

Research Article

Yield and Growth Response of Maize (*Zea mays* L.) to Varietal and Nitrogen Application in the Guinea Savanna Agro-Ecology of Ghana

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Background and Objective. Maize is one of the oldest cultivated crops. It is the third most important cereal after wheat and rice globally. Compared to all other cereals, maize has the highest average yield per unit area. The objective of the research was to evaluate maize varietal response to different nitrogen fertilizer rates. **Materials and Methods.** The treatment consisted of two factors, namely six varieties of maize and four levels of nitrogen application rates. These were arranged in 6×4 factorial combinations and laid out using randomized complete block design (RCBD) with three replications. The data collected were subjected to combined analysis for variation in factorial experiments in RCBD using Genstat statistical package edition 18. The means were separated using Duncan's multiple range test at a 5% probability level. **Results.** The study revealed that varieties, such as IWD-C3-SYN-F2 and OBATAMPA, produced the highest grain yield and growth parameters (agronomic traits) relative to other varieties. The maximum grain yield and biomass production also occurred at the nitrogen application rates of 90 and 120 kg N/ha. **Conclusion.** Varieties, such as IWD-C3-SYN-F2 and OBATAMPA, and N rate of 90 kg N/ha are, therefore, recommended to be used for maize production by the resource-poor farmers in the Guinea Savanna Agro-Ecology of Ghana.

1. Introduction

Maize or corn (*Zea mays* L.) is a plant belonging to the tribe *Maydeae* of the grass family *Graminae* (*Poaceae*). It is a native of Southern Mexico [1]. Maize is a versatile crop grown over a range of agroclimatic zones [2]. The genus *Zea* (*Zela*) was derived from an old Greek name for food grass. The genus *Zea* consists of four species of which *Zea mays* L. is economically important. The other *Zea* species, referred to as teosintes, are largely wild grasses native to Mexico and Central America [2]. The number of chromosomes in *Zea mays* is $2n = 20$. Maize is a tall, determinate, and monoecious plant. The plant has separate staminate and pistillate flowers on the same plant. It is an annual C_4 plant varying in height from 1 to 4 m [3]. Maize is generally a protandrous plant, i.e., the maize flower matures earlier than the female.

According to [4], maize ranks third globally in the area and total production after wheat and rice. Maize remains an essential cereal crop and is a polyvalent seed. A large

percentage of maize produced in Africa is utilized for household consumption even though it is progressively used for feeding animals [5]. In Northern Ghana, maize stovers are used as fuelwood [6], and for several decades, maize has been used as an industrial raw material from which products, such as cornflakes, oil, jam, alcohol, and paper are produced.

The current area planted to maize in Ghana stands at approximately 1 million ha. The per capita consumption of maize in Ghana is estimated at 44 kg/person/year, and the national demand is forecast to grow at approximately 1.83% per annum [7]. It is an important cereal produced in all five agroecological zones of Ghana. These include forest, Guinea savanna, coastal savanna, transitional zone, and Sudan savanna [8]. The Guinea and Sudan savannas, however, have the highest potential for increased maize production and productivity because of high solar radiation, low night temperatures, and low incidence of diseases [6]. Maize is one of the country's major food security crops. It also remains

Ghana's most consumed cereal crop with surging production since 1965 [9]. Maize is largely the utmost prudent cereal crop in Ghana, and it is cultivated largely by rural and peri-urban farm families and resource-poor smallholder farmers [10]. It is extensively eaten nationwide and is Ghana's second most essential staple food after cassava [11]. The maize crop, however, has a minimum stress tolerance among the three main cereal crops [12].

Maize production in Ghana is bedeviled with problems of soil degradation, low soil nutrient levels (particularly nitrogen and phosphorus), inappropriate fertilizer application, leaching of soil minerals, and bush burning. It has been the major cause of the low yield of maize in the guinea savanna agroecology of Ghana [13]. The average maize grain yield is approximately 1.7 tons/ha as against an estimated achievable yield of approximately 6.0 tons/ha [14] as a result of low nitrogen and phosphorus levels in the soil, inappropriate fertilizer application, drought, and *Striga* infestation [15]. Nitrogen is an essential part of chlorophyll [16] and also forms a significant unit of many enzymes, nucleic acids, and proteins. Therefore, the deficiency or overapplication of nitrogen affects maize yields negatively [17]. An optimal nitrogen application enhances the protein content aside from the resultant significant increase in the yield of the maize crops [18]. Nitrogen deficiency stems from low crop development, which reduces the crop yield, leaf area, leaf number, and photosynthetic rate. To boost the productivity of the maize crop, various nitrogen fertilizer application regimes need to be critically examined to determine the optimum N application rate for increased maize grain production. The objective of the study was to examine the varietal response of maize to different nitrogen fertilizer application rates.

