

Growth and Yield Performance of Some Varieties of Maize (*Zea mays*) in the Humid Ecological Zone of Owerri

¹Godfrey A. Iwo, ²Edith G. Okoish and ³Ojiako O. Gift

¹Department of Crop Science, University of Calabar, P.M.B.1115, Calabar, Cross River State

²Department of Crop Science, University of Uyo, Akwa Ibom State

³Department of Crop Science, Federal University of Technology, Owerri, Imo State

Corresponding Author Email: godfreyiwo@gmail.com

Abstract

The experiment was conducted in 2020/2021 cropping seasons at the research farm of Federal University of Technology, Owerri with the objectives to evaluate the growth and yield performance of six maize genotypes in addition to determine the association between yield and yield components. The experiment was laid out as a Randomized Complete Block Design (RCBD) in three replications. The maize genotypes included DMR-LSR-Y, Oba Super-2, Oba Super-4, DMR-SR-W, GSTEE-W and SammazA3. Seven agronomic traits were studied which are plant height (cm), days to 50% tasselling, days to 50% silking, cobs per plant, weight of cobs per plant, weight of 1000 seeds and grain yield (t/ha). The degree of variations observed for all the characters were high except number of cobs per plant. The results obtained indicated that SammazA3 was superior in four characters such as days to 50% tasselling, number of days to 50% silking, weight of 1000 seeds and grain yield (t/ha) followed by DMR-LSR-Y in plant height and weight of cobs per plant. The genotype Oba Super 2 gave greater number of cobs per plant. From the field results, three genotypes SammazA3, DMR-LSR-Y and Oba Super- 2 could be incorporated into breeding programs for production of hybrid varieties for the area. The result also showed a positive and significant correlation between plant height, number of cobs per plant and weight of 1000 seeds with grain yield (t/ha). Therefore, the three characteristics which included plant height, number of cobs per plant and weight of 1000 seeds could be used as selection indices for grain yield improvement in maize for the Owerri environs.

1.0 Introduction

Maize (*Zea mays*) is one of the major staples in Nigeria and has multiple utilization values for human, livestock and agro-allied industries. More than 300 million Africans depend on maize as the main staple food crop (IITA, 2022 and Makama *et.al*, 2022). Maize can be processed into a number of products which creates an extra source of income to maize farmers, maize processors, and distributors. Some of the products that can be gotten from maize include: Corn starch which is used as a thickener for liquid food. It is the main ingredient in biodegradable plastic, an ingredient that can be used to replace talc in body powder, and is also used by dry cleaners to keep clothes firm. Maize is mostly grown in the Northern guinea savannah, the Southern guinea savannah and the South-western agro-ecological zone of Nigeria. The production level in Nigeria in the past years was as low as 1.3tons/ha when compared to 8.6 tons/ha obtained in developed countries (IITA, 2009). From 2015 to 2019 a total of 7.7 million tons of maize grain was produced annually in Nigeria, representing 0.9% of the world production (Amudalat, 2015, FAO, 2019) However, recently many improved and high yielding varieties of maize have been released to farmers in an effort to increase the level of production. In the year 2021, Nigeria produced an estimated 12.7 million metric tons of maize with average yield of 2.2tons/ha. According to AATF, (2024) yield of TELA maize could reach up to 10 tons/ha, if grown under good agronomic practices. The yield performance of these varieties will depend on the effect of the environment to express its full genetic potentials. In order to adopt a crop variety, its growth as well as the yield potential should be evaluated in multiple environments. Therefore the purpose of this work is to evaluate the six selected varieties of maize for their yield potential in Owerri environment and also determine the association between yield and yield components of the evaluated genotypes. This will lead to positive selection of varieties to possible environmental adaptation and improvement.

2.0 Materials and Methods

The experiment was conducted at the teaching and research farm of the Federal University of Technology, Owerri in the tropical rainforest region of South Eastern Nigeria at latitude 05° 30 North and longitude 07° 02 East with altitude 90.91m above sea level .

The experiment was conducted for the 2020 and 2021 cropping seasons. The physico-chemical properties of the soil of the experimental area are presented in table 2.1. The seeds were obtained from the National Seed Service out-station located at the National Root Crop Research Institute (NRCRI) Umudike, Abia State. The maize varieties include DMR-LSR-Y, TZSR-W, Sammaz-A3, GSTEE-W, Oba-Super 2 and Oba Super 4. The experimental field measuring 17 x 8.25m was cleared and ridged manually before the commencement of planting.

