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# Response of Tigernut (*Cyperusesculentus*) to Different Rates of Two Mineral Fertilisers Under Pot Conditions on Loam-Sand Soil

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**Abstract**

Tigernut (Cyperus esculentus), is a family of sedge rhizome that with nuts. These nuts are important source of some essential amino acids and vitamins needed in human's diet. However, there are inadequate information on effect of the rates of mineral fertilisers on its production in Lagos state. Hence, this study evaluated the application rates of NPK 15-15-15 and Urea fertilisers on the growth and yield of *Cyperus esculentus* under pot conditions. An open field pot experiment was conducted in October 2018 at Teaching and Research Farm of Michael Otedola College of Primary Education, Epe, Lagos state. Experimental treatments applied are: three levels of two mineral fertilisers; (0, 40 and 60 kg/ha) each for; No fertiliser application-NFA, NPK, and urea fertilisers, respectively. The experiment was laid in complete randomized design (CRD), and the treatments were replicated thrice. Data collected at weeks after sowing (WAS) are: Plant height (PH), Number of leaves (NL), Fresh nut weight (FNW) and number of nuts per plant. All data were analysed using ANOVA ($\alpha_{0.05}$). The PH values were significantly low under NFA but increased under the two mineral fertilisers application. At 3WAS, tigernut PH and NL were significantly increased under 60 kg/ha application of NPK. Similarly, at 7WAS, the PH (48.6 cm) was not significantly different under 60 kg/ha urea when compared to the same rate of NPK fertiliser application. The highest FNW (13.8±4.3 t/ha) was obtained under60 kg/ha application rate of NPK fertiliser, while under urea fertiliser application at the same rate, FNW was 8.7±2.3 t/ha which was significantly lower compared to the yields obtained under 40 kg/ha application rates of both fertilisers. In conclusion, the application of urea fertiliser at both rates were not ideal for tigernut production. Hence, NPK 15 – 15 – 15 at 60 kg/ha is recommended at as this increased the growth and yield of tigernut.

**Keywords***: Different soils, Mineral fertilisers, Tigernut, Yield*

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**Background to the Study**

Tigernut is also called *Earth almond* or *Nut* grass and is one of the underutilised sedge crops is tigernut (*Cyperusesculentus* L) also. This crop has a place with the division *Magnoliophyta*, class *Liliopsida*, request *Cyperales* and family-Cyperaceae and observed to be a perpetual grass or sedge like plant. The plant foliage is exceptionally extreme and sinewy and is regularly confused with a grass (Chukwuma, Obiama, and Christopher, 2010). There are three fundamental types of tigernut species and these are dark, brown and yellow in colour, the yellow and darker ones are common in Nigerian markets. The roots are of a broad and complex arrangement with fine, sinewy roots having layered rhizomes attached to these rhizomes, which are little, hard; circular nuts at the basal part of the plant (Macho, 2014).

When tigernut plant is under cultivation it is an annual or ephemeral crop, but in the wild, it can grow up to 90 cm in tallness and grows more than one season or for years, with numerous tillers emerging from the rhizomes. The nuts are about 0.3 – 1.9 cm in diameter and vary in colour from yellow to dark. One plant can produce a few numbers of nuts from 10 to 30 nuts under well favourable conditions (Adejuyitan, 2011). Under adverse weather conditions, the foliage, roots, rhizomes, and basal knobs dry off, but the nuts remain passive and sprout immediately at the onset of the rainy season and continue its life cycle in full vegetative growth with numerous tillers and nuts. (Bamishaiye and Bamishaiye, 2011). The basal knobs start the stems and leaves over the ground, and stringy roots underground. Cyperus esculentus is wind pollinated and requires cross fertilization, also it regenerates through vegetative mean especially with the tillers and nuts (Udeozor, 2012).

Moreover, there is limiting information about the agronomic practices on the cultivation of tigernut in Nigeria as it is considered as wild grass under use (Adgidzi (2010).*Cyperusesculentus* requires a moderate sunshine, normal body temperature and fairly distributed rainfall with well-drained soil high in soil organic matter among other physiochemical dynamics as required by other arable crops. The nuts can grow downward to about 30cm depth into the soil, but considerable number of the nuts are found around the region of 10 to 20 cm (topsoil) deep round about the parent plant including the tillers.

