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GRAIN YIELD OF EXTRA-EARLY MAIZE VARIETIES AS INFLUENCED BY INTRA-ROW SPACING AND FERTILIZER RATES AT SAMARU, ZARIA

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ABSTRACT

Two field trials were carried out in 2014 and 2015 rainy seasons at the Institute for Agricultural Research (IAR) farm in Northern Guinea Savanna Zone of Nigeria. The experiment was conducted to evaluate effect of fertilizer rates and intra row spacing on maize grain yield and yield components. The treatment consisted of two extra early varieties of maize (Sammaz 28 and Sammaz 29), two fertilizer rates (0:0:0 and 120:26:50 kg NPK/ha), three intra-row spacing of 20, 30 and 40 cm. The trial was laid out in a 2 x 2 x 3 factorial arrangement fitted into a randomized complete block design (RCBD) with three replicates. The result showed that Sammaz 29, intra-row spacing of 30cm and fertilized plots produced higher 100 grain weight, grain weight per plot and grain yield per hectare significantly ($P<0.05$). It is recommended that Sammaz 29 should be planted at a spacing of 30cm and fertilized with 120:26:50 kg NPK fertilizer.

Key Words: Extra-early maize, fertilizer, intra-row spacing, variety

INTRODUCTION

Maize (Zea *mays* L.) originated from Mexico in Central America and is one of the members of the family graminae, (Anonymous. 1994). Maize in West and Central Africa is regarded as one of the most important staple food crops. Relatively higher solar radiation and lower incident of pest and diseases during the cropping season made the Savannah region of West and Central Africa to be one of the greatest potential regions for maize production (Badu-Apraku *et al*., 2006). The cultivation of maize spread from Mexico, northward to Canada and southward to Argentina (Anonymous, 1992). Maize is widely cultivated throughout the world, and more of maize is produced each year than any other grain. The United States produces 40 % of the world maize production. Other major producing countries include China, Brazil, Mexico, Indonesia, India, France and Argentina (FAO, 2009).

Maize is high yielding, easy to process, readily digested and costs less than the other cereals (Kumar, 1993). The consumption pattern of maize varies from state to state in Nigeria (Ekweze, 1993), but generally, maize serves as a basic raw material for production of starch, oil and protein, alcoholic beverages, food sweeteners and more recently fuel. The green plant made into silage has been used with much success in dairy and beef industry.

The dry leaves and stalks after harvest still provide relatively good forage for ruminant animals. The stalks are used for fencing, thatching and building. Maize is used as human food, chemicals, medicines, Biofuel, ornamental and other uses e.g. variegated and colored leaf forms as well as those with colorful ears are used as ornamentals (Jamal *et al*., 2010). In spite of the increasing relevance and high demand for maize in Nigeria, yield across the country continues to decrease with an average of about 1t/ha which is the lowest African average yield recorded (Fayenisin, 1993).This low yield tendency is attributed to rapid reduction in soil fertility, failure to identify high yielding varieties and negligence of soil amendment among others (Kim, 1997). Maize being a very important crop that provides food for human and livestock as well as raw materials for industries, has a paramount role to play in ensuring the food security of Nigeria especially considering the dramatic upsurge of human population in the country.

Any research work geared towards identifying the best agronomic practices inherent for realizing the maximum yield of maize is therefore of inestimable relevance and is also indispensable. The general objective of this study is to determine the response of two extra early maize varieties (SAMMAZ 28 and 29) to NPK fertilizer and intra-row spacing under Northern Guinea Savannah Agro-Ecological Zone.

The objectives are to determine the effect of NPK fertilizer on growth, yield and yield components of two varieties of maize; determine the effect of intra-row spacing on growth, yield and yield components of two varieties of maize; and determine the effect of variety on growth, yield and yield components of two maize varieties.

MATERIALS AND METHODS

An experiment to evaluate the effect of NPK fertilizer rates and intra-row spacing on maize varieties was conducted during rainy season of 2014 and 2015 at the Institute for Agricultural Research (I.A.R.) farm in Northern Guinea Savannah Zone of Nigeria ($11^o11'$N, $07^o38'$E and 686m above sea level). Meteorological Data of the area throughout the period of the experiment were collected from I. A. R. Sarnaru. Random samples of soil was taken at depth of 0 – 30 cm with an auger from the experimental site before land preparation and analyzed for physical and chemical properties (Table 1).The treatments consisted of two extra early maize varieties (SAMMAZ 28 and SAMMAZ 29), two fertilizer rates (0:0:0 and 120:26:50 kg NPK/ha) and three intra-row spacing (20, 30 and 40 cm).The treatments were laid out in a 2 x 2 x 3 factorial arrangement fitted into in a randomized complete block design (RCBD) and replicated three times. Area of the experimental site was 35m x 34m (1190m^2)

The experimental site was double harrowed and ridged 75cm apart. Plots were demarcated which consisted of 6 ridges per plot. Seeds were dressed before sowing using Apron Star at the rate of 10g per 3kg of maize seeds. The seeds were sown manually at the rate of two seeds per hole at varied intra row spacing as specified in the treatment combination. The plants were thinned down to one plant per stand at two weeks after sowing (2 WAS).

Fertilizer was applied in two doses at 3 and 6 weeks after sowing. The whole of P and K and half of N were applied at 3 WAS by side dressing at about 10 cm away from the base of the plant and covered with soil. Urea (46%N) was used for the second dose to top dress at 6 WAS during remolding. Manual weeding was done at 3 and 6 WAS. Remolding was also done at the time of second dose of nitrogen application to cover the fertilizer and provide support to the plant against lodging. Harvesting was done manually when cobs were physiologically matured. The cobs were removed from the stalks, dehusked and sundried.