2. Materials and Methods

2.1. Experimental Area. The studies were conducted at Nyankpala in the Northern Region of Ghana during the 2016 and 2017 cropping seasons. The experimental site has tree and weed species, such as Neem tree (*Azadirachta indica*), Shea tree (*Vitellaria paradoxa*), Dawadawa tree (*Parkia biglobosa*), Teak (*Tectona grandis*), Broom weed (*Sida acuta*), Spear grass (*Imperata cylindrica*), Pigweed (*Boehavia diffusa*), and *Andropogon gayanus* [19]. The soil in the area is of the Nyankpala series and is mainly made up of sand and loam. Rainfall, temperature, and relative humidity distribution in the area during the field studies were as shown in Tables 1–3. The rainfall, temperature, and relative humidity data were taken at the agrometeorological station of the CSIR-Savanna Agricultural Research Institute.

2.2. Soil Analysis. Before planting, the soil samples were arbitrarily collected from four different cores from 0 cm to 15 cm for the determination of soil physical and chemical properties using a soil auger. The results from soil analysis indicated that the soils at the experimental site were largely Sandy loam and classified as Ferric Acrisol, equivalent to

Typic Haplustult in the USDA soil classification system. The soil pH was 6.5 with very low nitrogen and organic matter content. The result of the initial soil analysis is presented in Table 4.

2.3. Land Preparation, Planting, and Experimental Design. The experiments were conducted at the experimental field of the CSIR-Savanna Agricultural Research Institute (SARI) at Nyankplala in the Northern Region of Ghana. In each of the experimental year, the land was prepared by ploughing, after which all debris was removed. Land demarcation was done using lining and pegs. The prepared land was leveled using a hoe before the seeds of the genotypes were planted. Six maize varieties obtained from the Savanna Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR) were screened under four nitrogen fertilizer application rates for improved grain yield, yield components, and other growth/agronomic characteristics during the 2016 and 2017 cropping seasons under field experimental conditions. The treatment consisted of two factors, namely six varieties of maize and four levels of nitrogen application rates.

The six varieties used for the study were TZE-W-DT-STR-C4, IWD-C3-SYN-F2, GH120 DYF/D POP, OBA-TAMPA, DT-STR-W-C2, and COMP 1 SYN. The four nitrogen rates used for the study were 0 kg N/ha, 60 kg N/ha, 90 kg N/ha, and 120 kg N/ha. These were arranged in 6 × 4 factorial combinations and laid out using randomized complete block design (RCBD) with three replications. The control plants (0 kg/ha N) did not receive nitrogen fertilizer. The furrows between the blocks/replications were 1.5 m, while a 1 m space was left in between the plots. A plot size of 6 m × 4 m was used with a planting distance of 75 cm × 40 cm. Planting was done in July 2016 and 2017. Three seeds per hill were planted and later thinned out to two per hill after germination. The plant populations for all plots were 66,666 plants/ha.

2.4. Cultural Practices. Four nitrogen fertilizer regimes were applied (0 kg N/ha, 60 kg N/ha, 90 kg N/ha, and 120 kg N/ha). The side placement method of fertilizer application was employed in a split application. Basal fertilizer (NPK 15-15-15) was applied at 2 weeks after planting at the rate of 0 and 45 kg NPK ha⁻¹. The plants were top-dressed with additional N using urea at the rate of 0, 15, 45, and 75 kg N ha⁻¹ at 4 weeks after planting. Pre-emergence chemical weed control was done. An application of a combination of pendimethalin [N-(1-ethyl propyl)-3,4-dimethyl-2,6-dinitrobenzenamine] and Gesaprim [2-chloro-4-(methylamino)-6-(isopropylamino)-5-triazine] at a rate of 1.51 ha⁻¹ and 1.01 ha⁻¹ were used at planting. Where there was heavy weed growth before planting, paraquat (1,1-dimethyl-4,4-bipyridinium ion) was also applied at 1.01 ha⁻¹ in addition to pendimethalin and gesaprim. Hand weeding was also carried out to keep the experimental field free of weeds 4 weeks after planting.

