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*Full-Length Research Paper*

# Bio-rational Nutrients and Variety as it Affects Maize (Zea mays) Production in Gombe and Makurdi, Nigeria

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**ABSTRACT:** The experiment's goal was to investigate the effect of bio-rational nutrients and variety on the growth and yield of maize grown in Gombe and Makurd during the 2020 rainy season. The two treatments used were ILOMAZI (Yellow maize) and SC 667 (white maize) as well as bio-rational nutrient sources such poultry droppings, night soil, dung site, goat manure and control. The treatments were laid out in a three-replicate randomized complete block design. The work was designed with 20 x 75cm spacing. Physiological variables were measured during the investigation, including growth, plant height, number of leaves, stem diameter, and the number of prop roots per plant. Other characteristics included the number of cobs, cob length, cob girth, and cob weight, as well as the number of seeds per cob, the number of grain rows per cob, the 100 gains weight, the threshing percentage, and the grain yield. The study found that maize responded to both varietal and bio-rational nutrient sources in a similar way. All of the parameters studied responded significantly ($P \leq 0.05$) to varietal effects, with SC667 (white maize) performing better in terms of plant height (180.11), leaf number (13.21), stem girth (4.21), number of pop root per plant (4.21), and grain yield (4.01tonne/ha). When compared to other nutrient sources, the use of dung site resulted in significantly higher growth, yield, and yield-related characters such as plant height (185.11), number of leaves (14.12), stem girth (4.01), number of pop roots per plant (4.24), and overall yield (4.91). Benue maize outperforms Gombe maize in yield-related characteristics such as number of cobs (Benue 2.83, Gombe 2.12), cob length (Benue 12.12, Gombe 11.16), and 100 grains weight (Benue 22.19, Gombe 21.21), as well as overall yield (Benue 3.99 tonne/ha and Gombe 3.12 tonne/ha). Based on the results, it can be concluded that the use of dung site and SC 667 (white maize variety) maize will result in the highest yield.

**Keywords**; Bio-rational nutrient, variety and production

## INTRODUCTION

Maize is a major cereal crop in most of Africa, including Nigeria, where it is grown extensively. More than half of all maize grown in West and Central Africa is produced in Nigeria (Ado, 2001). Although maize is still grown in large quantities in the southwest, dry gain production has shifted dramatically to the savannah, particularly the northern Guinea savannah, which is known as the maize belt. Despite the increase in maize production, yield remains low; some of the major factors affecting yield include soil fertility, location, temperature, relative humidity, and plant population (Bruresh et al., 1994). Many bio-rational materials are produced at home or can be obtained for little or no cost from livestock operations, municipal waste collection centers, and local land-fills; however, materials vary significantly in the concentration and rate at which this nutrient is released for plant use; some bio-rational/organic fertilizer are better for certain situations than others; and different materials must be applied at different rates to supply the correct amount for each situation (1999). However, yield is dependent on

many factors ranging from water availability, variety as well as nutrients supply, apart from the use of green manure, inorganic fertilizer, crop residuals and bio-fertilizers, organic manure remain one of the most effective tool in improving the fertility status tilt and soil productivity, organic manure out weight the inorganic fertilizer in terms of having wide range of essential nutrients and organic matter needed by plants, since nutrients are held in organic form, it is therefore important to supply nutrients most especially organic nutrient to the soil to boost plant growth and yield Akambi et al (2015). Consumers tend to use bio-rational products continuously, and this has become a global trend. In response to consumer demand, organic food products are quickly growing (Peng, 2019). All countries around the world report a trend of continual growth in the organic food and beverage market (Golijan and Dimitrijević, 2018). The demand for organic products has been reported to be increasing in both local and international markets (Declaro-Ruedas, 2019), and is expected to continue growing, especially in developed countries, while the supply of organic products is limited and still cannot produce enough organic products to meet the market demand. The fertility of a soil and the level of acidity or alkalinity play an important role in determining the yield of the crops, which can be affected by intensive farming, hence the reason why proper soil quality management is required to sustain high yield in plant production (Talpur *et al.*, 2013). Maize varieties also vary with farmers' preference, some farmers cultivate based on colour, taste, yield and even vegetative/ floral parts, some cultivate based on the crop resistance some pest and diseases while other based on its adaptability to environmental factors. The aim of this work is to determine the most appropriate bio-rational nutrient sources and variety for the cultivation of maize.