From field preliminary trial, the report by Oladele, Ntuem, Liman, and Adewoyin (2013), showed that with compound compost and other agronomic practices tigernut yield can be improved like other arable crops. Tigernut endures numerous unfavourable soil conditions and dry season with little or no tolerance for flooding. According to Oladele *et al*, (2013) tigernuts plant develops best on sandy soil. According to this report, planting is best done on well ploughed tilled flat land or ridges and the nuts are the planting material which are to be sown in wholly. Planting should be done at 1 or 2 seeds or nuts per hole at about 10 by 20 cm or 15 to 20 cm planting distance with a seed rate of about 120 kg (about 333, 333 stands per hectare) of nuts/ha (Pascual-Seva, San Bautista, López Galarza, Maroto, and Pascual, 2013).

Cultivation operations of *Cyperus esculentus* are best done between April and May, notwithstanding, when sown amid dry season, regular irrigation is important until they are harvested (Chukwuma, Obiama, and Christopher, 2010). Tubers or nuts formation begins around 6 to 8weeks after sowing and develop to maturity between 90 – 110 days. The yield is between 10 – 19 tons per hectare under field conditions (Agbabiaka, Madubuiko, and Anyanwu, 2012). The nuts are ready for harvest when more than 80% of the leaves of the plants in the entire field are brownish or show dryness.  more often than not happens when leaves are darker in shading then the tigernuts plant is hauled out of the ground. Harvesting is done by pulling out the plant at maturity, hand picking of the nuts and destoning manually. The nuts are then washed and air or sundry for further processing or storage  (Salau, Ndamitso, Paiko, Jacob, Jolayemi, and Mustapha, 2012). According to Gambo (2012), the drying is important especially in sun to reduce the moisture content and to increase the sucrose level of the nuts.

The nut as whole is of and medicinal important due to its composition of; non acidic and unsaturated top edible oil, great quality dietary fibre and sugar, highly rich in minerals (sodium, calcium, potassium, magnesium, zinc and fundamental amino acids). Its tubers or nuts likewise enhance sexual activity. Also it serves as; carminative, diuretic, stimulant and tonic to body system. Regardless of monetary significance of tigernut, for example, it provides employment opportunity, it is a very important source of raw material in most confectionary businesses, and serves as animals feed particularly the chaff or remains after extracting the juice or liquid.  (Atala, 2012; Macho, 2014).

In light of all these nutritional and medical usefulness, the tigernut production is not common in this part of the nation (Lagos) among the farmers. Moreover, whenever its cultivation is found, the agronomic practice including mineral fertiliser application is yet to be established. Other common arable crops such as maize, cowpea, soybean and groundnut are well known with various mineral and organic fertilisers but none is attributed to tigernut. Hence, this trial aimed and investigated rates of two minerals (NPK 15 – 15 – 15 and Urea) fertilisers on the growth and yield of tigernut.

## Materials and Methods

**Experimental location:** The experiment was conducted at Michael Otedola College of Primary Education. Teaching and Research Farm (TR&F) Noforija; located on 6.6$^0$N and 4.0$^0$E. The farm is located on the northern shore of the Lagos lagoon, about 32 kilometres south of Ijebu Ode, Lagos state. The coordinates of the experimental farm for the experiment are as follow: N0637.168', E003.323', N0637.166', E003.325', N0637.164', E003.333' and N0637.169', E003.332 (Olugbemi and Onibon, 2019).

**Land preparation for soil samples collection:** The land was cleared and soil samples were collected at a depth of 0 – 30 cm with the use hoe and shovel. The collected soil samples were air dried and gravels were removed, samples were bulked into composite, air-dried, crushed and sieved with 0.5mm mesh for soil physical and chemical laboratory analyses (Table 1).

**Experimental materials and procedures:** Each 10 litres size polythene bags were filled with 10 kg. The tigernuts were sourced from Hausa hawker and the best and viable nuts were selected for sowing. The mineral fertilisers used are NPK 15-15-15 and urea. The nuts were sown at two nut per pot and latter thinned to one seedling per pot. Each pot or unit of the experiment was manually irrigated to 60% field capacity throughout the experiment except rainy days.

**Experimental treatments and design:** The treatments are: Control (NFA-No fertiliser application); NPK and Urea Fertiliser at 0, 40 and 60 kg /ha of each fertiliser, respectively. The fertiliser materials were applied at 0, 40 and 60 kg/ha per pot at two weeks after sowing. The pots were placed in an open space and arranged in complete randomized design (CRD) and the treatments were replicated three (3) times given a total unit of fifteen (15) pots or experimental units. Manual weeding and irrigation were carried out on each polythene bag regularly through the experiment.

