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PERFORMANCE OF THREE MAIZE VARIETIES AS INFLUENCED BY NPK FERTILIZER RATES AND INTRA-ROW SPACINGS AT SAMARU, NORTHERN GUINEA SAVANNA, NIGERIA

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ABSTRACT

A number of studies conducted revealed a number of factors militating against large scale production of maize in the study area to include among other things such as low soil fertility, low and poorly distribution of rainfall, nonuse of optimum plant density, poor implementation of improved Agronomic practices and use of indigenous local and often un improved maize varieties. An experiment comprised of three NPK fertilizer rates, four intra -row spacings and three maize varieties was undertaken. The treatments were arranged in a Split plot design with fertilizer rates and intra row spacings assigned to main plot and varieties in the sub plot using three replications. Results obtained revealed that each increase in NPK fertilizer from 200 to 400 kg ha^{-1} significantly produced taller plants, longer ear height, heavier 100- grain weight, and grain yield while number of days to 50% tasseling became reduced with increased in NPK fertilizer rates. Each increase in intra- row spacing from 20 to 50 cm significantly enhanced all the growth and yield attributes of the crop. SAMMAZ 40 maize variety significantly produced taller plants, longer ear height and took longer days to attain days to 50% tasseling, higher 100-grain weight, and grain yield than the other two varieties that were statistically similar. It can be concluded that for good growth and yield, use of SAMMAZ 40 maize variety, use of 400 NPK kg ha^{-1} planted at 20 or 25 cm intra row spacings could be recommended to farmers at Samaru.

Keywords: Performance, Maize, Varieties, NPK fertilizer, Plant density, Savanna

INTRODUCTION

Maize production and consumption has increased dramatically in the country placing the crop at a very important position replacing the dominant crops such as millet and sorghum. In Nigeria today production of maize is beyond subsistence level, farmers took it as a business. A farmer producing 100 to 300 bags of maize is a millionaire, capable of shouldering all his responsibilities and that of his subordinates. Higher maize productivity and yield could be attributed to the inherent attributes of the crop such as easy to cultivate, harvest, transport, storage and high yield per unit area. It is a crop that is being cultivated from the rainforest region in the south to the sahel region in the far north. With irrigation facilities, 2 to 3 cropping is possible depending upon the variety. However, the major limiting factors to its production especially in the sudan and sahel regions is nutrient supply especially nitrogen, appropriate variety, optimum plant density, proper sowing date, weed control and timely insect pest and diseases control. If these factors are taking care of maize production and productivity could be doubled or tripled as the case may be. One important characteristic of the crop is its high and rapid nutrient requirement for good growth and yield. According to CIMMYT (1981) and CIMMYT (1990), the soil must supply about 50-60 kg N ha-^{1} (in form of soluble nitrates) and 30 kg P ha-^{1} in plant available forms for each ton of grain produced. Rowland (1993) reported maize grain to contain 2 % kg N (i.e. 100 kg of harvested grain contains 2 Kg N). It is therefore important to plant the crop in a fertile field that will guarantee the supply of essential nutrients for good growth and yield. Assessing fertilizer requirement of the crop in this study will greatly help in attaining maximum yield by matching the crop with appropriate fertility status following appropriate soil test. Plant density is an important agronomic factor which causes substantial increase or decrease in yield of maize. Therefore, optimum plant density should be used for the interception of adequate solar radiation for the manufacture of assimilates and its ultimate conversion to grain yield (Buah *et al*., 2009). Climate changes, leading to global warming where rainy days are decreasing and dry days increasing resulting to low maize production necessitated the need for the development of high yielding, drought tolerant, pest and diseases resistant, extra early, early, medium and late maturing varieties. One of the test materials SAMMAZ 40 is a late maturing variety (110 - 120 days), pest/disease tolerance, tolerance to southern corn leaf blight, corn leaf blight, curvularia leaf spot, maize streak virus and *Striga hermonthica*. It has high yield potential (7.1 t/ha) and drought tolerant. (Oyekunle *et al*., 2017).

