



**Effects of Variety and Spacing on the Growth and Yield of Tiger Nuts (*Cyperus esculentus*)  
in Two Agro-Ecological Zones of Taraba State, Nigeria**

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**ABSTRACT**

This study investigated the effects of variety and plant spacing on the growth and yield of tiger nuts (*Cyperus esculentus*) across two agro-ecological zones in Taraba State, Nigeria. Three varieties—Brown, Yellow, and Black—were evaluated under three spacing regimes (10×20 cm, 15×30 cm, and 20×40 cm) using a split-plot arrangement within a randomized complete block design (RCBD) with three replicates. Pre-planting soil analysis indicated that Bali's loamy soil, with higher clay content (10.8%), organic carbon (13.6 g/kg), and available phosphorus (8.7 mg/kg), provided more favorable growing conditions than Jalingo's sandy soil. Bali also had greater water-holding capacity (40.38%) compared to Jalingo (34.23%), which positively influenced plant growth and productivity. Among the cultivars, the yellow variety demonstrated superior performance, recording the highest germination percentage (72%), plant height (75.68 cm at 12 weeks after planting), and dry biomass (27.82 g/plant). It also produced the greatest fresh bulbil weight and number of nuts per plant, confirming its potential as the most productive variety. Plant spacing significantly affected vegetative and yield traits. The closest spacing (10×20 cm) yielded the highest plant biomass and number of nuts per plot, while the widest spacing (20×40 cm) produced the largest nut size (6.66 mm in Bali), ideal for premium markets. Moderate spacing (15×30 cm) provided a balance between nut size and quantity, making it suitable for commercial production. Overall, the yellow variety combined with moderate spacing is recommended to maximize tiger nut yield, particularly in the Southern Guinea Savanna region of Nigeria.

**Keywords:** Variety, Spacing, Growth, Yield and Tiger nuts.

**INTRODUCTION**

Vegetables are needed in the diet of average Nigeriens, tiger nuts are one of the vegetables that is underutilized with significant importance, tiger nuts received little or no attention in terms of research that can promote their effective commercial and industrial utilization (Arafat *et al.*, 2009; Opara, 2019; Ezeh *et al.*, 2014). Tiger nuts (*Cyperus esculentus*) are one of such neglected and

underutilized species, which belongs to the family Cyperaceae. It is an underutilized crop cultivated worldwide which is an edible perennial sedge plant and is a lesser-known root vegetable that produces sweet nuts-like nuts. These nuts are rich in energy content such as starch, fat, sugar, and protein. It is commonly used for animal feed and human consumption. The nuts or nuts are mainly as

beverages for refreshment it is milky in appearance (Udeozor, 2012). In Nigeria, tiger nuts are mostly grown in the central and the northern regions, particularly, the southern and northern Guinea savanna agro-ecological zones where it is sold locally for consumption. The tuber grows freely and is consumed widely in Nigeria and other parts of West Africa. The oil content of tiger nuts is about 25%, the oil yield per unit area is four times that of soybeans and two times that of rape (Wang *et al.*, 2019). The oil meal which is a by-product of oil extraction is a high-quality feed alternative to maize. The above-ground stems and leaves can be used as green fodder, green manure, paper-making, or packaging materials and the nuts can also be processed to make edible snacks (Liu *et al.*, 2020).

The high rate of production and lack of awareness of the benefits of tiger nuts had been underutilized resulting in its wastage. There is little information on the effect of plant density on the yield from tiger nuts. But due to increasing awareness of the use of tiger nuts oil, milk and fibre contents, there is needed to determine the appropriate methods necessary for high yields.

Tiger nuts close spacing can have significant effects on the yield of the crop, closer spacing increases the yield of tiger nuts. Spacing of 10cm between the plants resulted in the highest yield of tiger nuts compared to a spacing of 20 cm or 30 cm. similarly, a closer spacing of 25cm resulted in a significantly higher yield than a wider spacing of 50 cm. The reason for this increase in yield with closer spacing is that it promotes competition among the plants for resources utilization such as water and nutrients. With closer spacing, the plant also shades each other, reducing the amount of weed growth and increasing moisture retention in the soil. However, proper planting and crop management practices must be followed to ensure the plants do not become overcrowded and hinder growth (Onuoha and Afiaegbulam 2019). Most studies focus on effects of weeds, fertilizer (organic and inorganic), but there is few or no study or literature on how varieties and spacing affects tiger nuts production, in order to increase tiger nut output. The objectives of

this study were to evaluate the performances of the sampled varieties on the growth and yield of tiger nuts and to investigate the influence of plant spacing on the growth and yield of tiger nuts in Jalingo and Bali. Bali consistently showed higher growth and nutrient values compared to Jalingo, likely due to its superior soil and moisture retention properties. Therefore, Bali environment may likely be favourable for tiger production in Taraba state, however, further research with more tiger nut varieties should be conducted in the area.