TABLE 1: Total rainfall and its distribution during the experimental period.

Rainfall (ml)	2016		2017	
	Total rainfall (ml)	No. of rain days	Total rainfall (ml)	No. of rain days
May	45.6	5	38.4	4
June	166.0	8	68.9	5
July	122.9	10	146.4	12
August	240.0	15	180.5	15
September	195.6	20	227.5	16
October	153.1	11	124.3	8
November	0	0	7.6	1
December	0	0	0	0
TOTAL	923.2	69	793.6	61
MEAN	115.4	8.6	99.2	7.6

Source: SARI Agrometeorological station reports, 2015.

TABLE 2: Temperature distribution during the experimental period.

Temperature (°C)	2016			2017		
	Min.	Max.	Mean	Min.	Max.	Mean
May	26.8	35.5	31.2	25.9	35.5	30.7
June	25.6	33.2	29.4	25.3	34.3	29.8
July	24.9	30.9	27.9	24.2	30.7	27.5
August	23.3	30.4	26.9	24.0	29.8	30.8
September	23.1	30.5	26.8	24.0	27.5	27.4
October	23.5	32.7	28.1	24.5	32.5	28.5
November	24.3	35.6	30.0	23.2	35.7	29.5
December	20.7	35.8	28.4	18.6	34.2	26.4
TOTAL	192.2	264.6	228.7	189.7	260.2	230.6
MEAN	24.0	33.0	28.5	23.7	32.5	28.8

Source: SARI Agrometeorological station reports, 2015.

TABLE 3: Relative humidity distribution during the experimental period.

Relative humidity (RH %)	2015			2016			2017		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
May	60	83	73	56	83	70	67	85	76
June	68	89	79	64	88	70	48	94	69
July	75	93	84	71	91	81	56	94	75
August	75	93	84	73	93	83	64	96	80
September	74	89	79	75	93	84	72	94	83
October	68	90	79	68	90	79	67	93	80
November	53	82	68	54	82	68	39	74	57
December	52	68	60	38	56	44	37	57	44
TOTAL	525	687	606	499	676	579	450	687	564
MEAN	65.6	85.8	75.7	62.3	84.5	72.3	56.2	85.8	70.5

Source: SARI Agrometeorological station reports, 2015.

TABLE 4: Physicochemical characteristic of the soil at horizon 0–15 cm at Nyankpala

Parameters	Value	Remarks
Texture	Sandy loam	
pH	6.50	Mod. Acidic
Organic matter (OC)	1.9	Low
Total phosphorus (P) (mgkg ⁻¹)	1.80	Very low
Organic carbon (gkg ⁻¹)	1.58	Very low
Total nitrogen (N) (gkg ⁻¹)	0.65	Very low
Exchangeable potassium (K) (cmol.kg ⁻¹)	0.65	Low

Source: Reproduced from Bawa, 2020; DOI: 10.9734/jeai/2020/v42i230475

2.5. Data Collection and Analysis. During the 2016 and 2017 cropping seasons, the data on chlorophyll content, number of leaves, plant height, days to 50% tasselling, days to 50% silking, days to 50% physiological maturity, hundred seeds weight, total biomass production, number of grains per cob, and total grain yield were recorded and subjected to a combined analysis for variation in the factorial experiments in RCBD using Genstat statistical package edition 18. The means were separated using Duncan's multiple range test at a 5% probability level.

3. Results

3.1. Effect of Variety on Growth Parameters

3.1.1. Leaf, Shoot, and Biomass Production. The data for the two seasons were combined and analyzed, and the results indicated that the variety GH120 DYF/D POP produced the lowest number of 11 leaves, while OBATAMPA produced the highest number of 14 leaves (Table 5). There were significant differences ($p < 0.05$) between OBATAMPA and GH120 DYF/D POP with respect to leaf production (Table 6). COMP 1 SYN recorded the highest plant height of 181 cm whilst TZE-W-DT-STR-C4 recorded the least plant height of 121 cm. There was a significant difference ($p < 0.05$) between COMP 1 SYN and TZE-W-DT-STR-C4 for shoot production. The total biomass production was the highest in OBATAMPA (13,500 kg/ha). However, this was not significantly different ($p > 0.05$) from that of COMP 1 SYN, which recorded a biomass of 13,000 kg/ha.