## MATERIALS AND METHODS

The experiment was conducted during the rainy season of 2020 at the Teaching and Research Farm, the University of Agriculture, Makurdi (7° 41'N and 8° 37'E) and in Tal at (9° 50'N and 11° 09'E) Billiri Local Government of Gombe State. The experiment that was laid in a randomized complete block design (RCBD) with three replicate, a $4m^2$ plot was laid out with 1m between plots and 1m between blocks. There were 10 plots each within a block which gave the total number of 30 plots for the study for the two locations. The treatment where; varieties (ILOMAZ1 yellow maize and SC667 white maize) and the bio-rational nutrient sources used was (dung site, night soil, poultry dropping, goat manure and control). Agronomic practice such as land clearing, 1 seed per hill was planted at 20×75cm, weeding was done manually at 2 and 6 weeks after planting to ensure a weed free plots application of fertilizer at planting and top dressed at 6weeks after planting at the rate of (N100 kg/ha, P60 kg/ha K60 kg/ha) and harvesting and threshing was done manually, all the data were collected within the net plot of $4m^2$, where a total of 10 plants were tagged for data collection within each net plot. The parameters recorded were plant height (was taken with the aid of measuring tape from the base of the plant to the tip), the number for leaves (were counted fortnightly) from 10 plants that were tagged and the average used, stem girth and number of prop roots per plants were measured. Other characters like number of cobs (were counted), cob length (taken with the aid of measuring tape), cob girth (with the aid of a vernier caliper), and cob weight (with the aid of digital weighing balance), number of seeds per cob (were counted), number of grain rows per cob (were counted), 100 gains weight, threshing percentage and grain yield in kg was recorded. All data collected were subjected to analysis of variance (ANOVA) Gensat version 17, while the least significant difference (LSD) at 5% level of probability was used in separating the means.

## RESULTS AND DISCUSSION

Table1 shows the influence of variety and bio-rational nutrient sources on some growth parameters of maize during the 2020 rainy season grown at Gombe and Makurdi, where SC667 white varieties is significant difference ($P<0.05$) on plant height, number of branches, stem girth and number of pop root per plant over yellow variety, this could be associated with varietal difference influenced by inherent genetic make-up and ability to adopt to environmental conditions, this is supported by the findings of IITA (2019) who reported white maize variety out growing the yellow variety leading to increase in yield

On bio-rational nutrient sources dung site produced taller plants, higher number of leave, wider stem and higher number of poop roots when compared with other nutrient source used, with control recording the least in all the above mentioned parameter, this could be related to the ability of dung site to release its nutrient fast, this finding is in conformity with the work of Niringye et al. (2005) who reporting plant cultivated on dung site had good vegetation when compared with animal droppings, he attributed his reason to the ability of the dung site to leased it nutrients fast due to high decomposition and mineralization.

On location Benue location had superseded Gombe location on growth characters, which is not far from the fact that rainfall, relative humidity and soil nutrient could had led to that, this is collaborated with the work of

**Table 1**: Influence of variety and bio-rational nutrient sources on some growth parameters of maize during the 2020 rainy season grown at Gombe and Makurdi.

| Treatments | | | | |
|---|---|---|---|---|
| Varieties (V) | P/H | N/L | Stem girth (cm) | No. of Pop root/plant |
| Y/M (SC667) | 165.21 | 12.82 | 3.45 | 3.23 |
| W/M (ILOMAZ1) | 180.11 | 13.21 | 4.21 | 4.51 |
| F-LSD (0.05) | 21.21 | 2.04 | 1.01 | 1.11 |
| Nutrient (N) | | | | |
| Poultry dropping | 169.26 | 12.11 | 3.00 | 3.61 |
| Dung site | 185.11 | 14.12 | 4.01 | 4.24 |
| Night soil | 175.89 | 13.12 | 3.11 | 3.91 |
| Goat manure | 160.01 | 11.07 | 3.18 | 3.12 |
| Control | 149.03 | 10.23 | 2.65 | 2.91 |
| F -LSD (0.05) | 10.01 | 1.21 | 1.82 | 1.00 |
| Location (L) | | | | |
| Gombe | 172.32 | 13.21 | 3.16 | 3.12 |
| Benue | 188.01 | 14.00 | 3.12 | 3.83 |
| F-LSD (0.05) | 10.00 | 1.09 | 0.21 | 1.02 |
| Interactions | | | | |
| V X N | NS | NS | NS | NS |
| V X L | NS | NS | NS | NS |
| N X L | NS | NS | NS | NS |

