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Provenance variation in seed and seedlings attributes of *Jatropha curcas* Linn. in South Western Nigeria

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Research Paper

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Provenance variation in seed and seedling attributes of *Jatropha curcas* Linn was investigate within South-Western Nigeria (Ondo, Ogun, Ekiti, Oyo and Osun) with different climatic conditions. Germinated seedlings and cuttings were grown in top soil and sub-soil for Sixteen (16 weeks). The growth parameters measured included lateral branch length, number of leaves, and biomass. Analysis of variance showed that there was no significant ($p>0.05$) difference among the germination of seeds collected from all the provenances. Ondo provenance (S_1L) had the highest germination percentage (62%) followed by Ekiti provenance 99(53%) while the least provenance was Oyo (32%). Significant differences were observed on all the parameters measured among the provenances ($p < 0.05$). Seedlings and stem cuttings from Ondo (S_1L) and Ekiti recorded the best performance when grown on top soil. S_1L had the highest mean leaf numbers (13), mean leaf area (48.40 cm^2) and biomass (3.25 g/month). For stem cutting, S_1L also had the highest mean for the lateral branch length (23.5 cm) and number of leaves (54), followed by S_3L with 16.5 in term of branch length. Ondo (S_1L) and Ekiti Provenance (S_3L) seem to be superior to other provenances in the characters studied. The result showed the importance of adequate soil nutrient composition and good soil physical properties for improved growth performance of seedlings and stem cuttings of *Jatropha curcas*.

Key words: *Jatropha curcas*, characters, growth performance, traits, morphological variation

INTRODUCTION

Jatropha curcas Linn. (physic nut or Ratanjot), a genus of family Euphorbiaceae, is believed to be a native of Mexico and Central America. It has been introduced in Africa and Asia and is now cultivated worldwide.The specific name, Jatropha curcas, was first used by Portuguese (Doctor) Garcia de orta more than 400 years ago and is of uncertain origin. Common names include Barbados Nut, purging nut, Physic Nut or JCL (Haines, 2009). It is also known as Olobutuje or Lapalapa in Yoruba language. The species is a potential feed stock for biodiesel production. *Jatropha* plantation and products have been used for many applications such as medicine, biomass and fencing. *J. curcas* is among the most suitable tree species for production of biodiesel as it can be cultivated as a quick yielding plant even in problem soils and adverse environmental conditions. Potentially high yield of oil per unit land area in *J. curcas* is second only to oil palm (Fairless, 2007). Less variability in seedlings growth parameters is desirable for establishment of managed plantations and conducting experiments (WoldeMeskel and Sindair, 2000; Akinyele and Adegeye, 2010.). There is no potential policy measure for biodiesel production in Nigeria using *Jatropha* plant at present. It is critical to ascertain its advantage – disadvantage for the policy decision maker. *Jatrophacurcas* has limited natural vegetative propagation and is usually propagated by seed. Propagation through seed (sexual propagation) leads to a lot of genetic variability in terms of growth, biomass, seed yield and oil content. Low seed viability and the

Table 1. Analysis of variance for seedling height, number of leaves, leaf area, dry weight, branch length.

Source of variation	Seedling height (cm^2)	Number of leaf	Leaf Area (cm^2)	Dry Weight (gm)	Branch Length (cm)
Provenance (P)	69.29*	25.58*	652.02*	0.27*	75.07*
Location (L	180.60*	92.45*	676.28*	0.45*	177.61*
P x L	25.11*	36.32*	343.79*	0.02*	55.72*
Error	5.00	2.65	91.56	0.01	5.46

* Significant at 5%

recalcitrant nature of oil seeds also limit seed propagation. However, clonal technique can help in overcoming these problems that hinder mass propagation of this tree-born oil seed species. Vegetative propagation has been achieved by stem cutting, grafting, budding as well as by air layering techniques. This study is focused on ascertaining the provenances that produce *Jatropha* with good growth vigour using seeds and stem cuttings from South-Western Nigeria.

MATERIALS AND METHOD

Collection of seeds and stem cuttings

Ripe seeds and stem cuttings of *J. curcas* were collected over a wide range of its distribution in five provenances in South-western Nigeria. These are Ondo, Ogun, Ekiti, Oyo and Osun. From each provenance, mature seeds and stem cuttings were harvested from 10-15 shrubs. Samples were collected from shrubs spaced100-300 m apart to avoid a reduction in the variation due to inbreeding in the sample (Uniyal et al. 2002). Necessary procedure took place to ensure that each tree contributed an approximately equal amount of seeds and stem cuttings to pooled collection from a single provenance. Harvested seeds were kept in a cool dry environment before removing their pods.

