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Evaluation of Four Maize Varieties for Optimum Growth and Yield under Field Condition

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Abstract

In early 2000, world population stood at 6.0 billion people. It was projected to reach 8.0 billion by 2025, a 33 percent increase only in 25 years. During that little period, little change in total arable land is available for food production. Due to these facts, maize production has been improved with adoption of technologies by farmers. These technologies includes; the planting of improved seeds like hybrid and open pollinated varieties, timely planting, proper spacing, timely weeding and harvesting. Therefore, this experiment was conducted to determine the evaluation of four varieties of maize for optimum growth and yield under field condition. The experiment was laid down in a Randomised Completely Block Design (RCBD) with three (3) replicates. Each block consisted of four (4) treatments. The treatments include: TZEE-Y POP STRC4, EV99QPM, 2000SynEE-W QPM C_0 and 99TZEE-Y STR. The growth parameters evaluated include Leaf length, leaf width, plant height, number of nodes, Distance between nodes, Stem girth, Length of inflorescent, number of cob and Period it takes to tassel (days). Also the yield parameters were: Weight of cob, Weight of 100 Grains, and Number of grains per cob. The TZEE-Y POP STRC4 has the best potential for increased grain yield due to the fact that it has wide genetic base which enables it to perform well irrespective of soil and environmental difference. The said treatment is also resistant to a wide range of biotic and a biotic stress which makes it a variety of first choice to farmers especially in this period of climate change. Therefore, TZEE-Y POP STRC4 could be confirmed as a high yielding variety with stable vigour.

Keywords: Maize; Growth; Yield; Varieties

Abbreviations: RCBD: Randomised Completely Block Design; QPM: Quality Protein Maize; SSP: Single Superphosphate; IITA: International Institute of Tropical Agriculture; ANOVA: Analysis of Variance; DMRT: Duncan's Multiple Range Test; OM: Organic Matter.

Introduction

In past and even at recent times, a lot of works has been done on how to achieve or bring about a sustainable agriculture in Nigeria and the world at large.

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These efforts include considerations for future adequacies and also address issues such as the use efficiency, profitability for farmers and impact on the environment. Maize is world's one of the three most popular cereal crops. It is grown worldwide on approximately 130 million ha annually with a production of 574 million metric tons [1]. It occupies an important position in world economy and trade as a food, feed and an industrial grain crop. Several million people in the developing world consume maize as an important staple food and derive their protein and calories requirements from it. Maize is thus a potential source of protein for humans and animals [2]. Maize (*Zea mays L*) belongs to the grain under the family graminae and class of cereals that thrive under a wide range of environmental conditions. Maize does well with pH of 5.5 - 5.7 while strongly acidic soil (pH 5.0) is unsuitable for good yield [3]. Maize is essentially an important component of the farming systems and the diet of many people in the tropics which can be processed into different products for various end uses both at the traditional level and industrial scale, though a large production of products utilized in developing countries is obtained via traditional processing while industrial processing meets the bulk of the demand in developed countries [2,4].

On average, 1,500,000 meters, it is estimated as the annual maize production [5]. Of this, about 90% is used for human consumption locally and region and 10% as animal feeds [6]. Climatically, maize can be produced in most parts of Nigeria. However, efforts are underway to develop suitable varieties for the regions. Nutritionally, maize is very nutritious as a starchy food. It also has an appreciable level of essential Quality Protein Maize (QPM) hybrid which has higher levels of essential amino acids [**Error! Reference source not found.**]. Maize has been reported to be very sensitive to water scarcity or drought and requires sufficient water thorough out its growing period for better yield [8]. Further, it was reported that water stress conditions may cause 22.61-26.4% yield reduction which is directly correlated with the decrease in number and weight of kernel [9]. In many developing countries, farmers have limited financial resources and can rarely afford to purchase sufficient mineral fertilizer. The use of single superphosphate (SSP) and other synthetic fertilizers are beyond the reach of peasant farmers due to their cost and scarcity. Crops have become so expensive to grow that nutrient deficiencies should not be allowed to limit the yields. With management practices such as continuous cropping and reduce fallow periods, the soil can hardly support cropping. The need therefore, arises for production practices that will ensure high yield [4]. This study was conducted to compare the performance of
quality protein maize (EV99 QPM and 2000 Syn. EE-W QPM) and *striga* resistant varieties (TZEE-Y POP STR C4 and 99 TZEE-Y STR) obtained from IITA Ibadan to determine their adaptability and stability and to recommend a suitable one for the local maize grower.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm (Crops section) of the Federal University of Technology, Akure, Ondo State, Nigeria located at Obanla within the university premises between April and July, 2012. The area lies between the tropical rain forest belt, between latitude 5^{o}N and 15^{o}E. The rain fall pattern of Akure is bimodal with a wet season of about eight months occurring from April to October and with a brief dry spell, which in most cases occur in the second half of August. The peak rainfall period is June/July and September/October, while the short dry season last from November to December. Also the daily temperature ranges from 25^{o}C and 37^{o}C.