N= nutrient source, V= varieties, L = Location, P/H= plant height, N/L= number of leaves, F-LSD = Fishers' Least Significant Differences at 5% Level of Probability. Y/M= yellow maize, W/M = white maize.

**Table 2:** Influence of variety and bio-rational nutrient sources on some yield parameters of maize during the 2020 rainy season grown at Gombe and Makurdi.

| Treatments Varieties (V) | Cob weight (g) | Cob girth (cm) | Cob length (cm) | No. of cob per plant | 100garian weight |
|---|---|---|---|---|---|
| Y/M (SC 667) | 50.01 | 3.82 | 11.45 | 2.23 | 19.21 |
| W/M (ILOMAZI) | 59.11 | 4.21 | 12.21 | 2.21 | 22.01 |
| F-LSD (0.05) | 6.21 | 1.04 | 1.91 | 0.09 | 2.01 |
| Nutrient (N) | | | | | |
| Poultry dropping | 50.26 | 3.11 | 10.11 | 2.81 | 21.21 |
| Dung site | 55.11 | 4.12 | 11.21 | 2.98 | 25.91 |
| Night soil | 53.62 | 4.94 | 10.91 | 2.10 | 23.12 |
| Goat manure | 49.01 | 3.07 | 9.48 | 2.12 | 20.81 |
| Control | 40.03 | 3.23 | 8.65 | 1.91 | 18.34 |
| F -LSD (0.05) | 2.81 | 0.21 | 0.32 | 0.03 | 2.19 |
| Location (L) | | | | | |
| Gombe | 52.32 | 3.21 | 11.16 | 2.12 | 21.12 |
| Benue | 57.01 | 3.90 | 12.12 | 2.83 | 22.19 |
| F-LSD (0.05) | 2.00 | 0.09 | 0.61 | 0.02 | 2.01 |
| Interactions | | | | | |
| V X N | NS | NS | * | NS | * |
| V X L | NS | NS | * | NS | * |
| N X L | NS | NS | NS | NS | NS |

No= number of cob per plants. F-LSD = Fishers' Least Significant Differences at 5% Level of Probability. Y/M= yellow maize, W/M = white maize

Balasubramaniyan and Palaniappan (2001) who affirmed to the above accession. Starting that both climatic and soil factors determine the vegetative growth of plants.

Table 2 reports the influence of variety and nutrient source on some yield parameters of maize during the 2020 rainy season grown in Gombe and Makurdi where significant difference ($P<0.05$) was recorded on veracity, nutrient source and location. On variety the SC 667 white maize is out standing in cob length, cob girth, cob weight, number of cob per plant and 100 grain weight over the ILOMAZ1 yellow variety, this is not far from the fact that heritable trades could have led to the difference, this

**Table 3:** Influence of variety and bio-rational nutrient sources on yield and some yield parameters of maize during the 2020 rainy season grown at Gombe and Makurdi.

| Treatments | | | | | |
|---|---|---|---|---|---|
| Varieties (V) | **No. of grains/line** | **No. of grains per cob** | **Grain weight per cob(g)** | **Shelling (%)** | **Grain yield (tones/ha)** |
| Y/M (SC 667) | 18.21 | 191.82 | 35.45 | 75.23 | 3.21 |
| W/M (ILOMAZI) | 21.11 | 218.21 | 40.21 | 78.21 | 4.01 |
| F-LSD (0.05) | 2.21 | 10.04 | 4.91 | 4.29 | 3.01 |
| Nutrient (N) | | | | | |
| Poultry dropping | 19.26 | 201.11 | 33.11 | 78.81 | 3.81 |
| Dung site | 22.41 | 229.12 | 41.21 | 80.24 | 4.91 |
| Night soil | 20.22 | 211.89 | 38.91 | 77.90 | 3.03 |
| Goat manure | 18.61 | 196.07 | 30.48 | 75.12 | 3.01 |
| Control | 17.23 | 168.23 | 28.65 | 73.91 | 2.34 |
| F -LSD (0.05) | 1.21 | 9.21 | 2.02 | 2.00 | 0.79 |
| Location (L) | | | | | |
| Gombe | 20.32 | 220.21 | 32.16 | 78.12 | 3.12 |
| Benue | 22.01 | 223.00 | 35.12 | 79.23 | 3.99 |
| F-LSD (0.05) | 2.00 | 2.09 | 2.91 | 1.02 | 0.11 |
| Interactions | | | | | |
| V X N | * | NS | * | NS | * |
| V X L | * | NS | * | NS | * |
| N X L | NS | NS | NS | NS | NS |