3.1.2. Silk Production and Physiological Maturity. The variety COMP 1 SYN took a maximum of 68 days for silk production whilst DT-STR-W-C2 took a minimum of 59 days to produce silk (Table 5). There was a significant difference ($p < 0.05$) in terms of the number of days for silk production between the varieties COMP 1 SYN and DT-STR-W-C2 (Table 6). COMP 1 SYN took a maximum of 93 days to attain physiological maturity, and this was significantly different from all the other five varieties with respect to days to physiological maturity.

3.2. Effect of Variety on Grain Yield and 100-Grain Weight. OBATAMPA recorded the highest grain yield of 3.6 tons/ha under all N application rates (Table 5). The yield was, however, not significantly different ($p > 0.05$) from that of IWD-C3-SYN-F2 (3.5 tons/ha) (Table 6). The variety GH120 DYF/D POP produced the lowest grain yield of 2.5 tons/ha. For grain weight, OBATAMPA recorded the highest of 45 g, however, this was not significantly different ($p > 0.05$) from that of IWD-C3-SYN-F2 (39 g) and TZE-W-DT-STR-C4 (39 g).

3.3. Effect of Nitrogen Rate on Growth Parameters

3.3.1. Leaf, Shoot, And Biomass Production. All the varieties applied with 90 kg/ha N recorded an average of 13 leaves, whilst the varieties applied with 0 kg/ha N recorded the

lowest of 10 leaves (Figure 1). There were no significant differences ($p > 0.05$) between the 90 kg/ha N application rate and the other application rates (60 and 120 kg/ha N) with respect to leaf production (Table 6).

The control plants applied with 0 kg/ha N recorded the lowest biomass yield of 7500 kg/ha, whilst the varieties applied with 120 kg/ha N recorded the highest biomass yield (15,000 kg/ha) (Figure 2). There were significant differences ($p < 0.05$) between the plants applied with 120 kg/ha N rate and 0 and 60 kg/ha N rate (Table 6) with respect to biomass production. However, the biomass production was significantly similar among the plants applied with 120 and 90 kg/ha N.

3.3.2. Silk Production and Physiological Maturity. The control plants applied with 0 kg/ha N recorded the highest number of days (65 days) for 50% silking, whilst the varieties applied with 120 kg/ha N recorded the lowest of 58 days for silking (Figure 3). There were significant differences ($p < 0.05$) between the plants applied with 120 kg/ha N application rate and those applied with 0, 60, and 90 kg/ha N application rates with respect to the days to silk production (Table 6). The varieties applied with 90 kg/ha N took a maximum of 85 days to attain physiological maturity. However, this was not significantly different ($p > 0.05$) from the days taken to attain physiological maturity by the plants applied with N rates of 0 and 120 kg/ha (Figure 4).

3.4. Effect of Nitrogen Rate on Yield and Yield Components

3.4.1. Grain Production per Cob. All the varieties applied with 120 kg/ha N recorded a maximum of 500 grains per cob, whilst the varieties applied with 0 kg/ha N recorded a minimum of 310 grains per cob (Figure 5). There were no significant differences ($p > 0.05$) between the 120 kg/ha N application rate and the other application rates of 60 and 90 kg/ha N with respect to grain production per cob (Table 6).

3.4.2. Grain Yield. The plants applied with 120 kg/ha N recorded the highest grain yield of 4 tons/ha, whilst the control plants applied with 0 kg/ha N recorded the lowest grain yield of 1.3 tons/ha (Figure 6). There were, however, no significant differences ($p > 0.05$) between the 120 kg/ha N and 90 kg/ha N application rates with respect to grain production (Table 6).

4. Discussion

From the study, the varieties applied with 90 kg/ha N were not significantly different from 0 to 120 kg/ha with respect to the days taken to attain physiological maturity. It might occur as a result of the ineffective utilization of nitrogen by the plants that received 120 kg/ha N. The erratic rainfall distribution and the amount of rainfall could have considerably influenced the response of maize to nitrogen application. It is because the rain might have caused the runoff and leaching of applied nitrogen.

TABLE 5: Effect of variety on yield and growth parameters measured during the 2016 and 2017 cropping seasons.