## MATERIALS AND METHODS

### The Study Area

The Field experiment was conducted in Northern and Southern Guinea Savannah in Taraba State, Nigeria during the 2023 growing season. The first location was at the Taraba State University Teaching and Research Farm, Jalingo Nigeria, which is in Latitudes  $08^{\circ}52^1\text{N}$ ; Longitudes  $11^{\circ}18^1\text{E}$  of the equator. Jalingo lies within the Northern Guinea Savannah Agro-Ecological zone and the second location was sited at the Federal Polytechnic Teaching and Research Farm, Bali. Jalingo situated in Northern Guinea Savanna and is located between; Altitude 736m above sea level. The topography of Jalingo is gently undulating and sloppy. Jalingo has Moderate rainfall that starts from April to October averaging between 1058-1200 mm' with mean annual Temperature of  $28^{\circ}\text{C}$  and relative humidity (RH) of 70-80% in the dry season. Bali is situated in southern Guinea Savanna agro-ecological zone of Taraba State. The town is located between latitude  $07^{\circ}52^1\text{N}$  and longitude  $10^{\circ}58^1$ . (Nigerian Meteorological Agency [NiMet], 2022).

Bali has a Minor biomodal rainfall pattern. The dry season in Bali lasts from November to March. While the rainy season starts from April. Taraba State usually experiences the rainy season from April and ends October with high rainy days in the months of July, August and September. Agriculture is a key economic activity in the two locations that produce crops such as millet, rice, ground nuts cowpea, etc. Dry season commences towards

the end of October which starts by incoming harmattan and last for four (4) months (from late November to February) while early April is usually sunny time with high temperature ranges from 32°C – 41°C. (Taraba State

Government, 2021; Ayuba et al., 2019; NiMet, 2022).