MATERIALS AND METHODS

Field trials were conducted at the experimental farm of Institute for Agricultural Research, Ahmadu Bello University, Zaria in the northern Guinea savanna Latitude 11° 11' N and Longitude 07° 38 'E, 686 m above sea level during the cropping seasons of 2018 and 2018 rainy seasons. The trial consisted of three NPK fertilizer rates (200, 300 and 400 kg/ha); four intra-row spacings (20, 25, 40 and 50 cm) and three maize varieties; SAMMAZ 38 (PVA SYN 2); SAMMAZ 39 (PVA SYN 8) and SAMMAZ 40 (DT STR SYN 2) of different maturity periods. The treatments were

arranged in a Split plot design with NPK fertilizer rates and intra row spacing assigned to main plot and varieties in the sub plot using three replications. Plot size used was 3 m x 5 m (15m^2). Total number of rows per plot was 4, spaced 75 cm apart. Net plot consisted of two middle rows. Fertilizer was applied as per the varied treatments rates. Nitrogen was applied in two split doses, first half at 2 weeks after sowing (WAS) and the remaining at 6 WAS while P and K were applied at once (2 WAS). Data collected includes: plant height, ear height, number of days to 50% tasseling,100-grain weight, field weight and grain yield. All other recommended agronomic practices were duly observed. Analysis of variance (ANOVA) using SAS software was carried out on the data measured. Significant means were separated using Duncan Multiple Range Test (DMRT) at 5% probability (Duncan, 1955; Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The effects of NPK fertilizer, intra-row spacing and variety on plant and ear heights, days to 50% tasseling, 100-grain weight, and grain yield are presented in Tables 1 and 2. Results obtained revealed that each increase in NPK fertilizer from 200 to 400 kg NPK per hectare significantly produced taller plants, ear height, heavier 100- grain weight, and grain yield while number of days to 50% tasseling became reduced with increased in NPK fertilizer rates. The results obtained in this study shows the importance of fertilizer application to maize especially N which is essential in cell division and enlargement, meristematic growth that aided smooth growth and development of the crop. It is essential nutrient for the production of amino acids, proteins and nucleic acid as well as a component of the chlorophyll molecule which enable the plant to capture sunlight energy by photosynthesis, driving plant growth and grain yield. Nitrogen plays a significant role within the plant to ensure energy is available when and where the plant need it to optimize yield. This supported the observation reported by Badu *et al*. (2012) and Badu *et al*. (2014), phosphorus on the other hand is a constituent of cell division and development of the growing tip of the plant, thus vital for the growing tip for seedlings and young plants. It has been found to stimulate root development, increased stem and stalk strength and improved flower formation and seed production. While potassium aided water, nutrient and carbohydrates movements in plant tissue. It is involved with enzyme activation within the plant and affects protein, starch and ATP production which regulate rate of photosynthesis Application of NPK provided a complete package of nutrition for root development anchorage and water absorption strong stems, leaves for translocation of assimilate from roots via xylem to various parts of the plants. Above findings were supported by numerous researchers Marahatta (2021); Badu *et al*. (2014); Asghar *et al*. (2010); Mahdi and Ismail (2015).

Each increase in intra- row spacing from 20 to 50 cm significantly enhanced all the growth and yield attributes of the crop. Plant density is an important agronomic factor which causes substantial increase or decrease in yield. Use of sub-optimal plant density is the reason for the attainment of low growth and yield of crops. Realization of projected yield of 5 – 10 t/ha can only be achieved when optimum plant density is used. The results obtained in this study supported the above observation with 20 cm (66,600 plants ha^{-1}) and 25 cm (53,300 plants ha^{-1}) resulted in high grain yield. The observation is in line with report of Mani and Dadari, 2004 and Mani and Dadari, 2005 who observed that at lower plant density, high number of cobs per unit area and greater canopy light interception and at the same time, the closer the plants are, they are subjected to etiolating towards the sun direction, thus becoming taller (Rowland, 1993; Mani and Dadari, 2005 and Jaliya and Ruma, 2017).

