



INFLUENCE OF ORGANIC MANURE SOURCES AND UREA DEEP PLACEMENT ON THE PRODUCTION OF MAIZE (*Zea mays* L.) IN BAUCHI STATE, NIGERIA

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ABSTRACT

Field experiment was conducted at Bauchi state College of Agriculture, Bauchi during the rainy seasons of 2021 and 2022 to determine the influence of organic manure sources and urea deep placement on the production of maize in Bauchi State, Nigeria. The treatments consisted of four different organic manure (0 t/ha, 5 t/ha Poultry manure, 5 t/ha Cow dung, and 5 t/ha Rice husk) and three urea levels (0, 60, and 120 kg/ha), these were factorially arranged to give 12 treatments combination and laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on plant height, number of leaves, leaf area, stem girth, cob length, cob girth, 100 grain weight and grain yield. All data collected were subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT). The results obtained showed that, urea deep placement and organic manure had a positive effect on the growth and yield of maize. The result further revealed a significant ($P \leq 0.05$) difference among the treatments used. The result showed that, deep placement of 120 kg N/ha proved to be significantly ($P \leq 0.05$) better than the other rates in all the parameters observed. Organic manure on the other hand, application of 5 t/ha poultry performed significantly ($P \leq 0.05$) better than the other organic sources used throughout the study period. Results of the interaction revealed that, combine application of urea deep placement at 60 kg/ha with 5 t/ha poultry manure produced statistically ($P \leq 0.05$) higher growth and yield characters of maize. Urea deep placement application in combination with organic manure gave significantly higher yield than separate application and control. Based on the results of this findings, urea deep placement application at the rate of 60 kg/ha in combination with 5 t/ha poultry manure can be used in maize production to achieve higher productivity in the study area.

Keywords: Maize, Poultry manure, Cowdung, Urea.

INTRODUCTION

The cereal plant known as maize (*Zea mays* L.), sometimes referred to as corn, is produced extensively worldwide for its edible grain. Many nations consider it a staple food. The savannas of west and central Africa, Latin America, and some parts of Asia have one of the greatest potentials for maize production due to their relatively higher incidence of solar radiation and lower incidence of pests and disease during the cropping season (Badu-Apraku *et al.*, 2009). It is a significant cereal crop grown in Nigeria's Savannah zones (Ajala *et al.*, 2017). Maize is a key component of chicken feed and a staple food for a significant portion of Nigeria's population. In recent years, Nigeria's maize output has switched from subsistence farming to commercial agriculture (Ndaghu *et al.*, 2015) 1,112.01 million Metric tons of maize were produced worldwide, with 90 million metric tons going to Africa and 11 million metric tons going to Nigeria (FAO, 2021). 75% of Nigeria's maize is produced in the northern Guinea savanna and Sudan, with the remaining 25% coming from the humid forest (Ado, 2012).



According to Ajala *et al.* (2000), Nigeria produces 43% of the maize cultivated in West Africa. The northern Guinea savanna took up about 92% of Nigeria's total land used for maize cultivation alone. In emerging nations, notably those in sub-Saharan Africa, where populations are expanding quickly and white maize is a significant staple for many nations, maize for human consumption will mostly increase (OECD-FAO 2022). Hay, or silage, is made from the stalk and leaves. According to Badu-Apraku *et al.* (2009), the shell, cod, and stalk are used as sources of fuel. It is a significant part of animal feed and is tasty to pigs, cattle, and poultry. To address these difficulties and ensure Nigeria's self-sufficiency in maize, it is crucial to improve farming practices and provide farmers with better access to money and resources. Consistent use of organic fertilizer increases soil organic matter and water holding capacity. Improved soil structure, nutrient cycling, and assistance with maintaining soil nutrients specific exchange capability and biological activity in the soil (Shuaibu, *et al.*, 2022). According to Kidinda *et al.* (2015), organic manure is used to increase soil fertility, arrangement, and nutrient content, all of which support healthy plant growth and yields. Nitrogen, phosphorus, and potassium, plus micronutrients like calcium, magnesium, and sulfur, are vital plant nutrients that are abundant in organic manure. Furthermore, according to Adeyolanu *et al.* (2015), organic matter enhances soil aeration, water-holding capacity, and structure. Urea as a source of nitrogen has been shown to interact favorably with organic manure in the soil (McRoberts *et al.*, 2018).