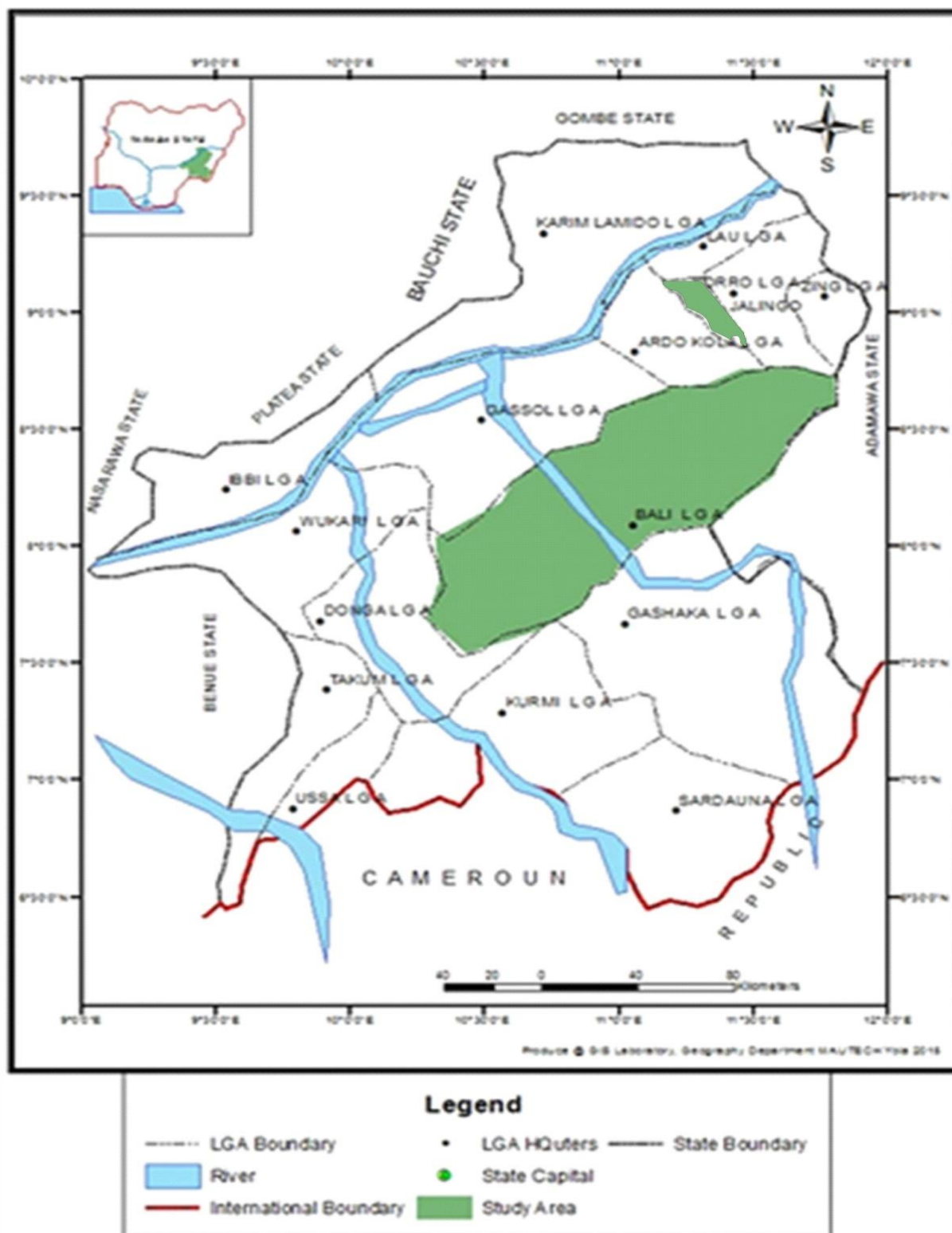


Figure 1: Map of Taraba State Showing Study Areas

Source: History Taraba State online (google)

### **Source of the Sampled Tiger Nut Varieties**

The experimental material consisted of three Varieties of tiger nuts Brown and Yellow Variety which were obtained from Agro store Zaria and Black Variety was obtained from Marysyn's Agro Store in Makurdi, Benue State.

### **Sampling Techniques and Study Design**

The selection of the two agro-ecological zones Jalingo (Northern Guinea Savannah) and Bali (Southern Guinea Savannah) was carried out using a purposive sampling technique. This non-probability sampling method was adopted based on specific criteria relevant to the research objectives. The experiment was a Randomized Complete Block Design (RCBD), laid out in a Split-plot design with three replicates. The size of the experimental field was 32m by 11.5m. The size of each main-plot was 10m by 5m (50m<sup>2</sup>) 1m walking space and the sub-plot was 3.6m by 2m (10.8m<sup>2</sup>) given 9 sub-plots on each replicate and a total of 27 sub-plots in the experimental field. The three (3) main-plots contain 3 varieties which are the Brown, Yellow and Black Variety, of tiger nuts. The sub-plots were 3 spacing 10 x 20, 15 x 30 and 15 x 40 cm; two nuts per hole were planted at 3 to 4cm. Weeding was done manually with hoe to control weed at regular intervals of three to six weeks.

### **Cultural Practices**

#### **Land preparation**

Before planting, the field was cleared; weeds were also raked out, ploughed and levelled manually before marking into experimental units (main and subplot).

#### **Planting**

The tiger nuts were planted on 17<sup>th</sup> July, 2023 in Jalingo and 28 July, 2023 in Bali using the following plant spacing (10 x 20cm, 15 x 30cm and 20 x 40cm). Two (2) nuts per hole were sown at about 5cm depth. Plants were thinned down to one plant, two weeks after seedling emergence, leaving a plant population of 240, 156 and 117 plants per plot, respectively.

#### **Data Collection**

Five plants were tagged from the two middle rows excluding the border plants per plot from

which data were collected. Data were collected on the following growth and yield parameters:

**Plant height (cm):** Measured from the base of the plant to the topmost leaf using a meter rule and recorded at 2-week intervals starting from 2 weeks after planting (WAP) until 12 WAP.

**Number of leaves per plant:** Counted manually by selecting five tagged plants per plot and taking the average.

**Number of tillers per plant:** Counted from the base of each tagged plant.

**Number of tubers per plant:** Counted after harvest from five randomly selected plants per subplot.

**Tuber size (length and diameter in cm):** Measured with a digital vernier caliper after harvest.

**Germination percentage (%):** Germination percentage were counted and computed in percentage

**Days to 50% germination:** Days to 50% germination were counted and computed in percentage

#### **Frequency and time of data collection**

**Growth data:** Plant Height (cm), Number of Leaves per Plant, Number of Tillers per Plant, Number of Tubers per Plant, Tuber Size (Length and Diameter in cm) and Germination percentage (%): Days to 50% germination: Days were collected fortnightly, beginning from 2 WAP to 12 WAP.

**Yield data:** Weight of fresh biomass, weight of dry matter, weight of 100 nuts, and size of nut per plant (tuber number, tuber weight, tuber size) were recorded at harvest.

#### **Collection of Soil samples**

Three composite soil samples were randomly collected using a soil auger at a depth of 0.25cm which were sent to the laboratory of the Department of Soil Science, Modibbo Adama University, Yola.

The pH was measured using the Soil pH was determined using the 1:2.5 soil-to-water suspension method, as described by Wang et al., (2021). Organic carbon content was assessed through the dry combustion method using a CHN analyzer, following the procedure outlined by Nelson and Sommers (2019).

