GROWTH AND YIELD RESPONSES OF MAIZE TO PARTIAL TO PARTIAL SUBSTITUTION OF INORGANIC NITROGEN WITH FARM YARD MANURE AT GIDAN KWANO

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ABSTRACT

Maize is the third most important cereal in the world, next to rice and wheat. It is the most heavily cultivated cereal crop globally. A number of factors are responsible for the low yield of maize crop, among which fertilizer is key. This study was specifically carried out in 2019 farming season to determine the variations in growth and yield response of maize to partial substitution of inorganic nitrogen with farm yard manure at Gidan Kwano. The treatment consisted of the following combinations: (T1; 0% recommended nitrogen with 0% FYM), (T2; 25% recommended nitrogen with 75% FYM), (T3; 50% recommended nitrogen with 50% FYM), (T4; 75% recommended nitrogen with 25% FYM), (T5; 100% recommended nitrogen with 0% FYM), (T6; 0% recommended nitrogen with 100% FYM). The treatment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. Result of the study showed that plant height of maize was significantly affected by the treatment application, while number of leaves, leaf area and stalk girth showed a non-significant response. The result also showed that there was significant ($P<0.05$) differences among the treatments for days to 50% tasseling and days to 50% silking. Significant differences was recorded for cob dry weight, number of seeds per cob, 100 seed weight and total grain yield with the application of 50% N+50%FYM and 75%N+25%FYM. It is concluded based on the findings of the study that the integration or partial substitution of inorganic nitrogen and farm yard manure performed better than the use of inorganic nitrogen source or farm yard manure alone. The application of 50% N+50%FYM and 75%N+25%FYM is suggested for farmers in Gidan Kwano.

Keywords: Maize, Inorganic N, Farm yard manure, partial substitution

INTRODUCTION

Maize is a cereal crop grown in various agro-ecological zones, as a single crop or in mixed cropping. It is the third most important cereal in the world, next to rice and wheat and with highest production potential among the cereals (Prathyusha *et al.*, 2013). It is the most heavily cultivated cereal crop globally, and one of the main cereals crops of West Africa and the most important cereal food in Nigeria (Onuk *et al.*, 2010). Every part of the maize plant has economic value: the grain, leaves, stalk, tassel, and cob

can all be used to produce a large variety of food and non-food products (IITA, 2009). World production of maize is around 790 million tones and it serves as a staple food providing more than one-third of the calories and proteins in some countries (Annual report, Decha District Agric Office, 2015). By 2050 demand for maize will double in the developing world, and maize is predicted to become the crop with the greatest production globally, and in the developing world by 2025 (Bemire, 2010).

A number of factors are responsible for the low yield of maize crop. Inappropriate crop nutrition management and poor soil fertility are the most important factors responsible for low yield (Arshad, 2003). The high cost, scarcity and low efficiency of fertilizer make them unprofitable for farmers, also without adequate supply of organic matter, continuous use of NPK fertilizer leads to soil acidification, nutrient imbalances and degradation of soil physical quality (Fasina, 2013). Therefore, this study was specifically design to determine the variations in growth and yield response of maize to partial substitution of inorganic nitrogen with farm yard manure at Gidan Kwano.

METHODOLOGY

Description of the study location

Field experiment was conducted during the 2019 cropping season at the Teaching and Research Farm of Federal University of Technology Minna, Gidan-Kwano Campus. (Lat 09˚ 31'N and Long. 06˚ 27'E of the equator, 212m above sea level.). The average annual rainfall ranges between 750mm-1250mm. Mean temperature ranges between 26^0C – 38^0C.

Experimental materials

Inorganic nitrogen (NPK 15:15:15), maize variety (Sammaz 34) were obtained from Kure market Minna and Farm Yard Manure (FYM) which was sourced from the Animal production farm of the Federal University of Technology Minna.

Treatment and Experimental Design

The treatment consisted of the following combinations: (T1; 0% recommended nitrogen with 0% FYM), (T2; 25% recommended nitrogen with 75% FYM), (T3; 50% recommended nitrogen with 50% FYM), (T4; 75% recommended nitrogen with 25% FYM), (T5; 100% recommended nitrogen with 0% FYM), (T6; 0% recommended nitrogen with 100% FYM).

The treatment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The gross plot size was a 4m × 4m, with an inter plot spacing of 0.5 m and a 1m provided between the blocks.