**Data collection and analysis:** The growth parameters such as plant height, number of leaves per plant were collected weekly after sowing. At the twelfth weeks after sowing (12 WAS), the following data were collected: fresh nuts weights and number of nuts. All data collected were analysed using analysis of variance (ANOVA $\alpha_{0.05}$) and mean treatments were subjected to standard error where there is significant difference.

## Results and Discussion

From table 1, the soil laboratory analysis showed that the nitrogen level is moderate (1.8g/kg), available P is medium and the exchangeable bases are in medium range. With these parameters, the values showed that tigernut is capable of responding positively to fertiliser application at various rates.

**Table 1:** Physical and chemical laboratory analysis of the soils used for the experiments

| Parameters | Values |
|---|---|
| pH ($H_2O$) (1:1) | 4.6 |
| pH (Cl) | 5.9 |
| Organic C (g $kg^{-1}$) | 21.4 |
| Total N (g $kg^{-1}$) | 1.7 |
| Available P (mg $kg^{-1}$) | 19.1 |
| **Exchangeable Bases (cmol $kg^{-1}$)** | |
| K | 0.16 |
| Ca | 2.79 |
| Na | 0.37 |
| Mg | 1.34 |
| **Particle size distribution (g $kg^{-1}$)** | |
| Sand | 805.0 |
| Clay | 72.2 |
| Silt | 99.0 |
| Textural class | *Loamy sand* |

**Source:** (2018) Institutional Base Research, IBR MOCPED.

Table 2 show plant heights and number of leaves of tigernut at 3 weeks after sowing (WAS); the plant height ranged from20.2 to 30.9 cm. the highest value was observed under application rate of 60kg/ha of NPK 15 – 15 – 15. This value was significantly higher than other application rates when compared.

However, there was no significant difference ($\alpha_{0.05}$) between plant height (27.3 cm) observed under application rate of 40 and 60 kg/ha of urea fertiliser and plant height (27.2 cm) under 40kg/ha of NPK fertiliser application (Table 2). The number of leaves was higher (19) under application of NPK at 60 kg/ha followed by (15) 40 kg/ha of urea. Nevertheless, this difference was not significant compared to number of leaves obtained under 40 kg/ha of urea (Table 3).

**Table 2:** Tigernut plant height and number of leaves at 3 weeks after sowing

| Fertilisers application rates | | Plant height (cm) | Number of leaves |
|---|---|---|---|
| No fertiliser application- NFA | | $20.2_c$ | $10_c$ |
| NPK | 40kg/ha | $27.2_b$ | $13_b$ |
| | 60kg/ha | 30.9a | $19_a$ |
| Urea | 40kg/ha | $27.3_b$ | $15_b$ |
| | 60kg/ha | $27.2_b$ | $13_b$ |

**Source**: Pot experiment, 2018

Values followed by the same alphabet are not significantly different ($\alpha_{0.05}$)

From table 3, the plant heights at 5WAS was significantly higher (37.4 and 36.7cm) under 60 kg/ha of urea and NPK fertilisers, respectively, these values were significantly higher when compared to values obtained under other application rates. However, at application rates of 40 and 60 kg/ha of (35.1 cm) urea, and (36.1 cm) NPK, these values were not significantly different from each other, but were higher than plant height obtained under no fertiliser application-NFA (31.9 cm).

However, the number of leaves at 5WAS ranged from 20 to 26 with the least value under the application rate of 40 kg/ha of NPK and the highest under the same rate of urea fertiliser (Table 3). More so, there is no significant difference between the number of leaves observed under NFA (24) and 60 kg/ha (24) NPK fertiliser (Table 3).

**Table 3:** Tigernut plant height and number of leaves at 5 weeks after sowing

| Fertilisers application rates | | Plant height (cm) | Number of leaves |
|---|---|---|---|
| No fertiliser application- NFA | | $31.9_c$ | 24 |
| NPK | 40kg/ha | $36.1_b$ | 20 |
| | 60kg/ha | 36.7a | 24 |
| Urea | 40kg/ha | $35.1_b$ | 26 |
| | 60kg/ha | $37.4_a$ | 22 |

**Source**: Pot experiment, 2018

Values followed by the same alphabet are not significantly different ($\alpha_{0.05}$)

Table 4 showed plant height and number of leaves, at 7 weeks after sowing (WAS), the performance was similar to that of week five after sowing (5WAS). The values ranged from 35.2 cm under NFAto 50.3 cm under 40kg/ha NPK application. There is no significant difference between the plant heights under 40kg/ha (49.0 cm), 60 kg/ha urea (48.6 cm) and 40 kg/ha NPK (50.3 cm) application.