Variety	Growth and yield parameters						
	Number of leaves	Plant height (cm)	Days to 50% silking	Days to 50% physiological maturity	Total biomass (in 1000 kg/ha)	100-Grain weight (g)	Grain yield (ton/ha)
TZE-W-DT-STR-C4	13 ^{ab}	121 ^d	60 ^{cd}	83 ^d	11 ^{ab}	39 ^{ab}	2.8 ^{ab}
IWD-C3-SYN-F2	12 ^{abc}	131 ^c	65 ^b	90 ^b	13.5 ^a	39 ^{ab}	3.5 ^a
GH120 DYF/D POP	11 ^c	161 ^b	60 ^{cd}	83 ^d	8 ^b	31 ^c	2.5 ^b
OBATAMPA	14 ^a	158 ^b	66 ^{ab}	88 ^c	13.5 ^a	45 ^a	3.6 ^a
DT-STR-W-C2	12 ^{abc}	130 ^c	59 ^d	83 ^d	11 ^{ab}	36 ^{bc}	2.7 ^{ab}
COMP 1 SYN	12 ^{abc}	181 ^a	68 ^a	93 ^a	13 ^a	38 ^b	2.9 ^{ab}
Mean	12.1	147	62.9	86.1	11.7	38	2.9
SEM	1	2	2	2	1	1	1

SEM means standard error of the mean.

TABLE 6: Analysis of variance for yield and yield components as influenced by varietal, N rates, and interaction effects in the 2016 and 2017 cropping seasons.

Source of variation	df	Number of leaves	Plant height (cm)	Days to 50% silking	F probability (0.05)			
					Days to 50% physiological maturity	Total biomass (kg/ha)	100-Grain weight (g)	Grain yield (ton/ha)
Fertilizer rate (N)	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Variety (V)	5	0.042	0.000	0.000	0.000	0.002	0.000	0.009
N xV	23	0.253	0.240	0.348	0.224	0.360	0.439	0.472
Residual	40							
Total	71							
SE		1	2	2	2	1	1	1
CV (%)		14.13	15.20	45.60	33.51	6.22	10.12	28.84

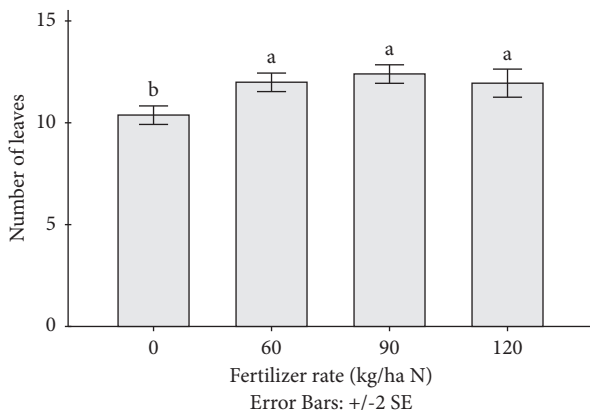


FIGURE 1: Effect of N rate on the number of leaves of maize grown under four fertilizer rates. Bars represent the standard error of mean.

Maize nitrogen use efficiency is estimated globally to be 33% because of the loss of N fertilizer from leaching below the root zone, denitrification, and soil- and plant-derived volatilization [20]. The inherent genetic factors could have also caused the uniformity of days to attain physiological maturity among the maize varieties. This observation confirms the findings of [21], who reported that maize varieties have a specific growth cycle. Chouhan et al. [22] also mentioned that genetic variability in growth and

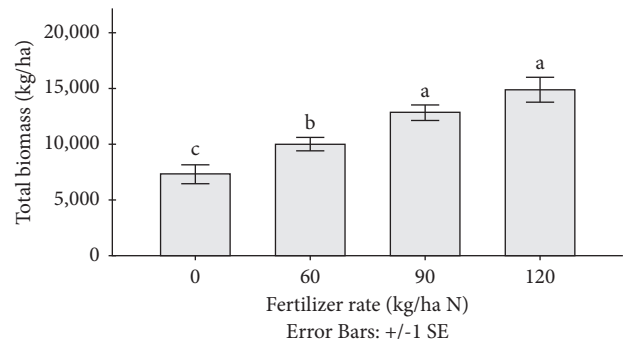


FIGURE 2: Effect of N rate on the biomass production of maize grown under four fertilizer rates. Bars represent the standard error of mean.

development exists among different maize cultivars, contributing to the differences in the observed days to 50% physiological maturity.