Collection of soil samples

Soil samples were collected from the depth of 45 cm (sub soil) and top soil. Soil collections were made from the forest nursery of University of Ibadan. Samples of the soils were sent to the laboratory for analysis. Twenty (20) polythene pots measuring 25 x 14.5 x 7.5 cm were filled with top soil and sub soil for each provenance. A total of 100 polythene pots were used for the five provenances.

Germination count

Eighty healthy seeds were selected from each provenance and sown in different tagged germination trays. Two replicates of each provenance were set in the green house of the Department of Forest Resources Management University of Ibadan (Lat 7^o 20' Longitude 3^o 48'). Germination trays were watered on alternative days. Germination counts were taken every day for two weeks.

Growth of seedlings and stem cuttings

Ten seedlings and ten stem cuttings of uniform sizes were randomly selected for planting in each provenance. The seedlings and stem cuttings were transferred to polythene pots and randomly arranged in the greenhouse. Data were collected for 16 weeks on shoot length, number of lateral branches, number of leaves and biomass. The data were statistically analysed using Least Significant Difference (LSD) was used to separate significantly different means.

RESULTS AND DISCUSSION

Seedling height

Mean height growth showed significant variability between the locations, interaction between provenance at ($p \leq 0.05$) (Table 1). The overall mean height growth was 27.07cm. Seedlings from S_1L showed the best seedling height growth with a mean value of 25.40cm while seedlings from S_3L (Ekiti) grown on top soil followed the Ondo provenance. The seedlings from Osun provenance grown on subsoil (S_5D) had the lowest height growth 15.90cm (Table 2). Height growth in plants is as a result of apical bud. Highly significant variation in height was observed between the provenances. This variability may have to do with genetic characteristic of the seed and environmental factors. This is in agreement with Kramer and Kozloweski (1999) who stated that interval between growth flushes among the tree populations and climatic regimes. WoldeMeskel and Sindair, (2000) reported that *Acacia nilotica* from different provenances were significant in variability of shoot length.

Number of leaves and leaf area

Significant differences were observed in number of leaves and leaf area from all the provenances (Table 1). Ondo (S_1L) had 13.4 leaves while Ekiti (S_3L) had 12.1 leaves (Table 2). Ekiti provenance (S_3L) has the highest leaf area with the value of 61.1cm^2, followed by the Ondo

Table 2. Mean values of growth parameters of seedlings of *Jatropha curcas.*

Provenance Codes	Height (cm)	Leaf Number	Leaf Area (cm^2)	Biomass (g)	Branch length (m)
S_1D	21.8	8.4	34.4	3.11	4.2
S_1L	25.4	13.4	48.4	3.25	12.4
S_2D	20.1	8	47.7	2.25	4.3
S_2L	20.4	9.1	42.6	2.67	4.5
S3D	19.6	7.8	27.4	2.85	3.76
S_3L	22.4	12.1	61.1	3.15	8.85
S_4D	19.5	8.3	22.4	2.93	2.34
S_4L	21.2	9.1	16	2.96	1.92
S_5D	15.9	9.8	28.9	2.88	2.43
S_5L	18.5	7.9	38.9	3.02	3.2
LSD	3.52	2.57	15.08	0.1	3.68
MEAN	27.07	16.85	51.41	3.59	8.76

provenance (S_1L) which has the value of 48.4 cm^2. Number leaf and leaf area are highly significance among the provenances. This variability may have to do with the genetic characteristic of the seeds and stem cuttings. Also, the highly significant difference may be attributed to increase in area of photosynthetically active foliage as the number of leaf and branches increases. It can also be due to a re-distribution of assimilate towards axial growth rather than apical growth. Constable, (1977) also reported that a vegetative period of 42 to 58 days depending on temperature, photoperiod and other growth condition are necessary to promote a Leaf Area Index (LAI) of 3.0 required to obtain maximum yield.

Biomass

The weight rate exhibited high level of variability among the provenances throughout the period of assessment. Seedling from Ondo provenance (S_1L) had the highest dry weight of 3.25 g (Table 2) while S_2D had the least value of 2.25 g. Highly significant variability recorded in dry matter accumulation throughout the duration of this study may be as a result of different photosynthesis abilities which seedlings and stem cuttings inherited from their parents, since, they were under uniform environmental condition. Throughout the period of study, it shown that the greatest biomass productions above were Ondo provenances (S_1L) and Ekiti provenances (S_3L). This supports the observation of Arya et al., (1992) who reported that as ideal seed sources for the production, there are significance between percentage of sound seed and various seed characters that this significantly enhanced dry weight and collar diameter of seedlings stem cuttings.