One hundred (100) grains were randomly counted from each net plot and weighed. The value was then recorded for each plot in grams. The harvested cobs from each net plot were threshed, cleaned and grains weighed and expressed in kg per plot. Grain weighed per plot obtained for each plot was later extrapolated to per hectare basis (kg/ha) as shown below:

Grain weight/plot = 1kg, Net plot area = 9m^2 then

If 9m^2 = 1kg

$$\text{Then } 10{,}000\text{m2} = \frac{1\text{kg x } 10{,}000\text{m2}}{9\text{m2}} = 1111.1\text{kg/ha}$$

The data collected were subjected to Analysis of Variance (ANOVA) as described by Snedecor and Cochran (1967). Means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the effect of intra-row spacing and fertilizer application rates on 100-grain weight (gm) grain weight/plot and grain weight per hectare (kg/ha) of extra-early maize varieties at Samaru is presented in Table 1. Varietal differences only significantly (P<0.05) influenced 100-grain weight in 2014 in which, Sammaz 29 was heavier than Sammaz 28. This could be attributed to the fact that the two varieties used for this study differ in their morphological structure as affected by genotypic variation. Hence, Sammaz 29 had higher photosynthesis that leads to production of higher assimilate. The higher assimilates produced were subsequently translocated to grain filling which lead to heavier grain weight of the species. This is similar to the findings of Majambu *et al*. (1996) and Ibrahim *et al*. (2000) that attributed the differences in yield indices of crops to genetic constitution. This observation also corroborates with the findings of Sajjan *et al*. (2002) who reported that yield characters of crops varied because of differences in their genetic make-up.

Intra-Row spacing significantly (P<0.05) influenced 100-grain weight only in 2014 with 30 cm spacing having heavier 100-grain weight than 20 cm spacing but at par with 40 cm spacing. The low density had greater canopy light interception than the high density. The wider spacing enjoyed a temporal difference which helped in reducing competition for the growth factor such as light. Most of the yield response of maize to reduction in row spacing was related to improvements in radiation interception at the critical flowering stage (Bullock *et al.,* 1998; Cirilo, and Andrade, 1995). Maize yield is known to increase with increased plant population until the increase in yield attributable to the addition of plants is less than the decline in mean per plant due to increased inter-plant competition (Mashingaidze, 2004). This was in agreement with the findings of Enujeke (2013), Futuless *et al*. (2010), and Dalley *et al*. (2006) that attributed the increased growth rates, earlier canopy closure and grain weight of narrow row spaced crops to quest for increased light interception as well as increased availability of soil moisture.

Fertilizer rate significantly (P<0.05) influenced 100-grain weight, grain weight per plot and grain yield per hectare in 2014 whereby the fertilized plots produced significantly (P<0.05) higher values than the unfertilized plots. The significant response of 100-grain weight, grain weight/plot, and grain yield/ha to application of NPK could have arisen from improvement of soil fertility of the experimental site. The findings also confirmed the results reported by Chaudhary *et al*. (1998); Sharma and Gupta (1998) and Younas *et al*. (2002).

Table 1: Effects of intra-raw spacing and fertilizer rates on 100- grain weight (gm) and Grain weight/plot of extra-early maize varieties at Samaru

Treatment	100-grain weight (gm)		Grain weight/plot (gm)		Grain yield/ha (kg)	
	2014	2015	2014	2015	2014	2015
Varieties						
Sammaz 28	17.49[b]	20.21	968.00	2057.84	1075.51	2286.49
Sammaz 29	19.88[a]	21.02	1140.60	3769.88	1267.38	4188.76
S.E. ±	0.603	0.958	133.713	1223.444	137.960	1359.382
Intra-Row Spacing (cm)						
20	17.62[b]	20.93	1050.90	1940.39	1167.71	2155.99
30	20.10[a]	21.22	1220.60	4939.41	1356.18	5488.23
40	18.33[ab]	19.69	891.40	1861.78	990.44	2068.65
S.E. ±	0.738	1.173	163.765	1498.407	168.965	1664.896
Fertilizer (kg NPK/ha)						
0:0:0	17.57[b]	20.32	600.60[b]	1841.91	667.35[b]	2046.57
120:26:50	19.80[a]	20.91	1509.00[a]	3985.81	1675.53[a]	4428.68
S.E. ±	0.603	0.958	133.713	1223.444	137.960	1359.382
Interaction						
V x S	NS	NS	NS	NS	NS	NS
V x F	NS	NS	NS	NS	NS	NS
S x F	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 5 percent level of significance using DMRT.

It was also observed that increase in fertilizer rate increased grain yield/ha and 100-grain weight. This may probably be attributed to NPK being part of the essential nutrients required for the promotion of the meristematic and physiological activities such as plant leaf spread, root development, plant dry matter production etc leading to an efficient absorption and translocation of water and nutrients, interception of solar radiation and assimilation of carbon dioxide. These activities promote higher photosynthetic activities leading to the production of enough assimilate for subsequent translocation to various sinks and hence the production of higher yield and yield components of maize. This is in conformity with the findings of Sharif *et al.* (1993), Adediran and Banjoko (1995) and Anonymous (1997) who observed that the crucial yield and yield components such as 1000-grain weight, ears/plant, were produced with increase in fertilizer.

CONCLUSION

The result obtained indicated that Sammaz 29, 120:26:50 NPK/ha and the 30 cm intra row spacing gave higher yield. There by removing the notion of some farmers that says, even without fertilizer when you widen the intra row spacing one will get higher yield. It is therefore recommended that farmers should adopt close spacing (30cm) and apply 120:26:50 kgN/ha and plant Sammaz 29 for higher yield.

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