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Genotype×Environment Interaction in Seedling Growth Characteristics of African Pear Fruit (*Dacryodes Edulis* (G.Don) H.J. Lam) Accessions

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Abstract:- African pear fruit (*Dacryodes edulis*) is valued for its potential to improve nutrition, boost food security and improve soil fertility. Nigeria is among the leading producer of *Dacryodes edulis* but its genotype by environment interaction is currently unknown. Consequently, screen house experiments were conducted across four locations to determine the genotype by location interaction seedling growth characteristics of 30 African pear fruit accessions in a Completely Randomized Design in 5 replications. Data collected on number of leaf production, leaf length, leaf breadth, leaf length/breadth ratio, internode distances, fresh leaf weight, fresh stem weight, fresh root weight, dry leaf weight, dry stem weight, dry root weight, plant height, collar diameter and biomass accumulation were subjected to Analysis of Variance. Treatment means were separated using Duncan's Multiple Range Test at 5% probability level. Results showed significant ($p<0.05$) differences among the genotypes in all the characters evaluated except in dry stem weight. Significant ($p<0.05$) location effect and genotype×location were also observed for all the traits studied.

I. INTRODUCTION

African pear fruit (*Dacryodes edulis* (G. Don) H.J. Lam), is an agroforestry plant species belonging to the Buseraceae family. It is one of the most important edible fruit trees indigenous to the gulf of Guinea and Central African regions. The species of edulis are perennial plants growing to 40m tall. Phenotypic variations among the species are enormous (Waruhiu *et al*., 2004). The flowers are yellow and are arranged in large inflorescence. The fruit is an ellipsoidal drupe which varies in length from 4 to 12 cm. The skin colour of the mature fruit is dark blue or violet while the immature colour is pink (Anegbe *et al.*, 2005).

Despite being an indigenous fruit tree that is undergoing domestication, it has attracted international trade (Ajibesin, 2011; Awono *et al*., 2002). Tabuna (1999) reported that in 1998, Europe (France and Belgium) imported 105 tons of *D. edulis* fruits of which, 100 tons came from Cameroon, 3 tons from Democratic Republic of Congo (DRC) (Congo Kinshasa) and 2 tons from the Republic of Congo (Congo Brazzaville) with volumes increasing yearly. In Cameroon, it is the most-collected agroforestry tree product (AFTP) and the most commercialized AFTP in southern Cameroon (Ndoye *et al*., 1998; Tabuna, 1999). Isseri and Temple (2000) estimated the total production at 10,000 to 16,000. In Nigeria, 70% of fruits are home-consumed whereas, the average market price per ton of fruits ranges from US$ 300-700 (Ajibesin, 2011). In general, the principal importing countries of pear fruits are Belgium, France and United Kingdom from countries such as Cameroon, Nigeria, Republic of Cameroon, Democratic Republic of Congo, and Central Africa Republic (Awono *et al*., 2002).

Dacryodes edulis has recently gained worldwide attention because of its ability to grow in various stress conditions like soil salinity, acidity, drought etc. (Kengue, 2002; Omonhinmin, 2012; Onana, 2008). Apart from this, it is a rich source of a wide range of minerals, vitamins, oil containing large amounts of linoleate, linolenate and natural antioxidants and high quality protein containing ample amounts of sulphur rich amino acids (Iyare, 2009; Obame *et al*., 2008). These benefits coupled with increasing demand for safou and insufficient supply from producing countries necessitates introduction of the crop to newer areas Kengue, 2002) .

Increasing population demands an increase in food production along with a shift towards environmentally sound sustainable agriculture. There is a need for cultivation of plant that requires minimum inputs and at the same can counter the nutritional deficiency prevalent in the increasing population of the developing countries. *Dacryodes edulis* is high in protein and oil (Obame *et al.*, 2008; Ajiwe *et al*., 1997; Ikhouria and Maliki, 2007: Kapseu and Tchiegang, 1996) which can help to make diets more balanced in and in turn plays an important role in combating mal nutrition among poor populations who have little access to protein rich diet.

