

**EFFECTS OF SEED PROVENANCE ON PLANT ESTABLISHMENT INDEX,
SEEDLING VIGOR INDEX AND SPEED OF GERMINATION OF PHYSIC NUT
(*Jatropha curcas L.*) IN SOKOTO STATE, NIGERIA**

Abstract

The study on effects of seed provenance on plant establishment index, seedling vigor index and speed of germination of *Jatropha curcas L.* was carried out during 2019 raining season, at Teaching and Research Farm, Shehu Shagari College of Education Sokoto, Nigeria. *Jatropha* seeds were collected from different live hedges of plant in the State, from four local government areas in each of senatorial districts. The treatments consisted of 16 different accessions of *Jatropha*. Laid out in a completely randomized design, replicated three times. Experimental land was ploughed manually using hand hoe and leveled using rakes. Fifteen rows of ridges at 0.5m apart were constructed. Seeds were planted in June, 2019 through dibbling. Two seeds per hole at a spacing of 0.5 x 0.5m. Which were later on thinned to a plant per stand after germination. Fertilizer was applied at one month after planting (IMAP). Data collected was subjected to the analysis of variance (ANOVA), using the statistical analysis system (SAS, 2003). Significant differences in the treatments means were separated using the Duncan's New Multiple Range Test (DMRT). The result obtained indicated statistically significant ($P < 0.05$) variations among different seed accessions on parameters observed at the various periods of the observation. Seed accessions at SE1, SE3 and SW3 performed better over and above all the others from the rest of the seed accession sources investigated. Therefore, it can be recommended for the environment of the study area for a maximum production dividend to the farmers and the other stakeholders in the production enterprise of the crop.

Key Words: Physic nut, seed provenance, plant establishment, seedling vigour

INTRODUCTION

Jatropha nut also referred to the physic nut, purge nut or pig nut, is derived from a Greek word, which means 'Doctor' and *trophe*, which means nutrition (Heller, 1996). It is a perennial shrub which originates from the Central America (Aponte, 1978), which later spread to other tropical and sub-tropical countries as wild plant.

Jatropha grows on wide range soil types (Srivastova, 1999) and requires a well-drained soil. It is adaptable to low fertility, alkaline soil, marginal lands and degraded soils (Open Shawn, 2000). Therefore, can be grown without competing with food production (Heller, 1996). Although not a native to Africa, Henning (2008) reported that it is fairly well established in many parts of continent (Tanzania, Mali, Zimbabwe, Botswana, Malawi, South Africa, Nigeria, Ghana etc.) as a live defense/hedgerow and for medicinal purposes. In Nigeria,

Jatropha is found growing as a live fence/hedgerow or as a wild plant with different local names, which show that it is spread throughout the country.

Depending on the species, germination response of seed varies according to geographical and environmental factors (*viz.* latitude, elevation, soil moisture, soil nutrients, and temperature), kind and diversity of plant cover, degree of habitat and disturbance of the soil where the plant matures (Ginwal *et al.*, 2005). Kaushik *et al.*, (2007) reported that despite the economic importance of *Jatropha*, its potentials in commercial production remains under exploited due to absence of improved technologies. Therefore, there is a need to develop agronomic technologies for mass propagation and improved productivity. The objective of this study therefore, is to determine the seed accession/provenance of *Jatropha curcus L.* that performs better from the four local government areas of the three senatorial districts of Sokoto state, Nigeria, with respect to plant establishment, seedling vigor and speed of germination of the crop.

MATERIALS AND METHOD

Experimental Site

The trial was conducted during the 2019 cropping season at fruits and vegetable Teaching and Research farm, Department of Agricultural Science, Shehu Shagari College of Education, Sokoto, Nigeria; in Semi-arid Sudan Savanna agro-ecological zone (latitude 13°7' longitude 5°12' E, 278m ASL),

Treatment and Experimental Design

Treatment consisted of 16 different accessions to *Jatropha* laid out in a completely randomized designed with three replications.