Maintenance of the physical integrity of the soil and replenishing nutrients lost by the crop from the soil are key components of a sustainable agricultural production system (Gruhn *et al.*, 2000). This can be done by applying both mineral and organic fertilizer. Mineral fertilizers have been a crucial component in increasing crop productivity, but excessive dependence on them is linked to a gradual deterioration of key soil characteristics and crop yield. The effect of urea fertilizer on maize growth and production, however, might differ based on a number of variables, including soil characteristics, climate, application rate, and timing. As a result, combining the use of organic and mineral fertilizer is a practical strategy for optimizing nutrient uptake, which increases the effectiveness of the mineral fertilizer while lowering nutrient losses. Integrated nutrient management systems that completely use the supply of nutrients from both organic and inorganic sources are the focus of recent developments in the management of soil fertility and plant nutrient supply (Singina and Woome, 2009). This study is therefore carried out to determine the effect of organic manure sources and urea fertilizer deep placement on the production of maize in Bauchi.

MATERIALS AND METHOD

The field experiments were carried out during the cropping seasons of 2021 and 2022 at Bauchi State College of Agriculture to study the influence of organic manure sources and urea deep placement on the production of maize. The treatments consisted of four organic manure (0 t/ha, 5 t/ha poultry manure, 5 t/ha Cow dung, and 5 t/ha rice husk) and three urea levels (0, 60, and 120 kg/ha), these were factorially combined to give 12 treatment combinations and laid out in a Randomized Complete Block Design (RCBD) with three replications. During the land preparation, cow dung, poultry manure, and rice husk were incorporated in to the soil two weeks before sowing, while urea fertilizer was applied in two divided doses at two and four weeks after planting using deep placement method. Data were collected at bi-weekly interval from five randomly tagged plants on the following parameters; plant height, number of leaves, leaf area, cob length, cob girth, 100 grain weight and grain yield. All data collected were subjected to Analysis of Variance (ANOVA) using SPSS version



21 and significantly different treatment means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Plant Height (cm)

Results on the application of organic manure sources and urea deep placement on plant height are presented in Table 1. The result revealed that the plants were significantly ($P \leq 0.05$) taller in 2021 than in 2022 cropping season. This might be due to better weather condition in 2021 cropping season as oppose 2022 growing season. The result further indicated that, except at 2 and 6 weeks after sowing (WAS) where no significant ($P \leq 0.05$) difference was observed, application of 60 and 120 kg N/ha through deep placement produced statistically ($P \leq 0.05$) similar result, but were significantly ($P \leq 0.05$) better than the control. Organic manure on the other hand, except at 10 WAS where poultry manure proved to be significantly ($P \leq 0.05$) better, all the three organic sources were statistically ($P \leq 0.05$) similar but better than the control in promoting plant height of maize throughout the study period.

The significant increase in plant height with respect to urea fertilizer application up 120kg ha^{-1} might be due to sufficient supply of nutrients. This is in agreement with the results obtained by Ayub *et al.* (2002) who observed that growth parameters were influenced by application of higher doses of nitrogen. It is also in conformity with the findings of Li *et al.* (2022) who reveal that use of urea fertilizer has a good effect on various growth parameters and ultimately result in greater maize yield. Similarly, Sarkin *et al.*, (2019) reported that, increment of fertilizer from 0 to 120 kg/ha had a significant influence on grain yield of maize. Organic manure on the other hand showed that, all three organic sources were significantly ($P \leq 0.05$) better than the control in promoting plant height of maize (Table 1). Poultry manure produced the tallest plants; this might be due to high N content in poultry manure. This agrees with the finding of Fiyyaz *et al.* (2021) who reported that application of poultry manure improves growth characteristics of maize. Similarly, it has been shown that poultry manure helps increases soil N content by more than 53%, this in turn, improves the soil fertility and crop production of maize (Tofiq *et al.*, 2022).

The taller plants observed when 60kg ha^{-1} urea fertilizer was combined with poultry manure could be attributed to increased nutrient use efficiency. It can also be said that application of urea fertilizer complimented with poultry manure aided mineralization of nutrients in poultry manure due to enhanced supply of nutrients, leading to better growth of maize. This study agrees with the findings of Bitew *et al.* (2019) who reported that growth and production of maize have been seen to increase from the combination of urea fertilizer and poultry manure. The result of this study also lend support from the findings of Abbasi *et al.* (2012) who reported a better performance of maize with the application of urea fertilizer and poultry manure. Similarly, Adekiya *et al.* (2020) reported that a combination of urea fertilizer with Poultry manure showed a highest growth and yield parameters of maize.