Soil sampling and Analysis

A composited initial soil sample before planting was taken at 0-30 cm soil depth from the

experimental site. The soil was processed following standard procedures and analyzed in the Soil Science Department laboratory of Federal University of Technology, Minna for organic matter content following the procedure by Walkley and Black (1934), total nitrogen by the Kjeldahl method (Bremner and Mulvaney, 1982). Soil reaction (pH-H2O) using a pH meter with 1:2.5 soil to solution ratio via a glass electrode attached, and Cation Exchange Capacity (CEC) leaching the soil with neutral 1 N ammonium acetate (FAO, 2008). Available phosphorous by Olsen et al., (1954); exchange able potassium by the use of flame photometer. The particle size analysis was done using the hydrometer method as outlined by Anderson and Ingram (1993)

Agronomic management of the experiment

All agronomic practices were implemented in accordance with the given recommendations for the crop. The field was cleared manually and ridged with a hoe. Ridges were spaced 75cm apart. Maize seed was sown manually on the 14th of July, 2019 at three seeds per hole with a planting depth of 5cm, at an inter and intra row spacing of 75cm × 25cm. The maize seeds were treated with Apron StarR (active ingredients Thiamethoxam, Mefanoxam and Difenoconazole at 10g per 4 kg seeds) before planting. Maize seeds were sown at the starting of rainfall, and the seedlings thinned to one plant per stand two weeks after sowing. Weeds were manually controlled at 3, 6 and 9 weeks after sowing (WAS).

Data collection

Phenological, growth, yield and yield components data were collected. The parameters taken were days to 50 % tasselling, days to 50 % silking, Plant height (cm), Number of leaves, leave area, stalk girth, dry cob weight, Number of seeds per cob, hundred (100) seed weight, and grain yield. All parameters were measured following the standard procedures. Growth data was taken at 9 weeks after planting (WAP).

Data analysis

Data collected were subjected to analysis of variance (ANOVA) using the Statistical Analysis System (SAS) software version 9.0 (2002). Where treatment means are significant, means were separated using Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Effect of partial substitution of inorganic fertilizer with farm yard manure (FYM) on the growth parameters of maize

Plant height

Result of statistical analysis for plant height shows a significant (P<0.05) difference among the treatments at 9 weeks after planting. Treatment one (0N:0FYP) recorded the shortest (168.83 cm) plant height (Table 1).The tallest (219.89 cm) plant was recorded in T4 (75:25) which was closely followed byT3 (50:50) and T2 (25:75) respectively ((Table 1).

Number of leaves, leaves area and stalk girth

The analysis of variance result for number of leaves, leaf area and stalk girth shows that all three parameters where non significantly affected by the treatments (Table 2). All treated plots performed better than the control plot (T1) across all parameters. Treatment T4 (75:25) recorded the maximum (12, 0.38 cm) values for leaf and stalk girth respectively. The reason for the non significant differences for these parameters could be attributed to the time of planting and the short period of drought witness during the season.

Table 1: Effect of partial substitution of inorganic fertilizer nitrogen with farm yard manure (FYM) on the growth of maize

Treaments	Growth parameters			
N:FYM	Plant height (cm)	No of leaves/plant	Leaf area (M^2)	Stalk girth (cm)
0:0	168.83b	10.83a	0.29a	0.30a
25:75	182.28ab	12.61a	0.36a	0.42a
50:50	217.67a	11.94a	0.38a	0.38a
75:25	219.89a	12.50a	0.32a	0.58a
100:0	206.39ab	11.39a	0.34a	0.37a
0:100	195.55ab	11.17a	0.32a	0.25a
SE±	6.61	0.26	0.12	0.06

Means followed by similar letter (s) with the same column are not significantly different at $p \leq 0.5$ according to Duncan's Multiple Range Test.

Effect of inorganic Nitrogen substitution with farm yard manure (FYM) on the phenology of maize

Days to 50% tasseling and Days to 50 % silking

The result showed that there was significant (P<0.05) differences among the treatments for days to 50% tasseling. Treatments T1 (0:0), T5 (100:0), and T6 (0:100) recorded the longest (54) number of days to 50% tasseling (Table 2) while T3 (50:50) and T4 (75:25) though statistically not significantly (P<0.05) different from each other, recorded the shortest (50) number of days to tasselling.

Statistically the result of days to 50% silking revealed that there was a significant (P<0.05) differences among the six treatments (Table 2). Treatments T1 (0:0) and T6 (0:100) showed the highest number to 50% silking followed by T2 (25:75), T5 (100:0) and T3 (50:50), while T4 (75:25) showed the lowest days to 50% silking (Table 2)

Table 2. Effect of inorganic fertilizer substitution with farm yard manure (FYM) on the phenology of maize.