No= number, F-LSD = Fishers' Least Significant Differences at 5% Level of Probability. Y/M= yellow maize, W/M = white maize

work is supported by the finding of NVRC (2020) who reported same in work on varietal difference in maize.

On bio-rational nutrient sources, dung site is superior on cob length, cob girth, cob weight, number of cob per plant and 100 grain weight, followed by night soil and control recording the least, this is true that nutrient plays an important role in both vegetative and yield related characters, this work is in agreement with the findings of Shah et al. (2003) who reported that dung site produced and increase maize yield due to its ability to release its nutrients fast translating such nutrient to production of cob, seeds and over all yield. In contras Giller et al. (1997) reported night soil having fast nutrient releases recording higher yield in maize production.

On location Makurdi recorded the highest on cob length, cob girth, cob weight, number of cob per plant and 100 grain weight over Gombe location, this could be attributed to climatic changes in temperature, rainfall pattern agronomic practice, this work is in agreement with the finding of Bello (2009) who reported same trend.

Table 3 shows the influence of variety and bio-rational nutrient sources on yield parameters of maize during the 2020 rainy season grown at Gombe and Makurdi where significant difference ($P<0.05$) was recorded in varieties, nutrient source and location. On variety SC667 white maize produced higher in terms of number of grains per line, number of grains per cob, grains weight per cob, shelling percentage and over all yield over ILOMAZI yellow maize, this could be as a result of genetic make-up of the varieties on cultivation. This is supported by the finding of Nathe (2020) who reported that varietal difference can affect yield positively.

On bio-rational nutrient sources, dung site performed better than the other nutrients source, followed by night soil, poultry and goat manure with control having the least, this is true that dung site had more microbial activities which in turn aid in fast nutrient release leading to increase in crop yield, this result is in conformity with the work of Muhammad and Saeed (2005) Who reported that dung site is fast in releasing and content more nutrient when compared with animal manure leading to seed initiation, seed formation and filling thereby increasing in crop yield.

On location, Makurdi had recorded higher in terms of number of grains per line, number of grains per cob, grains weight per cob, shelling percentage and over all yield over Gombe, this could be linked to the fact that climatic condition, soil factors and agronomic practice may have led to that, (Khalid, 2009) in his work also lend support to the above accretion starting that factors that lead to crop yield is directly related to climate, agronomic practice, rainfall and soil nutrient.

Table 4 is an interaction between variety and bio-rational nutrient source on yield and yield related characters, where significant ($P<0.05$) difference was observed where the interaction between SC667 white maize and dung site gave higher cob length when compared with other variety and nutrient source, this could be attributed to the fact that decomposed dung site and inherent genetic make-up might have led to release nutrient fact for lengthier cob, the work is collaborated with the findings of NCRI (2007) who stated that dung site recorded lengthier cob due to release and absorption of nutrient by the plants. Significant ($P<0.05$) difference