Tree development for higher fruit yield requires better understanding of genetic diversity and genotype×interaction for some major morphological components. The entire seedling characteristics are strongly influenced by the climatic conditions the plants experience during the respective phases the characters are been developed (Takoutsing, 2013; Omonhinmi and Idu, 2012). The final fruit yield of a given

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plant species depends on the interactions between the genotypes, its responses to environmental conditions and management practices (Eberhart and Russell 1966). Under the same management, the interactions between the genotypes and environmental conditions are the sole determinant of species performance (Ojo, 2000). The main aim of breeding programme is the development of cultivars with high yield and quality components, adapted to diverse agro-climatic regions.

Dixon *et al.* (1994) defined G × E interaction as the change in a genotype's relative performance over environments, which results from differential response of the genotype, to various edaphic, climatic and biotic factors. Genotype×environment is a phenomenon that is very important and is of significance important to plant breeders, agronomist and farmers. Propagating materials can be selected and evaluated based on their different responses to the environments (Ojo, 2000). The G × E interaction poses a serious problem in breeding programs because it is a major factor, which can affect any stage of the program and can also play a role in the expression of quantitative traits such as yield.

Understanding the effect of G × E interaction is very useful to breeders because this can limit the progress in the selection process and since it is a basic cause of differences between genotypes for yield stability, knowledge of this will help in selecting varieties with the best adaptation and that can give stable yields. Cultivars with low G × E interaction and high stable yields are desirable for breeders and farmers, because this is an indication that the environment has less effect on them and their higher yielding abilities are largely due to their genetic composition.

Inspite of the immense importance of the plant, not much work has been done for its genetic improvement leading to lack of information on many aspects. Breeding a crop for new and targeted environments requires the use of a range of cultivars/genotypes since it allows us to quantify intraspecific variability for different traits and their interactions (Atul *et al*., 2006).

Genetic variability in the base population plays a very important role in any crop breeding program. The characters of economic importance are generally quantitative in nature and exhibit considerable degree of interaction with the environment. Thus, it becomes imperative to compute the variability present in the material and its partitioning into genotypic, phenotypic and environmental ones Atul *et al*.,2006). Therefore, the objective of this research work to estimate the magnitude of genotype by environment interaction among *Dacryodes edulis* accessions.

II. MATERIALS AND METHODS

A. Seed collection

Seeds of thirty accessions of *Dacryodes edulis* were collected from Edo, Delta, Ondo and Oyo States of Nigeria. In each state, samples were collected at a distance exceeding 20m from each other to avoid collecting multiple seeds from the same parents. From each parent tree, seeds were collected, placed in plastic bags and kept for use.

ISSN No:-2456-2165

Genotypes	Accessions Codes	Source	Latitude	Longitude
G1	FOR1	Jericho, Oyo State	3.86	7.67
G2	FOR2	Agbofieti, Oyo State	3.86	7.67
G3	FOR3	Ofosu, Ondo State	5.14	6.75
G4	FOR4	Ore, Ondo State	4.88	6.75
G5	FOR5	Akoko, Ondo State	5.42	7.36
G6	FOR6	Okpanam,Delta state	6.24	6.65
G7	FOR7	Ibusa, Delta State	5.78	6.55
G8	FOR8	Asaba, Delta State	6.20	6.73
G9	FOR9	Umunede, Delta state	6.27	6.31
G10	FOR10	Iseleukwu, Delta State	6.22	6.48
G11	FOR11	Okogbo, Edo State	5.88	6.20
G12	FOR12	Iguere, Edo State	6.24	6.66
G13	FOR13	Iduonmiwina, Edo State	5.90	6.18
G14	FOR14	Igbekhue, Edo State	5.90	6.15
G15	FOR15	ObozogbeniroEdo State	5.30	6.15
G16	FOR16	Ugbokoniro, Edostate	5.96	6.14
G17	FOR17	Ubokonumagba, Edo State	6.56	6.58
G18	FOR18	Ugbougo, Edo State	6.00	6.13
G19	FOR19	Evbousa, Edo State	5.62	6.15
G20	FOR20	Aideyanoba Edo State	5.92	6.11
G21	FOR21	Idu, Edo state	6.22	6.81
G22	FOR22	Iguemokhia, Edo State	5.83	6.14
G23	FOR23	Ugo Edo State	6.00	6.09
G24	FOR24	Evbousa, Edo State	5.62	6.15
G25	FOR25	Avbugo, Edo State	5.82	6.20
G26	FOR26	Evbowe, Edo State	6.06	6.14
G27	FOR27	Ona, Edo State	5.64	6.20
G28	FOR28	Ekobi, Edo State	6.46	6.63
G29	FOR29	Urhonigbe, Edo State	6.51	6.58
G30	FOR30	Sakpoba,Edo State	5.64	6.20

Table 1:- List of 30 accessions used in the study, sources of collection and their morphological characteristics.

