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INFLUENCE OF CLONAL VARIATION AND CUTTING POSITION ON ROOTING OF DACRYODES EDULIS (G. DON) H. J. LAM.

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ABSTRACT: The effects of cutting position and clonal variation were investigated on rooting of *Dacryodes edulis* (G. Don) H. J. Lam. at the nursery of Moist Forest Research Station, Benin City. Single – node leafy stem cuttings were made from six coppicing trees each constituting a genetic origin from both the apical and basal region of stems of harvested shoots. Cuttings were all treated with 0.2% concentration of Indole-3- butyric acid (IBA). The experiment was a 2x6 factorial and laid out in a completely randomised design in non – mist propagators, hermetically sealed with a temperature range of 24^0C-33^0C. Decomposed sawdust was used as the propagation medium and 360 cuttings were used in the experiment. Variables taken were root length, root numbers and rooting percentage.

Clonal variation and cutting position had highly significant effect on root length ($P < 0.05$). Interaction (clone x cutting position) was also significant for root length development. Among the six clones investigated, C1 clone cuttings had the highest mean root length and from the apical region of the shoot. Neither of the tested factors had effect on root number and rooting percentage nor did the interaction between them ($P > 0.05$). The finding reveals that *D. edulis* is sensitive to both clonal variation and cutting position and amenable to vegetative propagation using leafy stem cuttings.

KEYWORDS: Vegetative propagation, cuttings, clones, rooting, *Dacryodes edulis*, propagators.

1 INTRODUCTION

New initiatives in tropical forest tree improvement aim at developing cultivars of trees with desired fruits, nut and medicinal characteristics. Forest tree improvement programmes have traditionally been timber –oriented and it is only in the last 10 years that high-value agroforestry trees, especially those for fruit/nut production have been the subject of domestication and improvement of yield and quality (Leakey *et al.,* 2004). Vegetative propagation or cloning is of practical value in tree improvement programs as it offers greater genetic gain through broad sense heritability which allows genetic evaluation of genotypes and their interaction with the environment through clonal testing (Zobel and Talbert, 1991). It offers the opportunity to rapidly overcome the limitations to domestication imposed by long gestation time, irregular fruiting and outbreeding.

There are many advantages for plant species that can be propagated early by cutting. Numerous new plants can be propagated in a restricted area from a few stock plants. Unlike the other asexual methods like grafting, budding and micro propagation, cutting is easy, cheap and quick (Hartmann *et al*., 1997). Vegetative propagation using stem cutting is an effective alternative means of raising planting stock for species with irregular seed production, recalcitrant seeds or for clonal propagation (Noor Aini *et al*.,1994). However, the development of adventitious root can be influenced by different factors such as genetic potentials, position of cutting, hormone, rooting media, environmental and physical factors (Wilson, 1993).

Dacryodes edulis also known as African pear is a medium-sized, evergreen tree attaining a height of 18-40m in the forest but not exceeding 12m in plantations. It is grown in southern Nigeria, Cameroon and DR Congo for its nutritional fruit rich in oil. It is dioecious with an allogamous reproduction system (Kengue *et al.* 2002). The fruit serves as a very important and strategic food supplement, being normally available during the ´hunger periods` following the planting of most staple food crops. The seeds are fed to sheep and goats and its potential in animal feed formulation has been indicated (Okafor and

Okolo, 1994). Different parts of the plant are locally used for the treatment of ailments such as toothaches (Maponguemetsen, 1994), stomach pains, dysentry, anaemia and various skin diseases (Adjanohoun *et al*., 1988). The wood has general use for tool handles, particularly axe shafts and occasionally for mortars and is suitable for carpentry. The bark is aromatic; on injury yields a resin that is used as pitch on calabashes and for mending earthenware. The leaves contain a dye and the tree can produce 7-8t/ha of oil (Burkil, 1994).

OBJECTIVES

The broad objective is to macropropagate *Dacryodes edulis* using leafy stem cuttings. The study also seeks to specifically;

(a) Investigate the effect of cuttings position that is, apical and basal portions of the stem on rooting of the species.

(b) Determine the effect of clonal variation on the rooting ability of the species.

2 MATERIALS AND METHODS

STUDY AREA

The experiment was carried out in the nursery of the Moist Forest Research Station, Benin City, Edo State, Nigeria, located within latitude 6^{o} 32'N and longitude 5^{o} 58'E; 99m above sea level. The mean annual temperature range between 27^{0}C and 32^{0}C and the mean annual rainfall is 2078mm.