The experiment was laid out as a Randomized Complete Block Design (RCBD) with three replications. There were six plots per replicate and each plot contained 4 rows with an inter-row spacing of 75cm and an intra-row spacing of 50cm respectively. Planting of seeds was manually carried out and three seeds were planted per hole at a depth of 2 to 3 cm. The maize seedlings were thinned to two plants per stand at 14 days after planting. Basal application of NPK (15:15:15) fertilizer was carried out three weeks after planting (WAP) after which a nitrogen fertilizer (urea) was applied before tasselling. Data were collected from the two central rows on

plant height (at physiological maturity), number of cobs per plant, days to 50% tasselling, days to 50% silking, weight of cobs per plant, weight of 1000 seeds and total grain yield.

Data collected were subjected to analysis of variance and means were separated using the Fishers Least Significant Difference (LSD) at a 5% probability level. Linear correlation was also used to determine the association among the physiological and morphological characters and with grain yield (t/ha) using the procedure described by Wahua (1999).

Table 2.1. Physico-chemical properties of the soil of the experimental area

| Soil properties | Value |
|-------------------------|--------------|
| pH (H ₂₀) | 5.51 |
| Organic matter (%) | 1.70 |
| Nitrogen (%) | 0.04 |
| Available P (cmol/kg-1) | 19.01 |
| Calcium (cmol/kg-1) | 2.04 |
| Magnesium (cmol/kg-1) | 1.11 |
| Potassium (cmol/kg-1) | 0.04 |
| Sodium (cmol/kg-1) | 0.04 |
| TEA (cmol/kg-1) | 0.87 |
| ECEC (cmol/kg-1) | 4.10 |
| BS (%) | 75.05 |
| Sand (%) | 88.60 |
| Silt (%) | 6.75 |
| Clay (%) | 4.80 |
| Textural class | Sandy loam |

3.0 Results

3.1 Growth and Yield Parameters of Maize Cultivars

Results from the field experimentation showed significant differences at $P < 0.05$ for all the characters except the number of cobs per plants (Table 3.2). The plant height varied among the maize genotypes with DMR-LSR-Y being the tallest with mean value of 206.31cm, followed by DMR-SR-W (197.2 cm), Oba super-4 (177.2 cm) and GSTEE-W (159.3cm) respectively while the least plant height was recorded with Sammaz-A3 (127.61 cm). There were significant differences in reproductive characters such as days to 50% tasseling and silking among the six evaluated maize genotypes. In terms of maturity period, the genotype Sammaz-A3 was the earliest to achieve 50% tasseling in 47.6 days and silking at 58.6 days followed by Oba super -2 at 59.07 days for 50% tasseling and 64.1 for 50% silking. Late tasseling and silking were observed on DMR-LSR-Y at 74 days for 50% tasseling and 82.16 days for 50% silking. The results revealed that three genotypes which included GSTEE-W, DMR-LSR-Y, and Oba super-4 tend to be late maturing because of the longer number of days to tasseling and silking. There was no significant difference at $p < 0.05$ in number of cobs per plant among the maize genotypes.

However, Oba super-2 produces the highest mean cobs per plant followed by DMR-SR-W while the lowest number of cobs was produced by Sammaz-A3. Variations in cob weight were observed among the maize genotypes. The genotypes DMR-LSR-Y produced significantly heavier cobs than all the maize genotypes and the lowest cob weight was recorded against Oba super-2. Variations in 1000 seeds weight were also eminent among the maize genotypes. The genotypes Sammaz-A3 gave the heaviest 1000 seed weight of 337.8g followed by GSTEE-W (297.08g) and Oba- super-4 (270.44g). The lowest 1000 seed weight value was recorded against DMR-SR-W, although not significantly different from Oba-super-2 and DMR-LSR-Y for the character.

Generally, the highest grain yield was recorded by Sammaz-A3(2.01t/ha) followed by GSTEE-W that recorded grain yield value of 1.91t/ha while the lowest grain yield of 1.04t/ha was recorded for DMR-SR-W.

3.2 Relationship between Maize Physiological/morphological Characters with Grain Yield

The result obtained from the linear correlation analysis of the morphological and physiological characters with grain yield of the maize genotypes are presented in table 3.3.

There was a positive correlation between plant height, number of cobs per plant and 1000 seed weight with grain yield. Similarly, three characters among the genotypes were negatively correlated with grain yield; namely number of days to 50% tasseling, number of days to 50% silking and cob weight per plant. On the other hand, days to 50% tasseling was significantly correlated with days to 50% silking and weight of cobs per plant and 1000 seed weight. Also, number of days to 50% silking was positively and significantly correlated with weight of cobs per plant, but negatively correlated with number of cobs per plant and 1000 seed weight in maize. It was however observed that number of cobs per plant showed a negative correlation with weight of cobs per plant and 1000 seed weight, while weight of cobs per plant correlated, though negatively with 1000 seed weight in maize.