B. Seed processing

Seeds collected were extracted manually to avoid splitting. The damaged and smaller seeds are discarded. The undamaged seeds are used for the experiment.

C. Description of experimental sites and climate

The experiment was conducted in four different state of Nigeria. Nigeria lies between 4-14^{0}N and 3-15^{0}E in the Southern edge of West Africa. The country is characterized by two main seasons: dry and wet seasons. The wet season commences from April till November, whereby, precipitation is usually distributed in a distinct bimodal pattern and with high proportion in July and September with a short dry spell in August. The dry season is from December to April. The dry spell is accompanied by a cold wind from the Sahara desert, known as harmattan. The climate is classified into: Tropical rainforest eco-climate, tropical savannah eco-climate, highland climate and tropical rainforest eco-climate, which characterized the southern region where this study was carried out in four locations:

Location 1: Federal University of Agriculture Abeokuta (FUNAAB), Ogun state. (7^o 15'N; 3^o 25'E; 159 m above sea level),
Location 2: Moist forest Research Station, Benin City, Edo State (6^o 20'N; 5^o 38'E; 86m above sea level).
Location 3: Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo State. (7^o 16'N; 3^o 47'E; 255m above sea level).
Location 4: Rainforest Research Station, Ore, Ondo State. (6^o 44'N; 4^o 52'E; 87m above sea level.

D. Experimental set-up and plant management.

Seeds of the 30 accessions were sown in a 17cm by 20 cm diameter depth propagating pots that were arranged in a completely randomized design (CRD) with five replications. The soils were well drained, with an average PH value close to 7.0 in all the experimental locations. The cultural operations

ISSN No:-2456-2165

carried out were manual weeding and adequate watering to maintain soil moisture. In all the locations, the experiments were terminated at 9 months old when enough morphological data had been collected.