Cultural Practices

Jatropha seeds were randomly collected from 16 live hedges of plant in Sokoto State. Drawn from four local government areas in each of three senatorial districts of the State. Comprising Sokoto South, Wamakko, Kware and Binji Local government areas (Sokoto Central); Bodinga, Yabo, Shagari and Tambuwal local government areas (Sokoto West) and Gwadabawa, Goronyo, Isah and S/Birni Local government areas (Sokoto East). The sample-seed accession collected were sundried properly and fumigated with nuval chemical, stored

bags and leveled to maintain identity. A uniform seed treatment was given to all accessions' seed samples prior to sowing on field, by soaking the seeds in water for 12 hours and later sown directly in the field.

i. **Land Preparation**

The experimental land was ploughed manually using hand hoe and leveled with a rake, 15 rows of ridge at 0.5 m apart were constructed.

ii. **Planting**

Seeds were planted in June 2019 through dibbling 2 seeds per hole at a spacing of 0.5 x 0.5cm was later thinned to one plant per stand.

iii. **Weeding**

Weeding was carried out at one month after sowing by using a hand hoe.

iv. **Watering**

Watering was carried out after every two weeks using watering can.

v. **Fertilizer Application**

Fertilizer was applied at one month after planting (45 kg N, 60 kg P2 O5, 150 kg K 20/ha (Kaushik *et al.*, 2007, through ring application method at a depth of 5cm and 15cm away from the plant (Anon, 2006).

Soil Sampling and Analysis

To determine the physico-chemical properties of the soil at the experimental site, soil samples were randomly collected from at 0 – 50cm and 50 – 100cm depth. The samples were subjected to routine analyses.

Data Collection

- i. **Germination Index** was calculated as described in the association of seed analyst (AOSA, 1991), by the following formula:

$$\text{Germination index} = \sum (6T/Tt) \text{ or } \left(\frac{\text{No of germinated seeds}}{\text{Days of first count}} \right)$$

$$\left(\frac{\text{No of germinated seeds}}{\text{Days of first count}} \right)$$

- ii. **Seedling Vigour Index.** This was calculated using the following formula:

$$\text{Seedling vigour index (SVI)} = \frac{\text{Seedling length (cm)} \times \text{germination seedling}}{100}$$

iii. **Speed of Emergence:** This was calculated in accordance with the following formula:

$$\text{Speed of emergence} = \left(\frac{\text{No of seedling emerged at 5 days after sowing}}{\text{No of seedlings emerged at 15 days after sowing}} \right) \times 100$$

iv. **Establishment Count:** Stand count was taken at one month after sowing by counting all the plants in each treatment at one month after planting

Data Analysis

Data collected was subjected to analysis of variance (ANOVA) procedure for randomized completely block design (RCBD) using Statistical Analysis System (SAS, 2003), and significant differences in treatment means were separated using Duncan's New Multiple Range Test (DNMRT).

RESULTS AND DISCUSSION

The results of soil analyses are presented on Table one. The measured Physico-chemical properties of soils obtained could be regarded as ideal for crop production in the area. Effects of seed provenance on plant establishment, germination index, seedling vigour index and speed of germination of *Jatropha* is presented on Table 2. Results indicated significant ($P > 0.05$) variation among different seed sources on plant establishment, germination index, seedling vigour index and the speed of germination of *Jatropha curcas L.* The significant differences in plant establishment indicated that SW3, SE1 and SC2 established significantly higher than those of other seed accessions. Whereas a significant germination index and seedling vigour index was also recorded at SE1 than the other seed accessions. While SC3 and SC4 recorded the lowest germination index and seedling vigour index respectively. Similarly, a significant speed of emergence which is statistically similar was recorded at all seed accessions. Performance of the SE1 could be attributed to factors of seed weight, speed of germination, seedling vigour index and germination index obtained earlier; that might result to significant plant establishment. This agrees with the finding of Okoro (1976), Ginwal and Gera (2000), and Roy *et al.*, (2004) who reported that seed sourced with a higher germination value is highly likely to have a better field performance.

Table 1: Chemical and physical properties of the soil at the experimental site.

Physico-chemical properties	0 – 50cm	50 – 100cm
Chemical properties		
pH in (H ₂ O)	6.34	6.4

pH (CaC ₂)	5.84	5.91
Organic carbon (%)	8.6	0.52
Total Nitrogen (%)	0.49	0.03
Available phosphorus (mg/Kg ⁻¹)	0.8	0.06
Exchangeable Cations (Cmol/kg)		
Ca (cmol kg ⁻¹)	0.65	0.3
Mg (cmol kg ⁻¹)	0.20	0.2
K (cmol kg ⁻¹)	1.64	18
Na (cmol kg ⁻¹)	1.43	10
CEC (cmol kg ⁻¹)	12.3	15.6
Physical properties (%)		
Sand (g kg ⁻¹)	900	929
Silt (g kg ⁻¹)	92	67
Clay (g kg ⁻¹)	8	14
Textural class	Sandy	Sandy