Treatment N/FYM	Days to 50% tasseling	Days to 50% silking
0:0	54a	60.67a
25:75	52.32ab	58.33ab
50:50	50.33b	55.33bc
75:25	50.67ab	54.67c
100:0	54.00a	57.67abc
0:100	53.67ab	60.33a
SE±	0.51	0.65

Means followed by similar letter (s) with the same column are not significantly different at $p \leq 0.5$ according to Duncan's Multiple Range Test.

Effect of partial substitution of inorganic fertilizer with farm yard manure (FYM) on the yield attributes and yields of maize.

Dry cobs weight

The statistical analysis of the dry cob weight shows that there was a significant difference between the control plot T1 with no fertilizer when compared to all other treatment combinations (T2, T3, T4, T5, and T6). The lowest (2.43g) dry cob weight was recorded on T1 (0:0) while the highest (4.83g) cob dry weight was recorded for T3 (50:50) followed by T4 (75:25) with 4.20g (Table 3). With the exception of T1 (0:0) all the other treatments were not significantly different.

Number of seeds per cobs

The result of number of seeds per cob shows a significant difference ($P<0.05$) among the treatments (Table 3). The control plot T1 (0:0) recorded the minimum (319) while the maximum number of seeds per cob was recorded in T4 (75:25), followed by T3 with 392 seeds. Moreover, statistically not significant differences exist between T3, T4, T5, and T6 (Table 3).

Table 3: Effect of inorganic fertilizer substitution with farm yard manure (FYM) on the yield components and yield of maize

Treatments N:FYM	Dry cob weight (kg)	No of seed/cob	100 seed weight (g)	Grain yield kg/ha
0:0	2.43b	319.90c	20.07b	4000.00d
25:75	3.97a	357.43b	18.71c	6466.67b
50:50	4.83a	392.53a	18.77c	8200.00a
75:25	4.20a	396.57a	20.77a	7133.33b
100:0	4.13a	387.77a	18.74c	6666.67b
0:100	3.70a	375.17a	17.55d	5333.33c
SE±	0.31	14.20	0.45	1334.58

Means followed by similar letter (s) with the same column are not significantly different at $p \leq 0.5$ according to Duncan's Multiple Range Test.

100 seeds weight and total grain weight

Analysis of variance result showed that there was significant ($P<0.05$) difference in 100 seeds weight among the treatments. There was no significant difference ($P> 0.05$) between T2 (25:75), T3 (50:50), and T5 (100:0) for 100 seed weight. However, the maximum (20.77g) weight for 100 grain was recorded in T4 (75:25) followed by T1 (0:0) with 20.01g (Table 3). Total grain weight (TGW) showed a marked significant difference ($P<0.05$) among the six treatments. Maximum total grain yield (8200kg/ha) was recorded in T3 (50:50) followed by T4 (75:25) which recorded a yield of 7133kg/ha (Table 3). Treatment one recorded the lowest

yield (4000kg/ha).

DISCUSSION

The result obtained in this study indicates that the application of inorganic nitrogen along with farm yard manure is far better than the application of the individual sources for all the parameters measured. Maximum plant height was recorded for treated plots as against the untreated control plot. Plant height is as the appearance of full vegetative potential and initiation of reproductive phase. The reason for tallest plants in treatments with a combine application of inorganic nitrogen with farm yard manure might be due to availability and uptake of sufficient quality of nitrogen from inorganic source at early growth stages and farm yard manure (FYM) which provides better nutrition to the crop. Similar results were obtained by Adnan Anwar Khan *et al.* (2017) where the nitrogen updates and soil fertility was highly significant for all growth parameters performance.

The total grain yield of maize as affected by the application of inorganic nitrogen and farm yard manure applied alone and or in combinations showed a significant differences. The highest grain yield of 8200kg/ha was obtained from treatment receiving inorganic source of nitrogen and farm yard manure at a ratio 50:50 followed by 7133.33kg/ha recorded for treatment receiving a ratio of N/FYM 75:25. The results indicated that treatment receiving nitrogen solely from NPK 15:15:15 or FYM produced lower yield compared with treatments receiving both inorganic source of nitrogen and farm yard manure. These results are in line with the findings of Shan *et al* (2007) who reported significant increase in grain yield of maize with integrated use of urea as source of Nitrogen and farm yard manure as compared to their sole application.

CONCLUSION AND RECOMMENDATION

In conclusion, the integrated or partial substitution of inorganic nitrogen and farm yard manure perform better than the use of inorganic nitrogen source or farm yard manure alone in terms of improving crop growth and yield. The application of 50% inorganic nitrogen with 50% farm yard manure and the application of 75% inorganic nitrogen with 25% farm yard manure were found to give the best maize crop performance at Gidan Kwano. Therefore, these combinations are suggested for farmers in the study area. Further experimental trial is needed to confirm this recommendation.

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