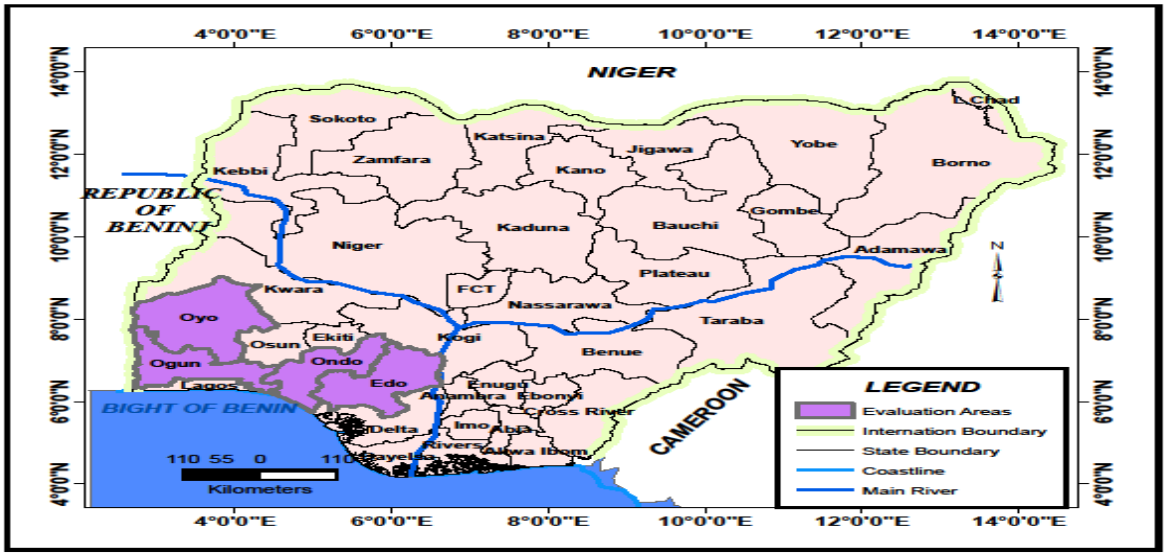

Fig 1

E. Data collection

Number of leaves per plant
Plant height (cm)
Collar diameter (mm)
Leaf length (cm)
Leaf breadth (cm)
Leaf length/ breadth ratio
Fresh weights (g)
Dry weights (g)
Biomass accumulation (g)

F. Data analyses

Data were analyzed using Statistical Analysis System (SAS 2000). Combined Analysis of Variance (ANOVA) across the four locations were performed to establish significant differences among the experimental factors (genotype, location and genotype × location). Means were compared using Duncan Multiple Range Test at 5% level of probability ($P \leq 0.05$).

III. RESULTS

Genotype×environment interaction is an attribute that affect the expression of a given plant. Scarce information is found on the genotype×environment performance of *Dacryodes edulis* in Nigeria. Providing such information is essential for the improvement of this long gestation and multipurpose fruit tree. Table1 reveals combined analysis of variance for biomass and morphological characters in 30 *Dacryodes edulis* genotypes evaluated across the four locations The mean squares revealed significant location effect for all the traits evaluated. Also, there were genotypic effect for all the traits except dry stem weight. There was also significant genotypes ×location interaction for all the characters evaluated except leaf breadth and fresh leaf weight.

Significant differences observed among the *D. edulis* genotypes for most of the traits (except fresh stem weight) evaluated in this study indicated variation in the performance of the genotypes. This is in agreement with the findings of Atangana *et. al*., 2002 and Kengue,2002. Therefore, there is potential for selection among the genotypes. The significant difference in the four locations observed provided the opportunity to evaluate the response of this tree crop to different locations. The effect of the locations on the genotype performance was important for all the traits studied. This suggests that *Dacryodes edulis* is a wide range adaptable crop and any of the traits can be selected in any of the locations.

All the accessions as well as the locations used differed significantly with respect to all the traits (Table 2). Biomass per plant ranged from 11.59g for accessions FOR20 to 3.84g for accession FOR9 while plant girth ranged from 6.172mm for accession FOR10 to 3.87mm for accession4. Tallest height of 29.42cm was observed in accession FOR10 whereas the shortest accession was FOR24 with a height of 17.17cm. The highest leaf production of 24.25 leaves was observed in accession FOR 14 followed by 21.75 leaves for accession FOR17 whereas the least leaf production of 13.10 leaves was observed in accession FOR7. The leaf length varied for all the accessions. The longest leaf of 12.12cm was recorded for accession FOR22 followed by leaf length of 11.98cm for accession FOR10 while the shortest leaf of 8.00cm was recorded for accession FOR24. The widest leaf of 11.09cm

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was observed in accession FOR22 whereas the least leaf breadth of 4.58cm was for accession FOR3. The dry leaves stem and root all varied for all the accessions evaluated. Accession FOR28, accession FOR29 and accession FOR5 had the highest dry leaves, stem and root of 3.35, 6.77 and 4.47g, respectively. The least was observed for accession FOR7, accession FOR3 and accession FOR10. The longest internode distance of 6.91cm was recorded for accession FOR12 while the shortest (2.01cm) was recorded for accession FOR8. Accession FOR14 (6.67g), accession FOR15 (20.85g) and accession FOR5 (7.69g) recorded the highest wet weight for fresh leaves, fresh stem and fresh root, respectivel.