PROPAGATORS

The high–humidity, non-mist propagators used in this experiment are as described by (Leakey *et al.*, 1990). These propagators consist of a wooden frame enclosed in clear polythene sheets so that the base of the propagator is watertight (3m x 1mx 1m), and the lid is hermetically sealed with temperature that ranged between 24^{0}C and 33^{0}C. The propagators were set three (3) days prior to the experiment and the propagation medium was treated with fungicide.

CUTTINGS PREPARATION

The juvenile cuttings used in this study were made from apical and basal regions of stems of harvested shoots from six (6) coppicing trees distanced at least 300m from each other, each constituting a genetic origin. The harvested shoots were sprayed with water from a knapsack sprayer and kept in labelled polythene bags for transportation to the on-station nursery of the Moist Forest Research Station. Using a sharp blade, pest and disease-free shoots were cut into single-node cuttings in preparation for planting according to the experimental design. All the cuttings were treated with 0.2% concentration of Indole-3- butyric acid (IBA) having been reported to be the best for survival rate of cuttings of the species.

EXPERIMENTAL DESIGN

A 2x6 factorial arranged in a completely randomised design (CRD) was laid out. Factors were cutting position (apical and basal) and six clones. Twelve treatment combinations were derived with ten cuttings assigned to each. The treatment was replicated 3 times resulting in a total of 360 cuttings used for the experiment.

DATA COLLECTION

Data were collected every two weeks. Rooting was assessed by carefully lifting the cuttings from the propagation medium. Cuttings were assessed for number of roots, root length and rooting percentage. To maintain a low saturation deficit whenever the propagator lid was opened for inspection, cuttings were sprayed with fine jet of water from a knapsack sprayer. A cutting was considered to be rooted when it had one or more roots.

3 RESULTS AND DISCUSSION

EFFECT OF CLONES AND CUTTING POSITION ON ROOT LENGTH

Results from this study indicate that rooting ability with respect to root length in *Dacryodes edulis* was affected by both clonal differences and cutting position. Clone had highly significant effects on root lengths (P = 0.002, 0.000, 0.000, 0.031 and

0.031 at 4, 6, 8, 10 and 12 weeks respectively after planting). Cutting position also significantly affected root length throughout the duration of the experiment P = 0.000 from week 4 to week 12 (Table 1).

Table 1. Effect of clones and cutting position on root length of D. edulis

Source of variation		Mean root length					P-value				
	WAP	4	6	8	10	12	4	6	8	10	12
Clone											
1		2.44^{b}	3.06^{c}	3.73^{c}	4.38^{c}	4.88^{b}	0.002 *	0.000*	0.000*	0.031*	0.031*
2		1.66^{a}	2.35^{b}	3.05^{b}	3.85^{ab}	4.43^{a}					
3		1.81^{a}	2.36^{b}	3.08^{b}	3.91^{abc}	4.51^{a}					
4		1.88^{a}	2.48^{b}	3.21^{b}	3.96^{abc}	4.53^{a}					
5		1.70^{a}	2.23^{a}	2.81^{a}	3.58^{ab}	4.33^{a}					
6		1.93^{a}	2.63^{b}	3.31^{b}	4.08^{b}	4.46^{a}					
Cutting position											
Apical		2.10^{a}	2.86^{a}	3.52^{a}	4.23^{a}	4.72^{a}	0.000*	0.000*	0.000*	0.000*	0.000*
Basal		1.65^{b}	2.18^{b}	2.88^{b}	3.69^{b}	4.33^{b}					

Means with the same alphabet along same row are not significantly different from each other P<0.05

** = significant difference at α =0.05*

EFFECT OF CLONES AND CUTTING POSITION ON ROOT NUMBER

In contrast to root length, none of the two tested factors had significant effect on root numbers as rooted *D. edulis* cuttings had an average of six roots. For both clones and cutting position, P > 0.05 in all the weeks

Table 2. Effect of clones and cutting position on root number of D. Edulis

Source of variation		Mean root number					P-value				
	WAP	4	6	8	10	12	4	6	8	10	12
Clone											
1		4.81	6.06	6.10	6.10	6.10	0.857NS	0.787NS	0.516NS	0.516	0.516
2		5.23	6.05	6.15	6.15	6.15					
3		5.21	6.11	6.13	6.13	6.13					
4		4.93	5.96	6.01	6.01	6.01					
5		5.08	5.91	5.91	5.91	5.91					
6		5.01	6.01	6.01	6.01	6.01					
Cutting position											
Apical		5.23	6.06	6.06	6.06	6.06	0.100NS	0.368NS	0.777NS	0.777NS	0.777
Basal		4.86	5.98	6.04	6.04	6.04					

NS= Not significantly different

EFFECT OF CLONES AND CUTTING POSITION ON ROOTING PERCENTAGE

The tested factors did not have significant effect on rooting percentage at any stage of the experiment. An average of 55% cuttings rooted at the end of the experiment with apical cuttings slightly higher than basal cuttings.