**Table 1: Parameters Measured, Measurement, Timing and Frequency**

| S/N         | Parameter                              | Measurement Timing                      | Instrument Used                | Frequency                   |
|-------------|----------------------------------------|-----------------------------------------|--------------------------------|-----------------------------|
| Growth Data |                                        |                                         |                                |                             |
| 1           | Plant Height (cm)                      | From 2 WAP to 12 WAP                    | Meter rule / Measuring tape    | Fortnightly (every 2 weeks) |
| 2           | Number of Leaves per Plant             | From 2 WAP to 12 WAP                    | Manual counting                | Fortnightly                 |
| 3           | Number of Tillers per Plant            | From 2 WAP to 12 WAP                    | Manual counting                | Fortnightly                 |
| 4           | Number of Tubers per Plant             | From 2 WAP to 12 WAP                    | Manual counting                | Fortnightly                 |
| 5           | Tuber Size (Length and Diameter in cm) | From 2 WAP to 12 WAP                    | Digital Vernier caliper        | Fortnightly                 |
| 6           | Germination Percentage (%)             | Early stage (7–14 Days After Planting)  | Field observation and counting | Once (early observation)    |
| 7           | Days to 50% Germination                | Early stage                             | Calendar / field observation   | Once                        |
| Yield Data  |                                        |                                         |                                |                             |
| 8           | Weight of Fresh Biomass                | At harvest (90–120 Days After Planting) | Digital weighing scale         | Once                        |
| 9           | Weight of Dry Matter                   | At harvest                              | Oven drying and digital scale  | Once                        |
| 10          | Weight of 100 Nuts                     | At harvest                              | Digital weighing scale         | Once                        |
| 11          | Size of Nut per Plant                  | At harvest                              | Digital Vernier caliper        | Once                        |

The cation exchange capacity (CEC) of the soil was evaluated using the ammonium acetate method at pH 7, according to the protocol of Gwenzi *et al.*, (2016).

Total nitrogen (N) was determined using the micro-Kjeldahl digestion method as updated by Jones *et al.*, (2012), while available phosphorus (P) was extracted using the Olsen method, modified for tropical soils, following Mehlich and Godsey (2020).

#### **Growth parameters**

**Germination percentage (%):** Germination percentage were counted and computed in percentage

**Days to 50% germination:** Days to 50% germination were counted and computed in percentage

**Plant height (cm):** Plant height is the length of the plant from the base of the stem (surface of the soil) to the apex of the leaves, it was measured at harvest after planting per plot at growth stage in centimeter using a measuring tape for the five tagged plants and the average computed

**Number of leaves:** The number of l leaves per plot was counted at harvest after planting at vegetative growth stage from the five tagged plants and the average computed after.

**Numbers of tillers:** The profuse numbers of tillers per plot were also counted at harvest after planting at vegetative growth stage per five tagged plants.

**Length of leaf (cm):** The length of leaf per plot in centimeters was measured at harvest after planting using a measuring tape during vegetative growth for the five tagged plants and the average computed.

**Yield parameters:** Weight of fresh biomass, weight of dry matter, weight of 100 nuts, and size of nuts per plant

**Fresh biomass (g):** Weight of fresh biomass was determined using a sensitive weighing balance in gram (g) at harvest.

**Dry biomass (g):** tiger nuts plants were dried at room temperature for two weeks after harvest, biomass was determined using a sensitive weighing balance in gram (g) after harvest.

**Hundred nuts (kg):** Weight of 100 nuts was determined using a sensitive weighing balance in gram (g) after harvest.

**Size of nuts per plant (mm):** The size of nuts per plant were measured using vernier caliper in millimeters also after harvest,

#### **Data analysis**

The data collected was subjected to Analysis of Variance (ANOVA) using Gen Stat (2010) and Least Significant Difference (LSD) for mean separation at 5% level of probability.

## **RESULTS AND DISCUSSION**

The table 2: The soil physiochemical analysis reveals notable differences between the Bali and Jalingo samples, with implications for soil fertility and agricultural potential. Bali's soil

has a slightly alkaline pH (7.20) compared to the slightly acidic pH (6.72) of Jalingo, which can influence nutrient availability and crop suitability. Bali also exhibits a sandy loam texture with moderate sand content (68%) and higher clay and silt percentages than Jalingo, which has a predominantly sandy loam texture (86% sand). These characteristics suggest that Bali's soil may retain water and nutrients better than Jalingo's, which has lower water-holding capacity and reduced nutrient retention due to its high sand content.

In terms of nutrient status, Bali's soil is richer in organic matter (23.45 g/kg) and organic carbon (13.60 g/kg) than Jalingo's (19.31 g/kg and 11.20 g/kg, respectively), indicating better soil structure and fertility. However, Jalingo compensates with higher total exchangeable bases (4.00 cmol/kg), resulting in a greater cation exchange capacity (5.70 cmol/kg) for nutrient retention and exchange. Despite these differences, Bali's soil has a higher sodium adsorption ratio (SAR: 1.09) and exchangeable sodium percentage (ESP: 14.71%), which may raise concerns about potential salinity issues. Overall, Bali's soil may support a wider range of crops due to its balanced texture and nutrient-rich profile, while Jalingo's sandy soil is better suited for drought-tolerant crops but may require amendments to improve its nutrient and water-holding capacities.