SV	DF	NOL	LL	LB	LLBR	ID	FL	FS	FR	DL	DS	DR	PH	CD	BA
Location (L)	3	103.25**	988.28**	144.59**	11.51**	163.84**	11.48**	289.92**	67.86**	6.91**	8.71**	14.93**	64.46**	151.25**	35.88**
Genotypes(G)	29	119.54**	26.02**	27.24**	0.71**	12.46**	10.52**	383.03**	26.67**	3.71**	46.01ns	11.32**	123.87**	4.15**	98.61**
L×G	87	100.60**	10.05**	8.86**	0.20**	2.79**	9.27**	338.79**	1.53**	3.67**	0.92**	0.24**	65.14**	3.52**	5.71**
Error	464	33.35	5.69	8.42	0.11	1.2	2.46	358.59	0.35	0.69	0.2	0.1	31.6	1.25	0.97

Table 2:- Mean square combined analysis of variance for biomass and morphological characters in 30 *Dacryodes edulis* genotypes evaluated across the four locations

*, ** Significant differences at 0.05 and 0.01 levels of probability respectively; ns not significant
NOL= no of leaves; LL= leaf length; LB= leaf breadth; LLBR= leaf length/breadth ratio; ID= internode distances; FL= fresh leaf weight; FS= fresh stem weight; FR= fresh root weight; DL= dry leaf weight; DS= dry stem weight; DR= dry root weight; PH= plant height; LXG= location by genotype; CD= collar diameter; BA= biomass accumulation,