4.0 Discussion

The observed high degree of variations among the maize genotypes for all the traits could be attributed to genotypic or varietal differences. The plant height was significantly different in all the genotypes. This conformed to the report by Efretuei and Udounang, (2020) and Iken *et al* (2002) who attributed the variation to diverse genetic background under different environments. The differences in days to 50% tasseling and silking revealed the variation in maturity period within the genotypes. This support the report of Emede and Alika (2014) pointing out the existing variability of the parental genotypes used for the development of most varieties. Early tasseling could predict emergence of silking in maize and consequently the maturity of cobs in maize.

Table 3.2: Yield component of six maize cultivars

| Cultivars | Plant height (cm) | Days-50% tasselling | Days-50% silking | Number of cobs/plant | Weight of cobs/plant (g) | Weight of 1000 seeds (g) | Grain yield (t/ha) |
|---------------------------|--------------------------|----------------------------|-------------------------|-----------------------------|---------------------------------|---------------------------------|---------------------------|
| SammazA ₃ | 127.61 | 47.60 | 58.60 | 1.01 | 112.67 | 337.80 | 2.01 |
| DMR-LSR-Y (Yellow Strong) | 206.31 | 74.00 | 82.16 | 1.06 | 193.30 | 250.32 | 1.21 |
| Oba Super 2 | 139.7 | 59.07 | 64.10 | 1.20 | 106.67 | 250.32 | 1.16 |
| DMR-SR-W | 197.2 | 62.00 | 70.2 | 1.10 | 135.00 | 240.33 | 1.04 |
| GSTEE-W | 159.3 | 72.00 | 80.76 | 1.05 | 162.67 | 297.08 | 1.91 |
| Oba-Super-4 | 177.2 | 70.00 | 80.33 | 1.04 | 143.33 | 270.44 | 1.34 |
| Mean | 167.8 | 64.11 | 72.69 | 1.076 | 142.20 | 274.30 | 1.44 |
| S.E | 5.25 | 0.98 | 1.06 | 0.19 | 5.73 | 6.77 | 0.51 |
| LSD | 11.69 | 2.17 | 2.37 | Ns | 10.81 | 11.95 | 0.04 |

Key: Ns. = Not significant.

Table 3.3: Correlation matrix of physiological characters, yield and yield

| Cultivars | Grain yield (t/ha) | Plant height (cm) | Days-50% tasselling | Days-50% silking | Number of cobs/plant | Weight of cobs/plant (g) | 1000 seed weight (g) |
|-----------------------------|---------------------------|--------------------------|----------------------------|-------------------------|-----------------------------|---------------------------------|-----------------------------|
| Grain yield | 1.000 | | | | | | |
| Plant height | 0.629 | 1.000 | | | | | |
| Days-50% Tasselling | -0.308 | 0.712 | 1.000 | | | | |
| Days-50% silking | -0185 | 0.709 | 0.978** | 1.000 | | | |
| Number of cobs/plant | 0.629 | -0.082 | -0.048 | -0.250 | 1.000 | | |
| Weight of cobs/plant | -0.094 | 0.746 | 0.841* | 0.072* | -0.371 | 1.000 | |
| Weight of 1000 seed | 0.958** | -0.694 | -0.506 | -0.368 | -0.647 | -0.258 | 1.000 |

As regards to the number of cobs per plant, the investigated maize genotypes tend to have close genetic relationship. The gene controlling the number of cobs in maize appears to emanate from the same sources. The genotype DMR-LSR-Y and DMR-SR-W appeared to have been derived from the same population while GSTEE-W and Oba-super-4 tend to have been selected together for bigger cob sizes. According to Ebong *et al.* (2006) selection of desirable traits with economic importance are usually carried out by farmers who maintained them for the next generation planting.

The grain yield recorded from the experimental results was higher above what is obtained from the farmers field which is about 1.5t/ha (FAO,2009). However, grain yield is a quantitative trait and is a product of both genetic and environmental effect. The high grain yield recorded with Sammaz-A3 gave the impression of being genetically distinct from other genotypes within the same environment. This can possibly lead to positive selection of the genotype for grain yield.

The significant positive correlation observed between some characters with grain yield is highly desirable and could be used as selection indices for yield improvement in maize. This agrees with Amuji *et al.*, (2014) and Efretuei *et al.*, (2024) that the main purpose of correlation is to establish association among characters and with grain yield which is the ultimate objective in maize breeding. Amuji *et al.*, (2014) suggested that selection of maize for grain yield should be based on yield components which are positively and significantly correlated with grain yield in maize to derive maximum genetic gain. For example, plant height and number of cobs per plant were positively correlated with grain yield, while weight of 1000 seeds was significant and positively correlated with grain yield in the environment. Therefore in selection of maize for the environment, only those which achieve optimum height with more than one ear and higher seed weight should be selected.

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