred (100) mg/l concentration of hormone and 50 mg/l concentration of hormone had values of 2.4 cm and 2.3 cm respectively.

Rooting media, leaf size and concentration of hormones had significant effect on the total root length. Interactions between rooting media and leaf area; and rooting media and concentration of hormones had significant effect on the total number of roots. Whole leaf size had the higher mean value of 13.5 cm for total root length while half leaf size had 5.9 cm. Topsoil had the highest value of 12.5 cm for total root length while sawdust and river sand had 11.4 cm and 5.2 cm respectively (Table 2). Total root lengths produced by the cuttings in topsoil and sawdust were not significantly different from each other but were different from those produced using riversand. The control experiment had the highest mean value of 13.2 cm for total root length. One hundred and fifty mg/l concentration of hormone had a value of 11.2 cm, 50 mg/l concentration of hormone had a value of 7.8 cm and while 100 mg/l concentration of hormone had the least value of 6.6 cm. Interactions between topsoil and whole leaf size had the highest mean value of 18.4 cm for total root length; interactions between sawdust and whole leaf size had a value of 15.3 cm. Interactions between sawdust and half leaf size had a value of 7.6 cm while interactions between topsoil and half leaf size had the least mean value of 6.6 cm. Interactions between riversand and half leaf size had a value of 6.7 cm. Zero concentration, using sawdust as the rooting medium had total root length of 20.7 cm. Also, zero concentration using topsoil as the rooting medium had 14.2 cm. Topsoil with 150 mg/l concentration of hormone had total root length of 14.1 cm while sawdust with 150 mg/l concentration of hormone had total root length of 12.3 cm. The least mean was observed in riversand with 50 mg/l concentration of hormone with a value of 3.9 cm. There were significant differences between total root length produced by rooting media topsoil and sawdust at zero and 150 mg/l concentration of hormone but no significant difference in other levels of interaction between rooting media and hormone concentration.

Discussion

The result of this experiment indicated the important role of determining the optimal rooting medium in the process of vegetative propagation. Retention of leaves seems to be necessary for the cuttings as they do not have very large reserves. The ability of cuttings to survive and produce long and massive roots is very important. Sawdust, followed by topsoil were able to serve this purpose in the studied species. Riversand was too porous and could not keep enough humidity required by the cuttings. The

presence of sufficient nutrients in decomposed sawdust and topsoil also gave them an edge over riversand that did not contain any nutrient. The use of external hormone in stimulating root growth or length is not necessary in this species. Cuttings without hormones and those with 150 mg/l concentration of hormones were not statistically different from each other. The type of hormone used did not have any effect on the cuttings either in the production of massive or long roots. Cuttings with whole leaf size actually produced better results than those with half leaf area.

The findings from this study agree with Oni and Ojo (2002) who reported that *Massularia acuminata* is amenable to cloning with or without auxin treatment. Also, Tchiogio and Duguma (1998) discovered that stem cuttings of *Calliandra calothyrsus* rooted better in a 1:1 mixture of fine sand and rotted sawdust. They also discovered that the addition of growth hormones had little overall effect on the percentage of rooted cuttings. The effect of different auxin concentrations, leaf size and propagation media on rooting ability of leafy stem cuttings of *Milicea excelsa* were also investigated by Ofori et al (1996). They indicated that IBA had no significant effect on the final rooting percentage although values declined with successive increase in IBA concentration above 0.2% and the highest rooting percentage was recorded in sawdust. However, Majeed et al (2009) recorded the highest rooting rate (50%) for *Aesculus indica* cuttings treated with IBA at 2000ppm. Baul et al (2008) also observed a similar trend in the vegetative propagation of *Stereospermum suaveolens* with cuttings treated with 0.2% IBA producing the longest root. Tchoundjeu et al. (1998) also concluded that cuttings of *Prunus africana* rooted better in sawdust and in sand-sawdust mixture than sand alone. They observed that the mean number of roots was proportional to leaf area. Contrary to the above findings, Mesen et al. (1997) worked on the effects of different concentrations of IBA, rooting media and cutting origins on the rooting of leafy stem cuttings of *Cordia alliodora*. They observed that increasing concentrations of IBA inhibited bud growth but higher rooting percentages were recorded in gravel and sand than in sawdust.

Conclusion

This study provides preliminary results concerning vegetative propagation of *Buchholzia coriacea.* The cuttings require a medium that is not too open but still allows for good drainage and sufficient spaces to prevent water logging and subsequent rooting of the cuttings. The retention of some active leaves on the cuttings is also important. The best result was actually obtained in cuttings with no hormone at all. The introduction of small quantity of hormone hindered the production of roots in this species. Single node cuttings of *Buchholzia coriacea* is amenable to cloning with or without auxin treatment.

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