Table 2: Effect of seed provenance on plant establishment germination index seedling Vigour index and speed of germination *Jatropha curcas L.*

Accession	Source	Plant Establishment	Germination Index	Seedling Vigour Index	Speed of Emergence
SC1	S/South	3.00bcde	9.16bc	10.63bcd	61.09ab
SC2	Wamakko	4.33ab	8.26bc	15.52b	56.53ab
SC3	Kware	2.00de	4.31e	5.92de	50.00b
SC4	Binji	2.33de	2.49f	4.27e	50.00b
SW1	Bodinga	4.33ab	7.25d	13.17bc	53.33b
SW2	Yabo	2.67cde	7.60de	9.87cd	56.67ab
SW3	Shagari	4.67a	9.57b	13.72bc	72.22ab
SW4	Tambuwal	2.00de	8.96bcd	9.76cd	56.56ab
SE1	Gwadabawa	4.67a	11.13a	23.30a	91.67a
SE2	Goronyo	2.33de	9.45b	13.10bc	56.56ab
SE3	Isah	4.00abc	8.61bcd	12.02bc	80.33ab
SE4	S/Birni	3.33abcd	9.05b	9.60cd	91.67a
SE±		0.439	0.519	1.614	80.56ab
Significance	*	*	*	*	73.33ab

Means in a column followed by same letter (s) are not significantly different (P>0.05) NS = Not Significant* = Significant at 5% level NS = Not Significant MAP = month after planting.

CONCLUSION

Seed provenance on plant establishment index, seedling vigor index and speed of germination had significant influence on *Jatropha Curcas L.* in the study area. Thus, a conclusion can be drawn that the seed accessions at the SE1, SE3 and SW3 performed better over others from the seed accession sources. Therefore, it can be recommended for the environment of the

study for maximum productivity of the crop and dividend to the farmers and stakeholders in the production enterprise.

References

- Ado, S. G. and Abubakar, I.U. (2008). Cultivation, harvesting and storage of *Jatropha curcas* Paper presented at a National workshop on *Jatropha* for Sustainable energy development held at Mumbayya House, Kano, May 5-8, 2008.
- Aponte, C. H. (1978). Estudio de *Jatropha curcas* L. Como recur so biotic. Diploma Thesis University, Veracruz. xalapa – Enriquez Veracruz, Mexico.
- Ginwal, H. S and Vera, M. (2000). Genetic variation in seed germination and growth performance of 12 *Acacia nilotica* provenance in India. *Journal of tropical forest science* 12 (2) 286-297.
- Ginwal H S., Rawat, P. S. and R. L. Srivastava. (2005). Seed source variation in Morphology, Germination and seedling growth of *Jatropha curcas* Linn. In Central India. *Silvae Genetica*. 54(2): 76-80.
- Grimm, C. (1996). The *Jatropha* project in Nicaragua, *Bagani Tulu Mali*, 1:10-14.
- Heller, J. (1996). Physic nut *Jatropha curcas* L. Promoting the conservation and use of underutilized and neglected crops. Institute of plant genetic and crop plant research. Gaterleben/IPGRI. Rome 66pp.
- Henning, R. K. (2008). *Jatropha curcas* L. in Africa. An evaluation, global facilitation unit for under-utilized species (GFUUS) Weissensberg, Germany
- Kaushik, N., K. Kumar and N. Roy (2007) Genetic variability and divergence studies in seed trait and oil content of *Jatropha (Jatropha curcas)* accession. *Biomass and Bioener* 31: 497-502.
- Okoro, O.O. (1976) Germination in Terminalia iogrensis seed source under various condition of germination in seed problem. Proceeding Second International symposium on physiology of seed germination Oct. 1976 Iupro Fiji Japan.
- Openshawn, K. (2000). A review of *Jatropha curcas* an oil plant of unfulfilled promise. *Biomass and Bioenergy*, 19 (1): 1-15.
- Roy, S.M., R.C.Thapliyal and S.S. Phartyal (2004). Seed source variation in cone, seed and seedling characteristics across natural distribution of Himalayan low level pine pinus rozburghii sarg. *Silvae Genetica* 53(3):116-123.
- Srivastava, L. M. (1999). *Plant Growth and Development Hormones and Environment*. Amsterdam: Academic Press, 140p.

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