ISSN No:-2456-2165

Genotypes	NOL	L.L (cm)	L.B (cm)	L.B/R	Int.D (cm)	FLW (g)	FSW(g)	FRW (g)	DLW (g)	DSW (g)	DRW (g)	PH(cm)	C.D(mm)	Biomass(g)
FOR1	15.45 d-j	10.53 a-h	4.69c	2.21a b	5.13d-i	4.97b -f	20.31 ab	3.98g -k	2.82a -c	1.58i-k	1.84g -j	23.90 b-e	5.16b-g	6.25i-l
FOR2	14.90 f-j	10.77 a-g	5.36b c	2.04a -e	4.68h-m	4.34d -h	3.75c	4.65d -g	2.33c 1.17l	2.39e	23.96 b-e	5.47a-e	5.89j-m	
FOR3	17.70 b-i	9.04g -j	4.58c	1.96c -f	4.71g-m	4.86b -f	2.25c	3.68j-l	2.42c -f	0.73 m	1.75j-l	20.63 d-h	4.92c-g	4.90o-q
FOR4	15.00 f-j	8.43j	5.51b c	1.64i -k	4.68h-m	4.05e -h	3.04c	4.09e -j	2.19 d-g	0.75 m	2.01f -h	18.45 gh	3.87h	4.96op
FOR5	15.45 e-j	10.15 b-j	5.04b cv	1.96c -f	4.71g-m	4.97b -f	4.64c	7.69a	3.02a b	1.79h -i	4.47a	20.17 e-h	5.13b-g	9.28ef
FOR6	17.45 b-j	11.37 a-e	6.57b c	1.79e -j	5.84b-d	4.44d -h	4.48c	3.46 ml	2.19 d-g	1.73h -j	1.48 m	25.35 bc	5.82ab	5.39m-o
FOR7	13.1j	10.82 a-g	6.10b c	1.89 d-i	5.80b-d	4.95e -h	3.01c	3.58k -m	1.76 g	0.89 m	1.64j-m	21.19 c-h	4.38gh	4.29qr
FOR8	16.95 c-j	10.25 b-i	5.59b c	1.79 d-j	4.01m	4.69b -g	3.43c	4.01f -j	2.31c -g	1.43j-l	1.99f -i	22.88 b-f	4.89d-g	5.73k-n
FOR9	17.70 b-i	10.03 d-j	5.47b c	1.98 b-f	4.50i-m	4.43d -h	2.21c	3.19 ml	1.77 g	0.84 m	1.23n	21.95 b-g	5.12b-g	3.84r
FOR10	21.00 a-c	11.98 ab	7.49b	1.68 h-k	6.07bc	5.62b c	3.28c	2.10n	2.27c -g	1.33k l	0.89o	29.42 a	6.17a	4.49pq
FOR11	17.30 c-j	11.49 a-d	5.61b c	2.11a -c	6.80a	4.36d -h	3.52c	3.44 ml	2.04 d-g	1.41j-l	1.69j-m	19.88 e-h	4.89d-g	5.14o-p
FOR12	18.85 b-g	11.88 a-c	6.76b c	1.74f -j	6.91a	4.78b -g	4.22c	4.27d -g	2.19 d-g	1.92g h	2.32e	24.92 b-d	5.78a-c	6.42i-k
FOR13	16.55 c-j	10.16 b-j	6.05b c	1,71 g-k	5.57b-f	4.46c -h	5.42c	3.41 ml	2.31c -g	2.52f	1.76j-l	22.48 b-g	5.29b-f	6.59ij
FOR14	24.25 a	11.08 a-f	5.40b c	2.08a -d	5.17d-i	7.45a 6.67a	-c	4.47d e	3.23a	4.43c	2.35e	21.89 b-g	5.64a-d	10.02cd
FOR15	17.95 b-i	11.96 ab	5.58b c	2.23a	5.50c-g	4.42d -h	20.83 a	4.12e -i	2.10 d-g	1.95g h	2.03f -h	22.11 b-g	5.07b-g	6.08i-m
FOR16	19.75 b-e	8.60ij	4.74c	1.86 d-i	4.09lm	5.46b -d	6.57b c	6.66b	3.11a b	3.51e	3.56b	20.10 e-h	4.91c-g	10.17cd
FOR17	21.75 a-c	10.07 c-j	5.90b c	1.74f -j	4.12k-m	5.44b -d	3.58c	3.42 ml	2.17 d-g	1.60i-k	1.68j-m	23.83 b-e	5.43a-e	5.46m-o
FOR18	16.08 d-j	10.23 b-i	5.72b c	1.89 d-i	5.43c-h	3.81f -g	4.67c	3.49 ml	2.19 d-g	1.72h -j	1.58k -m	21.23 c-h	5.10b-g	5.49m-o
FOR19	17.30 c-j	10.80 a-g	6.37b c	1.75f -j	4.88f-l	4.07e -h	5.32c	4.44d -f	2.04 d-g	2.60f	2.09f	20.24 e-h	4.77d-g	6.73i
FOR20	18.45 b-h	8.90h -j	5.51b c	1.65i -k	4.96e-j	5.04b -e	8.36a -c	6.75b	3.09a b	4.97b	3.53b	23.27 b-e	5.38a-f	11.59a
FOR21	18.15 b-h	10.59 a-h	6.03b c	1.79e -j	5.72b-e	4.71b -g	7.50a -c	5.34c	2.56 b-d	4.32c	2.85c d	22.61 b-g	5.10b-g	9.82de
FOR22	14.55 g-j	12.12 a	11.09 a	1.58j k	5.65b-f	3.59g h	4.78c	3.54 ml	2.33c -g	2.11g	1.57l m	22.12 b-g	5.19b-g	6.01j-m
FOR23	17.15 c-j	11.32 a-e	5.72b c	2.02a -e	5.71b-e	4.16e -h	8.23a -c	3.84i-l	2.19 d-g	4.86b	1.67j-m	22.95 b-e	5.52a-d	8.72fg
FOR24	13.55ij	8.j	5.64b c	1.49 k	4.47i-m	3.37h	5.53c	3.72i-l	1.89e -g	1.87h -i	1.84h -k	17.17 h	5.34f-h	5.57l-o
FOR25	14.25 h-j	8.73ij	5.34b c	1.67 h-k	4.71g-m	3.37h	4.67c	4.18e -h	1.81f g	1.92g h	2.06f g	18.52 f-h	5.17b-g	5.72k-n
FOR26	17.20 c-j	9.57e -j	5.66b c	1.70 h-k	5.57b-f	4.03e -h	6.80b c	5.22c	2.56 b-d	3.34e	2.74d	22.38 b-g	5.09b-g	8.64fg
FOR27	18.60	9.45f-	5.24b	1.87	4.71g-	4.19e	8.17a	4.31d	2.42c	3.99d	2.08f	20.00	4.63e-	8.50g

ISSN No:-2456-2165

	b-h	j	c	d-i	m	-h	-c	-g	-f			e-h	g	
	20.10	11.73	6.82b	1.76f			7.25a			4.19c		26.12	5.50a-	
FOR28	b-d	a-d	c	-j	4.92f-k	5.66b	-c	5.36c	3.35a	d	3.01c	ab	e	10.54bc
	19.1b		6.03b	2.03a		4.89b	10.07	4.36d	2.52		1.79i-	20.53	5.44a-	
FOR29	-f	8.42j	c	-e	4.47i-m	-f	a-c	-g	b-e	6.77a	l	e-h	e	11.08ab
	16.40	10.70	5.69b	1.91		4.23e	6.88a	3.80i-	2.25c		1.61j-	20.86	5.08b-	
FOR30	d-j	a-g	c	d-h	4.05m	-h	-c	l	-g	3.51e	m	d-h	g	7.37h

Table 3:- Mean performance of 30 accessions of *Dacryodes edulis* evaluated for morphological characters over the four environments.