The seeds of 4 maize varieties (TZEE-Y POP STRC4, EV99QPM, 2000SynEE-W QPM C_0 and 99TZEE-Y STR) were sourced from IITA (International Institute of Tropical Agriculture), Ibadan. The experimental field was manually cleared, ploughed with hoe and divided into block. Weeding commenced at two weeks after planting and subsequent weeding was carried out as at when due. The planting of the different varieties was carried out at a spacing of 75 X 30 cm in a Randomised Completely Block Design (RCBD) with three (3) replicates. Each block consists of four (4) treatments. Total land area measured 12m X 6m, block sizes measured 3 X 5.25m with 1m alley ways between replicates. The growth and development of the plants from seedling stage, through juvenile stage to maturity stage were followed and both qualitative and quantitative data were collected. All data collected were subjected to analysis of variance (ANOVA). The means were separated using Duncan's multiple range test (DMRT) using SPSS computer software programme.

Results

Analytical data of pre-cropping surface soil at the site of experiment are shown in Table 1. The test soil was marginal in organic matter (OM), adequate in Nitrogen, Calcium, Magnesium and Potassium but inadequate in Phosphorus and slightly acidic [10]. Therefore the soil requires application of fertilizing amendment that will particularly supply P for enhancing crop production.

Properties	Values
pH (H_2O)	6.50
Organic Matter (%)	2.62
Total Nitrogen (N) g/kg	0.09
Available Phosphorous (P) (mg/kg)	5.60
Exchangeable Calcium (cmol/kg)	2.60
Exchangeable Magnesium (Mg) (cmol/kg)	2 .10
Exchangeable Sodium (Na) (cmol/kg)	0.18
Exchangeable Potassium (K) (cmol/kg)	0.25
Sand (%)	81.20
Clay (%)	13.20
Texture	Loamy sand

Table 1: Initial soil analysis of experimental site.

The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, and distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Leaf length increase noticeably and differ significantly (p=0.05) across the treatments. Plots treated with TZEE-Y POP STRC4 recorded with highest leaf length (100.8). The lowest leaf length (80.8) was recorded on 99 TZEE-Y STR. The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP $STRC_4$, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Leaf width increase noticeably and differ significantly (p=0.05) across the treatments. Plots treated with TZEE-Y POP $STRC_4$ recorded with highest leaf length (9.89). The lowest leaf length (8.11) was recorded on 99 TZEE-Y STR.

The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Plant height increase noticeably and differ significantly (p=0.05) across the treatments. Plots treated with TZEE-Y POP STRC4 recorded with highest plant height (216.89). The lowest plant height (157.67) was recorded on 99 TZEE-Y STR. The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Number of nodes increase noticeably and differ significantly (p=0.05) across the treatments. Plots treated with TZEE-Y POP STRC4 recorded with highest number of nodes (12.44). The lowest number of nodes (10.11) was recorded on 99 TZEE-Y STR. The data presented in table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel.

The distance between nodes increase noticeably and differ significantly (p=0.05) across the treatments.
Plots treated with TZEE-Y POP STRC4 recorded with highest distance between nodes (18.00). The lowest distance between nodes (16.33) was recorded on 99 TZEE-Y STR. The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn. EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Stem girth increase noticeably and differ not significantly (p=0.05) across the treatments. However, plots treated with EV99 QPM recorded with highest stem girth (3.73). The lowest leaf length (3.13) was recorded on 99 TZEE-Y STR. The data presented in Table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel.

Length of inflorescent increased noticeably but not differ significantly (p=0.05) across the treatments. However, plots treated with TZEE-Y POP STRC4 recorded with highest length of inflorescence (50.33). The lowest leaf length (44.4) was recorded on 99 TZEE-Y STR. The data presented in table 2 shows the effect of the genotype on growth characteristics of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on leaf length, leaf width, plant height, number of nodes, distance between nodes, stem girth, length of inflorescence and period it takes to tassel. Period it takes to tassel increase noticeably and differ significantly (p=0.05) across the treatments. However, plots treated with EV99 QPM recorded with longest period to tassel (43.22). The shortest period to tassel (34.00) was recorded on 99 TZEE-Y STR.

Treatments	Leaf length (cm)	Leaf width (cm)	Plant height (cm)	Number of nodes	Distance between nodes (cm)	Stem girth (cm)	Length of Inflorescence (cm)	Period it takes to tassel (days)
EV99 QPM	85.21[b]	8.83[ab]	190.33[a]	11.22[ab]	18.11[ab]	3.73[a]	45.89[a]	43.22[a]
TZEE-Y POP STRC4	100.8[a]	9.89[a]	216.89[a]	12.44[a]	19.33[a]	3.50[a]	50.33[a]	39.11[b]
2000 Syn.EE-W QPM C_0	88.33[b]	9.11[ab]	194.56[a]	11.78[ab]	18.00[ab]	3.47[a]	43.72[a]	36.11[bc]
99 TZEE-Y STR	80.86[b]	8.11[b]	157.67[b]	10.11[b]	16.33[b]	3.13[a]	44.44[a]	34.00[c]
STANDARD ERROR	±3.50	±0.42	±7.50	±0.49	±0.78	±0.30	±2.4	±1.10

Table 2: The effect of the genotype on some growth characteristics of four varieties of maize.