To relate the findings of your research on the soil physicochemical characteristics of Jalingo and Bali to existing literature, it's important to highlight both consistencies and contrasts with studies conducted in similar agro-ecological zones, starting within Nigeria and then extending globally.

Several studies within Taraba State and other parts of Nigeria confirm that soil texture and composition significantly influence crop performance. For example, Audu *et al.*, (2018) reported that loamy soils in Bali and other southern Taraba regions, due to their balanced texture, tend to retain more moisture and

nutrients, thus enhancing the growth of tuber and root crops, including tiger nuts. This aligns with your findings that Bali's loamier soil composition (68% sand, 21.2% silt, 10.8% clay) supports better water and nutrient retention compared to Jalingo's sandy soils.

This finding is consistent with Brady and Weil (2008), who emphasized that sandy soils, like those found in Jalingo (86% sand), typically have low water-holding capacity and poor nutrient retention, which can limit crop productivity unless supplemented with irrigation and organic amendments. Similarly, the slightly alkaline pH of Bali's soil (7.20) aligns with Rengel (2015), who highlighted that a neutral to slightly alkaline pH enhances nutrient availability, especially phosphorus and micronutrients vital for root development in crops like tiger nuts.

The higher organic matter and organic carbon contents in Bali are also supported by studies such as Nardi *et al.*, (2009) and Agbede (2009), which show that increased organic matter improves soil structure, microbial activity, and nutrient cycling—all crucial for optimal crop performance. These results are particularly relevant for tiger nut cultivation, which benefits from fertile, well-structured soils.

Moreover, your data showing higher soil porosity in Bali (40.38%) compared to Jalingo (34.23%) concurs with Dexter (2004), who indicated that higher porosity promotes better aeration, water infiltration, and root penetration, all of which are critical for tuber crops.

In global contexts, studies such as Singh *et al.*, (2017) in India and Mwangi *et al.*, (2020) in Kenya also reinforce that loamy soils with balanced physical characteristics support higher yield performance in similar crops. These studies noted that soil organic content, pH, and porosity significantly correlate with yield metrics across varied agro-ecological zones.

**Table 2: Soil Physiochemical Analysis of Jalingo and Bali**

| Table 2: Soil Physicochemical Analysis of Saline and Sodic Soils |        |        |                    |        |                  |                    |                    |                               |                    |          |                     |        |       |        |
|------------------------------------------------------------------|--------|--------|--------------------|--------|------------------|--------------------|--------------------|-------------------------------|--------------------|----------|---------------------|--------|-------|--------|
|                                                                  | Sample | PH     | EC                 | % Sand | % Clay           | % Silt             | T. Class           | BD                            | PD                 | Porosity | WHC                 | MC     |       |        |
|                                                                  |        |        | (dS/m)             |        |                  |                    |                    | (g/cm3)                       | (g/cm3)            | (%)      | (%)                 | (%)    |       |        |
|                                                                  | BAL    | 7.20*  | 0.11 <sup>NS</sup> | 68.00  | 10.80*           | 21.20*             | SL*                | 1.55 <sup>NS</sup>            | 2.60 <sup>NS</sup> | 40.38*   | 35.50 <sup>NS</sup> | 7.70   |       |        |
|                                                                  | JAL    | 6.72   | 0.09               | 86.00* | 4.80             | 9.20               | LS                 | 1.71                          | 2.60               | 34.23    | 35.70               | 8.00*  |       |        |
|                                                                  | OC     | OM     | %TN                | AVP    | Ca <sup>2+</sup> | Mg <sup>2+</sup>   | K <sup>2+</sup>    | Na <sup>2+</sup><br>(cmol/kg) | TEB                | TEA      | ECEC                | PBS    | SAR   | ESP    |
|                                                                  | (g/kg) | (g/kg) |                    | (g/mg) |                  |                    |                    |                               |                    |          |                     |        |       |        |
|                                                                  | 13.60* | 23.45* | 0.13 <sup>NS</sup> | 8.70*  | 0.80             | 0.60 <sup>NS</sup> | 0.88 <sup>NS</sup> | 0.79 <sup>NS</sup>            | 3.07               | 2.30*    | 5.37                | 57.17  | 1.09* | 14.71* |
|                                                                  | 11.20  | 19.31  | 0.10               | 6.40   | 1.90*            | 0.46               | 0.97               | 0.67                          | 4.00*              | 1.70     | 5.70                | 70.18* | 0.65  | 11.75  |

Keys: EC: Electrical Conductivity; T. Class: Textural Class; SL: Sandy Loam; LS: Loamy Sand; BD: Bulk Density; PD: Particle Density; WHC: Water Holding Capacity; MC: Moisture Content. OC: Organic Carbon; OM: Organic Matter; TN: Total Nitrogen; TEB: Total Exchangeable Bases; TEA: Total Exchangeable Acidity. PBS: Percent Base Saturation; SAR: Sodium Absorption Ratio; ESP: Exchangeable Sodium Percentage; AVP: Available Phosphorus.