Values followed by the same alphabet in a column are not significantly different from each other.NOL= leaf production; LL= leaf length; LB= leaf breadth; L/BR= leaf length/breadth ratio; IntD= internode distances; FLW= fresh leaf weight; FSW= fresh stem weight; FRW= fresh root weight; DLW= dry leaf weight; DSW= dry stem weight; DRW= dry root weight; PH= plant height;CD= collar diameter; Biomass= biomass accumulation.

The selection of genotypes with wider adaptation performance in targeted agro- ecology remains an important goal in plant breeding programme. This is often preceded by multi environmental testing, in which the relative performance of the test genotype is determined from one environment to another. The presence of G×E interactions makes it difficult for breeders to decide which genotype(s) should be selected (Ojo, 2000). Thus, the estimation of genotype by environment performance becomes important to identify consistent performing genotypes whenever such interactions assume a practical importance in a testing programme (Kang, 1998).

The *D. edulis* genotypes differed significantly for all the character evaluated except for fresh stem weight and fresh leaf weight (table 3). Ore had the highest number of leaves of 18.61 leaves, which was significantly different from the other locations. Ibadan had the highest leaf length (12.82cm), leaf breadth (6.80cm), leaf length/breadth ratio (2.06), fresh root weight (5.23g), dry leaf weight (2.57g), stem girth (6.34cm), plant height (29.63) and Biomass yield of 7.59g. Ibadan recorded the highest fresh leaf weight of 5.50g which was not significantly different from the other locations. Ibadan recorded the highest dry leaf weight of 2.57g. Benin recorded the highest inter node distance of 5.93cm, fresh stem weight of 7.49g, dry stem weight of 2.82g, dry root of 29.63g and plant height of 29.63cm.

LOCATION	NOL	LL	LB	LLBR	ID	FL	FS	FR	DL	DS	DR	PH	CD	BA
Abeokuta	17.31ab	12.47a	6.21a	2.05a	5.33b	4.83a	7.18a	3.89c	2.52ab	2.31c	1.77c	21.66c	3.89c	6.61c
Benin	16.96b	8.41b	6.11a	1.85c	5.93a	4.70a	7.49a	4.28b	2.09c	2.82a	2.39a	29.63a	5.24b	7.30b
Ibadan	16.77b	12.82a	6.8a	2.06a	5.71a	5.50a	6.14a	5.23a	2.57a	2.63b	2.37a	28.13b	6.34a	7.57a
Ore	18.61a	8.03b	4.51b	1.84b	3.63c	4.55a	4.41a	3.74d	2.35b	2.34b	1.9b	13.67d	5.12b	6.62c

Table 4:- Performance of the four locations used in the study for morphological characters evaluated in *Dacryodes edulis accessions*.

Means with the same alphabet in a column are not significantly different from one another according to DMRT at 5% probability level

NOL= leaf production; LL= leaf length; LB= leaf breadth; LLBR= leaf length/breadth ratio; ID= internode distances; FL= fresh leaf weight; FS= fresh stem weight; FR= fresh root weight; DL= dry leaf weight; DS= dry stem weight; DR= dry root weight; PH= plant height; LXG= location by genotype; CD= collar diameter; BA= biomass accumulation.

IV. CONCLUSION AND RECOMMENDATION

The significant differences observed among the accessions as well as the locations used in the study indicated that the genotypes and locations are different from each other. The study showed that the genotypes performed differently under the four environments used in this study as shown by significant genotype × location (environment) interaction effects. This study had clearly revealed that *Dacryodes edulis* is location specific.

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