Table 3: ANOVA for rooting percentage

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	111133.333[a]	12	9261.111	39.224	.000
C	1766.667	5	353.333	1.496	.228
CP	11.111	1	11.111	.047	.830
C * CP	455.556	5	91.111	.386	.854
Error	5666.667	24	236.111		
Total	116800.000	36			

EFFECT OF INTERACTION BETWEEN CLONE AND CUTTING POSITION

The interaction between cutting position and clone did not affect root length, root number and rooting percentage (Table 3).

4 DISCUSSION

Results from this study have shown that both clonal variation and cutting position affect rooting ability with respect to root length in *Dacryodes edulis*. Genetic potential as well as propagation environment, cutting position and environment, stockplant physiology and management have been reported to influence rooting. Differences in rooting between clones could be due to genetic differences in cutting morphology and physiology (Leakey, 2004). Such differences in rooting ability have also been reported for some forest tree species (*Allanblackia floribunda,* Atangana *et al.* 2006; *Albizia guachapele,* Mesen *et al.* 2001). Clonal variation in rooting ability found in this study corroborate the results of Atangana *et al.* (2006), Mesen *et al.* (2001), Foster *et al.* (1984), Baltunis *et al.* (2005), Farmer *et al.* (1989) and Shepherd *et al.* (2005) in *Allanblackia floribunda, Albizia guachapele* (Kunth) Dug., *Tsuga heterophylla, Pinus taeda, Populus balsamifera* and *Pinus elliottii* respectively. However, none of the factors investigated had significant effect on number of roots. Furthermore, clone 1 showed higher potential for vegetative propagation from this study having recorded the highest mean root length. As found in *T. heterophylla* (Foster *et al.* 1984) and *Larix decidua* x *L.kaempferi* (Radosta *et al.* 1994), clonal variation for rooting traits in tree species could be due to genetic and non-genetic effects, the latter defined as the physiological or morphological characteristics unique to the ortet and reflecting its growth environment.

The juvenility of the stock plant can also be an overriding factor in root formation especially for plants which are difficult to root (Hartman and Kester, 1983). Result of this study indicated that WAP showed significant effect on root development in *D.edulis* with respect to root length. Apical and basal cuttings started to develop roots within 4 weeks of planting and the number of rooted cuttings was highest after 10 weeks. This agrees with the report by Ofori *et al.* (1996) on a rooting percentage of *Milicia excels* which increased with time after planting.

Result also corroborate the views of Ansari *et al* (1995) who reported that in *Dalbergia sissoo,* the cuttings from the apical end of the branch rooted better than the basal end. Apical cuttings recorded higher mean percentage of rooted cuttings and root length than the basal cuttings. Similarly, Palanisamy and Kumar (1997) have noted that rooting of *Azadirachta indica* cuttings from the proximal end of the branches rooted better than those from the distal end in terms of root number and root length. The ability of cuttings to form roots is determined by the position where the cutting is obtained. However, the differences in rooting responses with respect to cutting positions are greatly affected by the extent of lignifications, secondary thickening and chemical composition of plant tissues. Basal cuttings could be too mature and highly lignified to develop roots than the apical cuttings ((Lo, 1985, Hartmann *et al*. 1990). In woody plants, these differences in rooting due to cutting position can be related to the difference in the chemical composition of the shoots (position where the cuttings were taken; apical or basal), age of the stem, carbohydrate accumulation or due to bud growth. Result from this study however contrast with the view of Hartmann and Kester (1983) that the best rooting of cuttings is usually found from the basal portion of shoots.

5 CONCLUSION AND RECOMMENDATION

The development of rapid and more efficient vegetative propagation techniques for important but neglected indigenous African tropical fruit trees species like the African pear will to a very large extent, facilitate the full domestication and fruit production potentials. This would be a very efficient and effective way of combating hunger and by extension, extreme poverty.

It is therefore recommended that

- Further work be carried out to clarify if observed between-clones variation in rooting in *D. edulis* can be minimized by manipulating physiological status of cuttings and clones.
- Investigation be carried out to identify optimal environmental conditions to achieve best rooting, seasonal effects, nature tissue exudates and rooting medium temperature as they affect rooting in the species.

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