The data in Table 3 demonstrates the effects of different tiger nuts varieties (Brown, Yellow, and Black) and spacing (10X20cm, 15X30cm, 20X40cm) on key vegetative growth parameters. Among the variety, the Yellow (YEL) variety outperformed the others, exhibiting the highest germination percentage (68.50%) and the shortest time to reach 50% germination (9.82 days).

It also showed superior plant height (73.58 cm) and leaf length (62.74 cm), suggesting robust early growth and development. In contrast, the Black (BLK) variety lagged significantly, with the lowest germination percentage (43.10%) and the longest time to 50% germination (14.30 days). The Brown (BRW) variety performed moderately across most parameters, demonstrating a balanced growth profile. These results indicate that YEL is the most promising cultivar for enhanced vegetative growth.

Spacing treatments also significantly influenced tiger nuts growth. The closest spacing (10X20cm) resulted in the highest germination percentage (67.20%) and tallest plants (72.28 cm), suggesting better utilization of available resources at higher plant densities. Moderate spacing (15X30cm) showed intermediate results, while the widest spacing (20X40cm)

resulted in the poorest growth across most parameters, with the lowest germination percentage (45.20%) and shorter plant height (67.67 cm). These findings indicate that closer spacing (10X20cm) supports better vegetative growth, potentially due to more favorable microclimatic conditions and reduced inter-plant competition during early stages. However, the suitability of such spacing may vary based on factors like soil fertility and water availability.

Yellow (YEL) variety had superior vegetative growth traits—highest germination percentage (68.50%), shortest time to 50% germination (9.82 days), and greatest plant height (73.58 cm) and leaf length (62.74 cm). These findings align with Panda *et al.*, (2017), who found that varietal characteristics significantly affect early crop vigor, and that varieties with greater early biomass accumulation tend to yield more effectively under favorable conditions.

The Black (BLK) variety's poor performance in germination and plant height, and the Brown (BRW) variety's intermediate performance, also reflect varietal differences in genetic potential for stress tolerance and early vigor, as reported in studies by Maya *et al.*, (2018). These scholars emphasized that yellow cultivars of tiger nuts often outperform other color morphs in vegetative parameters, particularly under tropical and savanna climates.

closer spacing (10X20 cm) led to better germination (67.20%) and taller plants (72.28 cm) this supports the findings by Kariaga *et al.*, (2017), who reported that closer spacing tends to create favorable microclimates (e.g., higher humidity, moderated temperature) that benefit early plant development. The influence of spacing on plant morphology is a well-documented factor in tuber crops, where denser spacing can lead to early canopy closure, enhancing photosynthetic efficiency during vegetative stages.

moderate spacing (15X30 cm) showed optimal balance in plant height and leaf length confirms the conclusions of Zhang and Liao (2017), who found that intermediate spacing often optimizes the use of light, water, and nutrients without creating excessive competition or underutilizing the field area. On the other hand, wider spacing (20X40 cm) resulted in the lowest germination and shortest plants likely reflects lower plant population pressure, leading to inefficient land use, as also observed by Fageria *et al.*, (2010).

According to Table 3. The Yellow (YEL) variety also performed best in yield parameters, including dry matter weight (26.46 g), fresh tuber weight (33.80 g), and number of tubers per plant (34.63). This consistency across both vegetative and yield traits strongly aligns with Akintoye *et al.*,

(2022), who highlighted the importance of selecting genetically superior cultivars for both biomass and tuber yield potential. The superior performance of YEL further supports the idea that cultivar selection is one of the most critical determinants of tiger nut productivity, particularly under variable climatic conditions like those in Jalingo.

Moderate spacing (15X30 cm) resulted in the highest number of tubers per plant (37.99) and good tuber weight (77.70 g) are consistent with literature on plant density management. For example, Fageria *et al.*, (2010) emphasized that optimal plant spacing improves nutrient use efficiency, reduces competition, and ultimately enhances yield. While wider spacing (20X40 cm) improved individual tuber size (6.66 mm) and weight (85.60 g), it reduced tuber number per plant—highlighting a common trade-off reported in tuber crop studies.

This trade-off is also consistent with the conclusions of Zhang and Liao (2017), who observed that while wider spacing favors individual plant growth (due to more space and resources), it may reduce total yield per hectare. In contrast, closer spacing (10X20 cm) supports higher total biomass and nut number per plant, as seen in your data, but can limit individual tuber size due to intra-specific competition.