Silking and physiological maturity were earlier among DT-STR-W-C2, TZE-W-DT-STR-C4, and GH120 DYF/D POP but delayed among Comp 1 SYN and OBATAMPA for all nitrogen application rates. It is possible that DT-STR-W-C2, TZE-W-DT-STR-C4, and GH120 DYF/D POP had a relatively high nitrogen use efficiency relative to the other varieties, resulting in an earlier production of silk. This result is supported by that of Khan et al. [23] but contravenes that

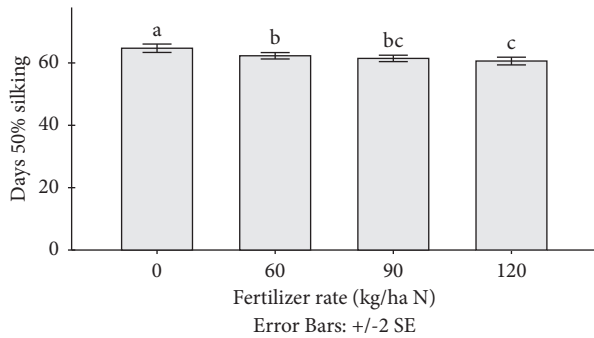


FIGURE 3: Effect of N rate on the days to 50% silking of maize grown under four fertilizer rates. Bars represent the standard error of mean.

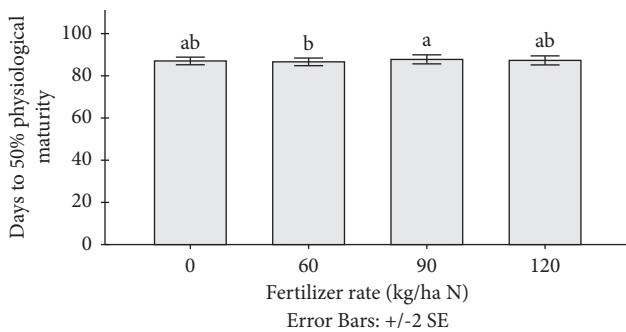


FIGURE 4: Effect of N rate on the days to 50% physiological maturity of maize grown under four fertilizer rates. Bars represent the standard error of mean.

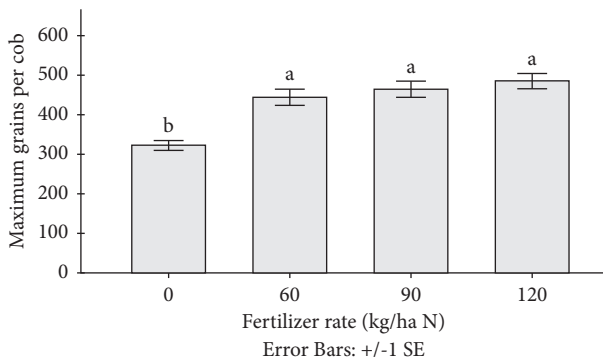


FIGURE 5: Effect of N rate on the maximum grain production per cob of maize varieties grown under four fertilizer rates. Bars represent the standard error of the mean.

of Hassan et al. [24], who revealed that maize cultivars had significant differences in the days to 50% silking and physiological maturity. The variation in maturity periods could be a result of genetic and environmental factors.

The studies of [25] and Bationo et al. [26] revealed that the growth, development, and maturity of maize are directly related to the number of nutrients that are made available to the plant during its growth period. Air-dried grain yield was the highest among OBATAMPA and IWD-C3-SYN-F2 but lowest among GH120 DYF/D POP. The observed increase in

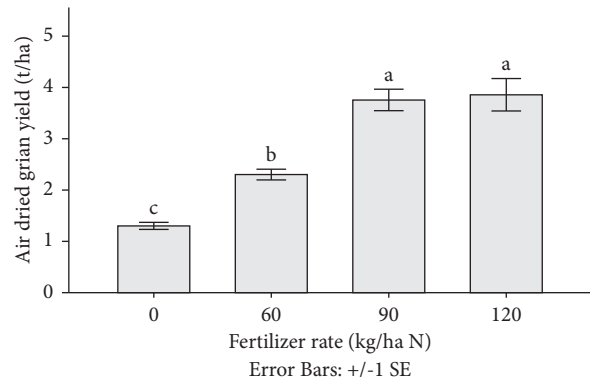


FIGURE 6: Effect of N rate on the grain yield of maize grown under four fertilizer rates. Bars represent the standard error of the mean.

yield with increasing N rates is in agreement with the finding of Singh et al. [27], who observed that a moderate absorption of nitrogen by the maize plants tends to increase its net returns. The differences in the yield of different varieties may be attributed to the existence of differences in the cultivars in terms of their reactions to external factors and utilization of soil and water resources, which also have a significant effect on the yield and other agromorphological parameters [28].