**Table 4:** interaction between variety and bio-rational nutrient source on the yield and yield related characters.

| | Cob length | | | | |
|---|---|---|---|---|---|
| **Variety** | **PD** | **DS** | **NS** | **GM** | **Control** |
| Y/M(SC667) | 10.41 | 11.12 | 11.11 | 9.24 | 8.91 |
| W/M(ILOMAZI) | 10.22 | 11.89 | 11.91 | 9.90 | 9.03 |
| F-LDS(0.05) | 0.61 | 0.47 | 0.38 | 0.42 | 0.61 |
| **No. grains/lines** | | | | | |
| Y/M(SC667) | 19.21 | 21.12 | 22.51 | 20.24 | 17.21 |
| W/M(ILOMAZI) | 20.22 | 22.89 | 23.91 | 21.90 | 18.98 |
| F-LSD(0.05) | 1.21 | 1.07 | 1.38 | 1.09 | 1.61 |
| **100 grain weight (g)** | | | | | |
| Y/M(SC667) | 21.41 | 22.12 | 24.31 | 20.34 | 18.21 |
| W/M(ILOMAZI) | 22.22 | 23.89 | 25.98 | 21.91 | 19.93 |
| F-LSD(0.05) | 1.21 | 1.47 | 1.38 | 1.32 | 1.21 |
| **Grains weight/cob (g)** | | | | | |
| Y/M(SC667) | 36.21 | 38.12 | 39.41 | 35.44 | 32.31 |
| W/M(ILOMAZI) | 37.42 | 40.89 | 41.01 | 36.01 | 33.39 |
| F-LSD(0.05) | 1.61 | 1.47 | 1.38 | 1.02 | 1.61 |
| **Grain yield (t/ha)** | | | | | |
| Y/M(SC667) | 3.21 | 3.80 | 3.92 | 3.04 | 2.11 |
| W/M(ILOMAZI) | 3.42 | 4.00 | 4.52 | 3.20 | 2.60 |
| F-LSD(0.05) | 0.01 | 0.11 | 0.38 | 0.43 | 0.21 |

Y/M= Yellow maize, W/M= white maize.

**Table 5:** Interaction between variety and location on yield and yield related characters.

| | Cob length(cm) | |
|---|---|---|
| **Variety** | Gombe | Benue |
| Y/M (SC 667) | 10.21 | 11.46 |
| W/M (ILOMAZI) | 11.62 | 12.01 |
| F-LSD (0.05) | 1.01 | 1.07 |
| Number of grains/line | | |
| Y/M (SC 667) | 18.21 | 19.26 |
| W/M (ILOMAZI) | 20.32 | 21.41 |
| F-LSD (0.05) | 1.34 | 1.67 |
| 100 grain weight (g) | | |
| Y/M (SC 667) | 20.31 | 22.46 |
| W/M (ILOMAZI) | 25.62 | 26.45 |
| F-LSD (0.05) | 4.01 | 4.07 |
| Grains weight/cob | | |
| Y/M (SC 667) | 35.23 | 36.46 |
| W/M (ILOMAZI) | 39.62 | 40.01 |
| F-LSD (0.05) | 2.01 | 3. 07 |
| Grain yield (t/ha) | | |
| Y/M (SC 667) | 3.01 | 3.46 |
| W/M (ILOMAZI) | 3.62 | 4.01 |
| F-LSD (0.05) | .01 | 0.07 |

Y/M= Yellow maize, W/M= white maize

was recorded on higher number of grains per lines, weightier grains/cob, 100 seed weight and over all yield with the interaction between white SC667 maize and night soil superseding other treatments, this can be attributed to the fact that genetic make-up in SC6667 white maize and the ability for the plant to utilized the nutrient gottern from night soil as a result of fast nutrient release could have led to that, this findings is in agreement with the work of Chikowo et al. (2006) who reported the same trend, he added that night soil have ability to improve soil and crop yield when applied at the appropriate time.

Table 5 is an interaction between variety and location on yield and yield related characters of maize grown in

Gombe and Benue, significant (P<0.05) difference was recorded in all the yield and yield related characters where the interaction between maize and Benue was outstanding in all the yield related characters, this could be true due to improvement in agronomic practice, climatic factors such as rainfall, temperature, relative humidity and soil nutrient, this finding collaborate with the finding of Gadgil et al. (2002) who stated that soil, climatic factors and agronomic practice play and important role in crop yield when considering location.

## Conclusion

The result of this investigation revealed that all the parameters studied responded significantly (P ≤ 0.05) to varietal effects, with SC667 (white maize) performing better in terms of plant height, leaf number, stem girth, number of pop root per plant and grain yield. On nutrient sources, the result revealed the use of dung site resulted in significantly higher growth parameters, yield, and yield-related characters. It can be recommended that the use of dung site and SC 667 (white maize) variety will result in the higher yield.

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