Means having the same letter(s) in the same column are not significantly different from each other at 5% level of probability by Duncan Multiple Range Test (DMRT).

The data presented in Table 3 shows the effect of genotype on some yield attributes of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on number of grains per cob, weight of cob, weight of 100 grains, and number of grain per cob. The number of cob increased noticeably but not differ significantly (p=0.05) across the treatments. However, plots treated with 2000 Syn. EE-W QPM C_0 recorded with highest number of cob (1.78) and The lowest number of cob (1.44) was recorded on 99 TZEE-Y STR.

The data presented in Table 3 shows the effect of genotype on some yield attributes of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn. EE-W QPM C_0, 99 TZEE-Y STR on number of grains per cob, weight of cob, weight of 100 grains, and number of grain per cob. The weight of cob increase noticeably and differ significantly (p=0.05) across the treatments. However, plots treated with TZEE-Y POP STRC4 recorded with highest number of cob (182.11) and The lowest weight of cob (131.22) was recorded on 99 TZEE-Y STR. The data presented in Table 3 shows the effect of genotype on some yield attributes of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn.EE-W QPM C_0, 99 TZEE-Y STR on number of grains per cob, weight of cob, weight of 100 grains, and number of grain per cob. The weight of 100 grains increase noticeably and differ significantly (p=0.05) across the treatments. Plots treated with 2000 Syn. EE-W QPM C_0 recorded with highest weight of 100 grains (33.00) and the lowest weight of 100 grains (26.56) was recorded on 2000 Syn.EE-W QPM C_0.

The data presented in Table 3 shows the effect of genotype on some yield attributes of EV99 QPM, TZEE-Y POP STRC4, 2000 Syn. EE-W QPM C_0, 99 TZEE-Y STR on number of grains per cob, weight of cob, weight of 100 grains, and number of grain per cob. The number of cob increase noticeably but not differ significantly (p=0.05) across the treatments. However, plots treated with 2000 Syn. EE-W QPM C_0 recorded with highest number of cob (1.78) and the lowest number of cob (1.44) was recorded on TZEE-Y POP STRC4.

Treatments	Number of cob	Weight of cob (g)	Weight of 100 Grains (g)	Number of grains per cob
EV99 QPM	1.56[a]	144.67[b]	28.78[ab]	375.56[a]
TZEE-Y POP STRC4	1.44[a]	182.11[a]	33.00[a]	427.89[a]
2000 Syn.EE-W QPM C_0	1.67[a]	146.22[b]	26.56[b]	413.22[a]
99 TZEE-Y STR	1.78[a]	131.22[b]	28.56[ab]	376.56[a]
STANDARD ERROR	±0.25	±5.64	±1.40	±25.85

Table 3: The effect of the genotype on some yield attributes of four varieties of maize.

Means having the same letter(s) in the same column are not significantly different from each other at 5% level of probability by Duncan Multiple Range Test (DMRT).

Discussion

TZEE-Y POP STRC4 had the highest growth and yield when compared with other maize varieties. The higher result obtained in plots with TZEE-Y POP STRC4 over the other treatments may be due to the presence of wide genetic base constitution which enables it to thrive well on ecological zone of the tropics and ability to resist *striga* infestation as reported by Badu-Apraku *et al.* who conducted a research on comparative evaluation of growth and yield of EV99 QPM, TZEE-Y POP $STRC_4$, 2000 Syn. EE-W QPM C_0, 99 TZEE-Y STR, 2000Syn. EE-Y QPM C_0, EV2000 QPM, and TZEE-W POP $STRC_4$ and found significant increase in grain yield and growth response.

Olakojo & Kogbe [11] emphasized the need to evaluate maize varieties in various agro-ecological zones for their adaptation, yield potential and disease reactions so as to release suitable varieties for cultivation on farmers' fields. Therefore, it is imperative to understand the relationship among yield testing locations for better adaptation of germ plasm to different production environments [12]. Stenger *et al.* [13] also reported that TZEE-Y POP STRC4 was significantly productive and has higher vigour due to its genetic composition which had enabled it to give higher performance irrespective of the location most especially tropical Africa. It also confirmed that it has highest genetic base which had been helping it to thrive well on different locations [14]. This is also in line with IITA (2007) bulletin which reported that it has ability to resist *striga* of different varieties. The bulletin also reported that it is tolerant to drought and a high yielding crop under soil condition of low nitrogen.

Conclusion

From this experiment, conclusions can be made that TZEE-Y POP $STRC_4$ has the best potential for increased grain yield. This is due to the fact that it has wide genetic base which enables it to perform well irrespective of soil and environmental difference. For this reason, TZEE-Y POP $STRC_4$ could be confirmed as a high yielding variety with stable vigour. It is also resistant to a wide range of biotic and abiotic stress which makes it a variety of first choice to farmers especially in this period of climate change.

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