This implied that the presence of nitrogen (N) at both levels or rates of application of both fertilisers gave the optimum vegetative performance of tigernut plant. Besides, increase in nitrogen from either of the fertiliser inhibited the plant height and number of leaves. This was observed under 60 kg/ha application of both NPK and urea fertilisers that produced 33 and 34 leaves, respectively. These values are lower when compared with the number of leaves (48), under no fertiliser application-NAF (Table 4).

**Table 4:** Tigernut plant height and number of leaves at 7 weeks after sowing

| Fertilisers application rates | | Plant height (cm) | Number of leaves |
|---|---|---|---|
| No fertiliser application- NFA | | 35.2 | 48 |
| NPK | 40kg/ha | 50.3 | 32 |
| | 60kg/ha | 44.1 | 33 |
| Urea | 40kg/ha | 49.0 | 31 |
| | 60kg/ha | 48.6 | 34 |

**Source**: Pot experiment, 2018

Values followed by the same alphabet are not significantly different ($\alpha_{0.05}$)

From table 5, the fresh nut yield ranged from 6.8±2.0t/ha to 13.8±4.3t/ha, these were obtained under application of NFA and 60 kg/ha NPK fertiliser application. At the application rates of 40 and 60 kg/ha of urea fertiliser, there w no significant difference between fresh nut yields (8.1±2.2 and 8.7±2.3 t/ha) obtained under (6.8±2.0t/ha) NFA when compared (Table 5). The average number of nut per plant ranged from 22±0.9 to 34±3.6, which is equivalent to 7,300,000 to 113,000,000 per hectare. Similar trend as observed under the fresh nut yields, application rate of 60 kg/ha of NPK gave the highest number of nuts (Table 5).

**Table 5:** Tigernut yield under different levels of two mineral fertilisers application

| Fertilisers application rates | | Fresh nut weight (g/pot) | Number of nut per pot |
|---|---|---|---|
| No fertiliser application- NFA | | 20.5±2.0 | 22.0±0.9 |
| NPK | 40kg/ha | 32.0±2.0 | 23.0±2.9 |
| | 60kg/ha | 41.4±7.3 | 34.0±3.6 |
| Urea | 40kg/ha | 24.2±4.1 | 26.0±2.9 |
| | 60kg/ha | 26.1±2.3 | 31.0±3.4 |

**Source**: Pot experiment, 2018

Values followed by the same alphabet are not significantly different ($\alpha_{0.05}$)

## Discussion

From above results, tigernut growth parameters observed showed that there is no significance difference in terms of number of leaves and plant heights under the various rates of at the early stage of mineral fertilisers application. This is in agreement with the report from Maroto and Pascual (2012). This showed that tigernut is capable of responding to application of mineral fertilisers (NPK 15 – 15 – 15 and urea) especially, on loam-sand soil amidst other physiochemical properties with moderate nitrogen and organic matter among other fertility indicators. This agreed with the findings according to Pascual *et al.,* (2012), that tigernut plant grows well on sandy soil with high nitrogen. The nut yield from this experiment was significantly higher under NPK 15 – 15 – 15 fertilisers application at 60 kg/ha rate compared with the fresh nut yield obtained under the same application rate of urea fertiliser. This yield under this application rate do not agree with application rate as reported by Bamishaiye and Bamishaiye (2011). Similarly, there was no significant difference between the fresh tigernut yields obtained from the two application rates of urea fertiliser.

**Summary and Recommendations**

From the ongoing it can be deduced that the choice of soil for these research (loamy sand) soil, moderate or medium nutrient level which can be referred to as ideal soil for tigernut production. The vegetative growth of tigernut under the two rates of fertilizer application showed that at the initial state, the 60kg/ha increase growth performance compared to the same rate of urea fertilizer. However, 40kg/ha of both mineral fertilizers do not increase the vegetative growth of tiger nut. At harvest the fresh nut yield and number of nuts per plant follows similar trend. This implied that NPK fertilizer, been a compound fertilizer is more suitable for tigernut production compared to urea fertilizer the presence of three principal nutrients namely; nitrogen, phosphorus and potassium where source of increase in growth and yield performance of tigernut. In conclusion straight fertilizer such as urea is not appropriate for tigernut production. Beside application of NPK 15:15 fertilizer at 60kg/ha is therefore recommended for Tigernut production on loamy sand soil.

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