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# 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

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## 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 district. 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).

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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 than the rest 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.

*Keywords: Physic nut; seed provenance; plant establishment; seedling vigour.*

## 1. 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 [1]. It is a perennial shrub which originates from the Central America [2], which later spread to other tropical and sub-tropical countries as wild plant.

*Jatropha* grows on wide range soil types [3] and requires a well-drained soil.it is adaptable to low fertility, alkaline soil, marginal lands and degraded soils [4]. Therefore, can be grown without competing with food production [1]. Although not a native to Africa, Henning [5] 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 [6]. Kaushik et al., [7] 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.

## 2. MATERIALS AND METHODS

### 2.1 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 $13^{o}7$" longitude $5^{o}12$" E, 278m ASL).

### 2.2 Treatment and Experimental Design

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

### 2.3 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 05, 150 kg K 20/ha [7], through ring application method at a depth of 5cm and 15cm away from the plant (Anon, 2006).

## 2.4 Soil Sampling and Analysis

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

## 2.5 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:

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

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

$$\text{Speed of emergence} = \left[\frac{\text{No of seedling emerged at 5 days after sowing}}{\text{No of seedlings emerged at 15 days after sowing}}\right] \text{ X } 100$$

**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

## 2.6 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).

## 3. RESULTS AND DISCUSSION

The results of soil analyses are presented on Table 1. 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 [8,9]. 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 [10], Ginwal and Gera [11], and Roy et al., [12] 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 ($H_20$) | 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*

## 4. 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.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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