Reference [29] observed the genetic variability in the growth and development among different cultivars of maize. The highest number of leaves was recorded by OBATAMPA, however, it was not significantly different from that of TZE-W-DT-STR-C4. It may be attributed to the inherent ability of these varieties to generate more leaves. However, GH120 DYF/D POP produced the least number of leaves. The variation in leaf production could have been because of the differences in response to different rates of N application. The variation in leaf appearance could also be a result of the crop's inherent ability to efficiently utilize soil resources.

Reference [30] also reported that increasing the nitrogen fertilizer rate from 0 kg N/ha to 250 kg N/ha significantly increased leaf production in the maize plants. IWD-C3-SYN-F2 and OBATAMPA produced the highest biomass, however, it was not statistically different ($p > 0.05$) from that of COMP 1 SYN. The lowest biomass production was recorded by GH120 DYF/D POP. Reference [31] observed a significant disparity in the genotypes with respect to biomass production. The insignificant differences in the maximum grains per cob of the varieties are in contrast to the findings of Akmal et al. [31, 32], who observed significant differences in varieties with respect to the yield and other agromorphological traits. Generally, all treatments at $N > 0$ kg/ha significantly produced more grains per cob than the control. The findings are partly in agreement with those of Maqsood et al. [33] and Sharar et al. [34], who observed that the number of grains per cob varied with different varieties.

In general, it was observed from the field data that the grain yield and yield components produced are related to the variation in N rates. All the varieties applied with 120 kg/ha N recorded a relatively higher grain yield and several grains per cob as compared to the yields produced at 0, 60, and 90 kg/ha N. [35] reported that increasing the N levels

significantly increased the grain yield, days to 50% silk emergence, percent grain moisture content at harvest, and 1000-seed weight, however, it negatively impacted the ear acceptability rating and percent total lodging. Nitrogen is a vital plant nutrient and a major yield-determining factor required for maize production [36].

Reference [37] reported that the nitrogen fertilizer levels are significant for grain yield, days to mid-silking, days to mid-anthesis, anthesis-silking interval, plant height, ear height, open tip, cob aspects, dry stover weight, cob length, and grain depth at nitrogen levels of 0, 45, and 90 kg N/ha. It may be because of adequate nitrogen in combination with P and K, which greatly influenced the vegetative growth of the plant. The observed trend in cob weight confirms the results of [28], who observed significant differences in the cob weight among different genotypes at different N rates. Differences arise as a result of the difference in the genetic composition of the cultivars that also influence their responses to the external environment. On the contrary, Akmal et al. [32] observed no significant differences in cob weight for different varieties. Different N levels also produced significant differences in the empty cob weight. The results are supported by the findings of Hassan et al. [24], who reported that the grains per cob increased with the increasing levels of NPK fertilizers. The highest number of grains per cob was recorded at 120 kg/ha N across all the six genotypes used in the study.

5. Conclusion and Recommendations

The study was conducted to examine the varietal response of maize to different nitrogen fertilizer application rates. From the results and discussion of the experiment, the following conclusions were deduced:

The varieties OBATAMPA and IWD-C3-SYN-F2 produced the best results with respect to grain yield, total biomass, leaf, and shoot production. All the varieties applied with 120 and 90 kg/ha N recorded relatively higher grain yield and growth parameters as compared to 0 and 60 kg/ha N.

The cultivation of OBATAMPA and IWD-C3-SYN-F2 will result in an increased grain yield. The application of 90 kg/ha N will also result in increased grain production.

Data Availability

The data used to generate the results in this manuscript is not available.

Additional Points

This study discovered that the type of maize variety and nitrogen fertilizer rate used by the farmers for production influence the maize grain yield in the Savannah Agroecology of Ghana. The use of low-yielding varieties, coupled with an inappropriate nitrogen application rate is the major cause of the continuous low yield of maize in Northern Ghana. Through this study, the researcher had discovered that the use of varieties, such as OBATAMPA and IWD-C3-SYN-F2,

and the application of 90 kg ha⁻¹ N will result in increased maize productivity in Northern Ghana.

Conflicts of Interest

The author has declared no conflicts of interest.

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