**Table 3: Effects of Cultivar and spacing on Vegetative Growth of Tiger Nuts in Jalingo and Bali**

| Treatment  | GERM%       | D50%GERM    | PHPP12(cm)  | NTPP12    | NLPP12      | LLPP12 (cm) |
|------------|-------------|-------------|-------------|-----------|-------------|-------------|
| BRW        | 64.40±66.90 | 11.80±11.49 | 71.33±73.65 | 6.19±5.85 | 78.24±83.67 | 61.11±61.27 |
| YEL        | 68.50±72.00 | 9.82±9.61   | 73.58±75.68 | 6.13±6.22 | 77.32±84.28 | 62.74±62.92 |
| BLK        | 43.10±47.00 | 14.30±12.34 | 65.66±73.64 | 5.03±5.48 | 63.80±82.68 | 59.20±60.03 |
| LSD (0.05) | 3.02±13.36  | 3.86±3.86   | 4.19±3.00   | 0.92±0.41 | 4.74±6.46   | 3.75±3.59   |
| 10x20cm    | 67.20±69.90 | 11.90±10.24 | 72.28±76.59 | 5.78±6.08 | 75.71±87.02 | 61.12±61.84 |
| 15x30cm    | 64.70±63.60 | 9.15±9.15   | 70.43±64.79 | 5.16±5.71 | 73.97±84.53 | 62.05±62.70 |
| 20x40cm    | 45.20±52.40 | 14.86±14.00 | 67.67±71.79 | 5.46±5.75 | 69.69±79.09 | 59.58±54.69 |
| LSD (0.05) | 3.53±5.73   | 2.02±2.02   | 1.69±2.62   | 0.40±0.41 | 3.88±4.34   | 2.40±2.58   |

GERM%: Germination Percentage D50%G: Days to Fifty Percent Germination PHPP12: Plant Height at three, Six, Nine and Twelve weeks after planting NTPP12. Brown: BRW Variety, Yellow: YEL Variety, Black: BLK Variety, 10x20cm, 15x30cm and 20x40cm, and LSD: Least Significant Difference at 5%\*Level of Significance.

The data in Table 4 shows significant differences in the yield performance of tiger nuts variety and the effects of spacing on yield parameters. Among the variety, the Yellow (YEL) variety demonstrated superior productivity with the highest wet dry matter (26.46 g), wet fresh biomass (33.80 g), and number of nuts per plant (34.63). This indicates that YEL has robust growth and tuber production potential. The Black (BLK) cultivar recorded comparable values for tuber weight (69.70 g) and size (5.95 mm) but had the lowest number of nuts per plant (26.68), suggesting less efficient tuber production. The Brown (BRW) cultivar performed moderately across most parameters, showing balance in its yield characteristics. These results suggest that YEL is the most suitable cultivar for maximizing both tuber quantity and biomass in Jalingo conditions.

Spacing significantly influenced yield outcomes, with wider spacing (20X40cm) producing the heaviest nuts (85.60 g) and the largest tuber size (6.66 mm). This indicates that reduced competition at wider spacing allows individual plants to access more nutrients and resources, promoting larger tuber growth. However, closer spacing (10X20cm) led to the highest biomass production (34.32 g) and a relatively high number of nuts per plant (32.71), making it favorable for maximizing overall yield. Moderate spacing (15X30cm) offered a balance, with good tuber weight (77.70 g) and the highest number of nuts per plant (37.99). These results imply that closer spacing benefits biomass and tuber quantity, while wider spacing enhances individual tuber size and weight, allowing producers to tailor spacing to specific yield goals. The study investigated the influence of cultivar types and plant spacing on the growth and yield of tiger nuts (*Cyperus esculentus*) in Jalingo and Bali, both located in Taraba State, Nigeria. The results indicated significant differences in growth and yield performance based on cultivar selection and spacing. The results in Tables 2 and 3 show that the YEL (yellow) cultivar of tiger nut consistently outperformed the others across most vegetative and yield parameters in both

Jalingo and Bali. YEL recorded the highest germination percentages ( $68.50\% \pm 72.00\%$ ) and the shortest days to 50% germination ( $9.82 \pm 9.61$ cm), indicating better seed vigor and rapid establishment. It also had the tallest plants at 12 weeks ( $73.58 \pm 75.68$  cm), a high number of tillers ( $6.13 \pm 6.22$ cm), leaves ( $77.32 \pm 84.28$ cm), and the longest leaf lengths ( $62.74 \pm 62.92$ cm). BRW (brown) followed closely in vegetative performance, while BLK (black) lagged significantly behind, especially in germination percentage ( $43.10 \pm 47.00\%$ ) and number of leaves ( $63.80 \pm 82.68$ ). Regarding yield in Jalingo, YEL again showed superiority with the highest values in weight of dry mass ( $26.46 \pm 27.82$  g), weight of fresh bulbils ( $33.80 \pm 39.01$  g), and number of nuts per plant ( $34.63 \pm 36.12$ ), while also maintaining competitive values in harvested nut weight ( $69.60 \pm 68.60$  g) and nut size ( $5.30 \pm 5.41$  mm). Although BLK produced the largest nuts in size ( $5.95 \pm 5.69$ mm) and comparable harvested nut weights ( $69.70 \pm 70.70$  g), its overall lower vegetative and reproductive performance, especially fewer nuts ( $26.68 \pm 33.12$ ), suggests limited potential compared to YEL and BRW under the tested conditions.