SAMMAZ 40 maize variety significantly produced taller plants, longer ear height and took longer days to attain days to 50% tasseling, higher 100-grain weight, and grain yield than the other two varieties that were statistically similar except 100-grain weight in which SAMMAZ 39 and SAMMAZ 38 differed significantly. The longer a crop variety stays in the field, the higher yield potential of that variety, mainly because of the accumulation of assimilates of photosynthate which is translated in to the grain yield (Jaliya *et al*., 2008). Thus, early and intermediate varieties yield lower than late maturing varieties. This supported the observations reported by earlier researchers (Mani and Dadari, 2005; Fajemisin, 1991) who reported that maize yield is directly proportional and positively correlated with its growth duration, that is why extra-early maize yield lower than early maize and in turn lower than that obtained by late maize variety.

Table 1: Effect of NPK fertilizer, intra-row spacing and varieties on maize growth parameters during 2017 and 2018 cropping season at Samaru northern guinea savanna

	Plant height (cm)		Ear height (cm)		Days to 50% tassel	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
NPK Fertilizer (kg/ha)						
200	115.0c	140.1c	40.4c	78.6c	60.4c	60.6a
300	120.0b	161.5b	48.6b	80.0b	59.0b	58.6b
400	124.0a	180.4a	54.5a	90.4a	58.4c	57.8c
SE	4.1	4.3	2.23	0.39	0.37	0.39
Intra-row spacing (cm)						
20	125.0a	167.0a	56.9a	60.0a	58.4d	60.0a
25	120.0b	163.0a	50.1b	59.0b	59.5c	59.0a
40	114.0a	150.4b	43.1b	58.0b	60.2b	58.0b
50	109.0d	154.0b	40.0d	57.0b	61.2b	57.0b
SE	2.9	3	2.1	2.2	0.3	0.49
Variety						
SAMMAZ 38	114.0b	152.0b	41.0c	80.0b	58.3b	56.8b
SAMMAZ 39	121.7a	156.0b	48.0b	83.0b	59.0a	58.0b
SAMMAZ 40	122.0a	175.0a	53.8a	89.0a	60.5a	60.0a
SE	4.1	4.3	2.23	2.33	0.37	0.39

Interactions						
F x S	NS	NS	NS	NS	NS	NS
F x V	NS	NS	NS	NS	NS	NS
S x V	NS	NS	NS	NS	NS	NS
F x S x V	NS	NS	NS	NS	NS	NS

Means followed by unlike letter within the same column are significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT)

Table 2: Effect of NPK fertilizer, Intra-row spacing and varieties on maize yield parameters during 2017 and 2018 cropping season at Samaru northern guinea savanna

	100 grain weight (g)		Field weight (G)		Grain yield (kg/ha)	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
NPK Fertilizer (kg/ha)						
200	19.5c	23.1c	986.4c	2608c	859.3c	2001c
300	20.8b	25.3b	1097b	3176b	1076b	2556b
400	21.4a	26.9a	1299a	4209a	1366a	3001a
SE (±)	0.6	0.64	108	189.7	110	126.8
Intra-row spacing (cm)						
20	19.4d	24.0a	1000a	3571a	1190a	2767a
25	20.2c	24.5b	850.0b	3459a	1161b	2703a
40	21.0b	25.0a	780.8c	3280b	1054c	2409b
50	22.7a	26.0a	750.0d	3014b	996.0d	2199b
SE (±)	0.48	0.51	103	201.9	105	161.3
Variety						
SAMMAZ 38	20.0b	24.0c	1090b	3052c	853.8c	2279b
SAMMAZ 39	20.5ab	25.0b	993b	3256b	1176b	2526b
SAMMAZ 40	21.3a	26.0a	1299a	3684a	1231a	2754a
SE (±)	0.6	0.64	108	189.7	110	126.8
Interaction						
F x S	NS	NS	NS	NS	NS	NS
F x V	NS	NS	NS	NS	NS	NS
S x V	NS	NS	NS	NS	NS	NS
F x S x V	NS	NS	NS	NS	NS	NS

Means followed by unlike letter within the same column are significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT)

CONCLUSION

Based on the results obtained in this study, it can be concluded that for good growth and yield of SAMMAZ 40 maize variety, the use of 400 kg ha^{-1} (equivalent to 120-60-60 kg NPK ha^{-1}) planted at 20 or 25 cm intra row spacing could be recommended to farmers at Samaru and areas having similar ecology.