Stem cuttings

Branch length

Branch length production varied between the provenances. At fourth week of planting; (S_1D), (S_3D) and (S_4D) did not have a pronounced branch length. Ondo provenance (S_1L) had the highest value of 23.5 cm followed by Ekiti provenance (S_3L) which had the value of 16.5 cm. The least provenance was Oyo (S_4L) had value of 4.5 cm. This supports the observation of (Bergin and Kimberley,1992) that there are variations in *Podocarpus totara* and Significant differences also occurred in branch length of seedlings.

Leaf number

Tables 3 and 4 showed that Ondo provenance(S_1L)had the best performance in leaf number with a mean of 54.0 followed by Ekiti provenance (S_3L) 40.5,while the least performance was recorded in Oyo provenance (S_4L) with mean value of 15.0. Jimoh, (1997),affirmed that, there were significant differences among the stem cuttings of *Tetraplepleura tetraptera* from different provenances.

Leaf area

From (Table 4), Ondo provenance (S_1L) had the highest performance in leaf area with a mean of 107.9 cm^2 followed by Ekiti provenance with mean value of 89.7 cm^2 while the least performance was recorded in Osun provenance (S_5L) with a mean value of 26.2 cm^2 .This supported the observation of Chijioke,2003) that *Tithonia diversiflora* from different provenances were significant in variability of leaf area.

Biomass

The mean biomass showed significant variability among the locations,interaction between provenances at ($p<0.05$) (Table 4). The overall biomass mean was 4.82g/month. Table 4 showed that Ondo provenance had the best performance in biomass of 6.47 g/month followed by Ekiti provenance (6.24 g/month), while the

Table 3. Analysis of variance for branch lengths, leaf count, leaf area and biomass of stem cuttings.

Source of variation	Branch length (cm)	Number of leaves	Leaf Area (cm^2)	Biomass (g)
Provenance	75.07*	391.95*	1070.65*	2.43*
Location	177.61*	140.45*	1932.57*	2.61*
PXL	55.72 *	144.70*	814.74*	0.65*
Error	5.46	17.95	88.79	0.01

* Significant at 5%,

Table 4. Mean values of growth parameters of stem cuttings of *Jatropha curcas.*

Provenance Codes	Leave number	Branch length (cm)	Leaf Area (cm^2)	Biomass (g)
S_1D	36.0	8.4	34.4	3.11
S_1L	54.0	13.4	48.4	3.25
S_2D	29.0	8	47.7	2.25
S_2L	26.5	9.1	42.6	2.67
S_3D	25.0	5.8	55.7	4.75
S_3L	40.5	16.5	89.7	6.24
S_4D	23.0	5.0	43.4	4.93
S_4L	15.0	4.5	68.5	4.95
S_5D	24.5	4.8	51.5	4.77
S_5L	25.5	6.3	26.2	5.02
LSD	6.67	3.68	14.8	50.16
MEAN	30.15	8.76	64.5 5	4.82

least performance was recorded in Ogun provenance (S_2D) with mean value of 4.12 g/month. Toda et al. (2005) reported that *Jatropha curcas* from Chhindwara were significant in variability of biomass.

Trees and shrubs are predominantly out crossing, thus resulting in progeny that segregate with respect to parental traits thereby affording the opportunity for selection The strategy of tree improvement involve the survey and collection of seeds from different sources, structural and agronomic studies of clonal seed orchards and gene banks of the species for afforestation programme. According to Uniyal *et al*. (2007), variation, a product of interaction between the environment and intended qualities could be defined as the difference between and within population of a species. Variability in fruit and seed characteristic in relation to provenances, cumulative germination and germination rate in relation to provenances as well as growth parameters and physiological characteristics of seeding and stem cuttings in relation to the provenance as observed in this study on *Jatrophacurcas* is common phenomenon in provenance studies as similar observations have been recorded by other researchers (Dutta, 1981; Akinyele and Adegeye, 2010).

The outcome of this study is in agreement with (Oni and Gbadamosi, 1998; Akinyele and Orosun, 2010). Environmental variabilities such as climatic, edaphic and biotic factors primarily influence on plant growth such that trees with the same or similar genotypes under different environmental conditions (Salazar,1989). Ondo provenance (S_1L) and Ekiti provenance (S_3L) produced the best growth vigour in terms of growth height, leaf count, leaf area and even dry height. This may be due to the climatic and edaphic factors of the area (Fasehun, 1980; Kramer and Kozloweski, 1999.). This is a probable indication that the Ondo provenance (S_1L) may possess certain genetic attributes which favour growth vigour.

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