Spacing treatments significantly influenced the vegetative growth and yield. The closest spacing (10x20cm) produced the highest biomass and tuber number per plant, suggesting that dense planting is beneficial for overall yield. However, wider spacing (20x40cm) allowed for larger nuts, indicating that spacing adjustments could be tailored to specific yield objectives, depending on whether larger individual nuts or greater overall biomass is desired. The moderate spacing (15x30cm) provided a balance between tuber size and number, offering optimal productivity in terms of both quality and quantity.

Soil analysis revealed that Bali's soil, being more-loamy with better water and nutrient retention properties, supported better growth compared to the sandy soil of Jalingo. This highlights the importance of considering soil type and its impact on the cultivation of tiger nuts.

**Table: 4: Effects of Cultivar and Spacing on Yield of Tiger Nuts in Jalingo**

| Treatment  | WDM (g)     | WFB (g)     | NNPP        | WHN (g)     | SNPP (mm) |
|------------|-------------|-------------|-------------|-------------|-----------|
| BRW        | 22.49±27.08 | 32.76±37.08 | 30.59±33.13 | 67.50±68.50 | 4.92±5.32 |
| YEL        | 26.46±27.82 | 33.80±39.01 | 34.63±36.12 | 69.60±68.60 | 5.30±5.41 |
| BLK        | 25.94±26.97 | 30.43±36.56 | 26.68±33.12 | 69.70±70.70 | 5.95±5.69 |
| LSD (0.05) | 1.59±1.59   | 1.44±2.10   | 7.26±4.58   | 4.64±4.64   | 1.30±1.30 |
| 10x20cm    | 27.09±27.25 | 34.32±39.14 | 32.71±35.39 | 43.60±44.80 | 4.38±4.38 |
| 15x30cm    | 26.48±27.45 | 32.82±38.50 | 37.99±34.23 | 77.70±80.80 | 5.13±5.15 |
| 20x40cm    | 26.32±27.13 | 29.85±34.98 | 28.22±32.76 | 85.60±82.30 | 6.66±6.80 |
| LSD (0.05) | 1.61±1.61   | 1.89±1.97   | 1.89±1.05   | 8.11±8.11   | 0.50±0.50 |

WDM: Weight of Dry Matter WFB: Weight of Fresh Biomass NNPP: Number of Nuts Per Plant, WHT: Weight Hundred Nuts SNPP: Size of Nuts Per Plant, Brown: BRW Variety, Yellow: YEL Variety, Black: BLK Variety, 10x20cm, 15x30 cm and 20x40cm, \*Level of Significance.

## CONCLUSION

The study investigated the influence of cultivar types and plant spacing on the growth and yield of tiger nuts (*Cyperus esculentus*) in Jalingo and Bali, both located in Taraba State, Nigeria. The results indicated significant differences in growth and yield performance based on cultivar selection and spacing. The results in Tables 2 and 3 show that the Yellow (YEL) cultivar of tiger nut consistently outperformed the others across most vegetative and yield parameters in both Jalingo and Bali. YEL recorded the highest germination percentages (68.50±72.00%) and the shortest days to 50% germination (9.82±9.61cm), indicating better seed vigor and rapid establishment. It also had the tallest plants at 12 weeks (73.58±75.68 cm), a high number of tillers (6.13±6.22), leaves (77.32±84.28), and the longest leaf lengths (62.74±62.92 cm). BRW (brown) followed closely in vegetative performance, while BLK (black) lagged significantly behind, especially in germination percentage (43.10±47.00%) and number of leaves (63.80±82.68). Regarding yield in Jalingo, YEL again showed superiority with the highest values in weight of dry mass (26.46±27.82 g), weight of fresh bulbils (33.80±39.01 g), and number of nuts per plant (34.63±36.12), while also maintaining competitive values in harvested

nut weight (69.60±68.60 g) and nut size (5.30±5.41 mm). Although BLK produced the largest nuts in size (5.95±5.69 mm) and comparable harvested nut weights (69.70±70.70 g), its overall lower vegetative and reproductive performance, especially fewer nuts (26.68±33.12g), suggests limited potential compared to YEL and BRW under the tested conditions.

Spacing treatments significantly influenced the vegetative growth and yield. The closest spacing (10x20 cm) produced the highest biomass and tuber number per plant, suggesting that dense planting is beneficial for overall yield. However, wider spacing (20x40 cm) allowed for larger nuts, indicating that spacing adjustments could be tailored to specific yield objectives, depending on whether larger individual nuts or greater overall biomass is desired. The moderate spacing (15x30 cm) provided a balance between tuber size and number, offering optimal productivity in terms of both quality and quantity. Soil analysis revealed that Bali's soil, being more-loamy with better water and nutrient retention properties, supported better growth compared to the sandy soil of Jalingo. This highlights the importance of considering soil type and its impact on the cultivation of tiger nuts.

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