REFERENCES

Asghar, A., Ali, A., Syed, W. H, Asif, M., Khaliq, T. and Abid, A. A. (2010). Growth and yield of maize (*Zea mays* L.) cultivars affected by NPK application in different proportion**.** *Pakistan Journal of Science*, 62 (4): 211-216.

Badu –Aparaku, B., Oyekunle, M., Obeng-Anws, K., Osuman, A. S., Ado, S. G., Coulibaly, N., Yallou, C. G., Abdullahi, M. G., Boakyewaa, A. and Didjeira, A. (2012). Performance of extra-early maize cultivars based on GGE bi plot and AMMI analysis. *Journal of Agricultural Science*, 150, 473 – 483. Cambridge University Press.

Badu–Aparaku B., Robert, A. A., Fakorede, B. and Asafo–Adjei, A. (2014). Strategies for sustainable maize seed production in West and Central Africa, CIMMYT and IITA pp.140

Buah, S.S.J., Abatania, L.N. and Aflakpui, G.K.S. (2009). Quality Protein Maize Response to Nitrogen Rate and Plant Density in the Guinea Savanna Zone of Ghana, West *African Journal of Applied Ecology*. 6:9-21.

Byerlee, D. and Eicher, C. K. (1971). Africa's Emerging Maize Revolution, Boulder, C. O.Lyne Rienner Publishers.

CIMMYT (1981): World maize Facts and Trends, Report one: Analyses of change in reduction, consumption, trade and practices over the last two decades Mexico D.F.

CIMMYT (1990). World maize Facts and Trends: Realizing the potential of maize in the sub-Saharan Africa, Mexico D.F.

Duncan, D. B. (1955). Multiple range and Multiple F-tests. Biometrics, 11L1-42.

Jaliya, A. M., Falaki, A. M., Mahmud, M. and Sani, Y. A. (2008). Effects of sowing date and NPK fertilizer rate on yield and yield components of quality protein maize (*Zea mays* L.). *ARPNJ. Agricultural and Biological Sci*ences, 2:23-29.

Jaliya, M. M and Ruma, D. S. (2017). Effects of variety, row spacing and fertilizer rates on growth of extra-early maize varieties at Samaru. *Nigerian Journal of Agricultural Extension*, 18 (4), 115-119.

Mani, H. and S. A. Dadari (2004). Agronomic and economic evaluation of popcorn (*Zea mays* everta) under variable plant

densities and fertilizer rates. Nigerian *Journal of Scientific Research*, 4(2): 62-72.

Mahdi, A. H. A. and Ismail, S. K. A. (2015). Maize productivity as affected by plant density and nitrogen fertilizer. *International Journal of Current Microbiology and Applied Sciences*, 4(6): 870-877.

Marahatta, S (2021). Effect of plant densities and fertilizer rates on grain yield of spring maize in inner Terai. *Agronomy Journal of Nepal*, 5: 63-78.

Mani H. and S. A. Dadari (2005). Performance of popcorn (*Zea mays* L.) under different population intervals and sowing dates. The Nigerian Academic Forum, Nnamdi Azikwe University, Awka, 9(1): 62 – 72.

Menkir, A. (2003). The role of GIS in the development and targeting of maize germplasm to farmers needs in West and Central Africa. Proceedings of a Regional Maize Workshop pp120.

Oyekunle, M., Haruna, A, Badu-Apraku, B, Usman, I. S, Mani, H., Ado, S. G., Olaoye, G., Obeng-Antwi, K., Abdulmalik, R. O. and Ahmed, H. O. (2017). Assessment of early-maturing maize hybrids and testing sites using GGE Biplot analysis. *Crop Science*, Vol 57, Pp.99.

Snedecor, G. W. and Cochran, W. G. (1967). Statistical methods. Iowa State University Press. Iowa USA 425pp.