Table 1: Effects of urea deep placement and organic nutrient sources on plant height of maize

Treatment	Weeks after Sowing				
	2	4	6	8	10
Urea Fertilizer					
Control	24.80	64.68 ^b	96.82	125.13 ^c	119.35 ^b
60	24.41	72.68 ^a	107.42	144.53 ^b	142.24 ^a
120	23.81	71.33 ^a	109.30	155.25 ^a	144.25 ^a
LS	NS	**	NS	**	**
SE±	0.48	1.65	4.03	2.97	2.67
Organic manure					
Control	22.32 ^b	56.34 ^c	89.26 ^b	118.28 ^c	116.98 ^c
CD	24.76 ^a	64.44 ^b	99.48 ^{ab}	136.06 ^b	130.64 ^b
PM	25.32 ^a	77.55 ^a	114.78 ^a	165.68 ^a	154.03 ^a
RH	24.96 ^a	79.92 ^a	114.53 ^a	146.53 ^b	139.46 ^b
LS	**	**	**	**	**
SE±	0.56	1.91	4.65	3.43	3.05
Year					
2021	26.31 ^a	73.17 ^a	109.53 ^a	142.27	138.23
2022	22.36 ^b	65.96 ^b	99.49 ^b	141.01	132.33
LS	**	**	*	NS	NS
SE±	0.39	1.35	3.29	2.43	2.18
Interaction					
OM*year	NS	NS	NS	NS	NS
UF*year	NS	NS	NS	NS	NS
OM*UF	NS	*	NS	*	**
OM*UF*year	NS	NS	NS	NS	NS

Means followed by the same letter are statistically similar by DMRT, LS = Level of significance, NS = Not significant, * & ** = significant @ 0.05 & 0.01 probability level.

Key: CD= Cow dung, PM= Poultry manure, RH= Rice husk, OM= Organic manure, UF= Urea fertilizer,

Number of Leaves

The result of the application of organic manure sources and urea deep placement on number of leaves is presented in Table 2. The result revealed a significant difference among the treatments used throughout the study period. The result further indicated that, except at 10 WAS where 2021 cropping season significantly produced more leaves than 2022, 2022 cropping season produced statistically ($P \leq 0.05$) highest number of leaves throughout the study period. The result also indicated that, except at 2 and 4 weeks after sowing where no significant ($P \leq 0.05$) difference was observed, application of 60 and 120kgN/ha through deep placement produced statistically ($P \leq 0.05$) similar result but were significantly ($P \leq 0.05$) better than the control throughout the study period. The significant increase in number of leaves with the application of 60 and 120 kg N/ha over the control could be due to sufficient supply of nutrients. This agrees with the report of Krismawati, (2020) who reported that applying more nitrogen fertilizer with different application rates can boost soil fertility and productivity. This conforms

to the work of Li *et al.* (2022) who revealed that use of urea fertilizer has a good effect on various growth parameters and ultimately result in greater maize yield. Also, Abubakar *et al.* (2019) reported that application of nitrogen affected growth metrics such as plant height, number of leaves per plant, stem diameter, leaf area per plant, green fodder yield, dry matter yield, and dry matter percentage.

Organic manure on the other hand, poultry manure produced the highest mean number of leaves, this might be possible because poultry manure helps increases soil N content. This agrees with the findings of Asfaw, (2022) who reported a significant increase in growth parameters and yield of maize when poultry manure was used as N source. More so, leaf production and leaf retention can be influenced by growing conditions and season (Oyun, 2008).

Table 2: Effects of urea deep placement and organic nutrient sources on number of leaves of maize

Treatment	Weeks after sowing				
	2	4	6	8	10
Urea Fertilizer					
0	4.67	7.25	8.25 ^b	10.03 ^b	13.21 ^b
60	4.67	7.54	9.25 ^a	11.08 ^a	14.38 ^a
120	4.71	7.58	9.17 ^a	11.25 ^a	14.33 ^a
SE±	0.11	0.15	0.16	0.13	0.22
LS	NS	NS	**	***	***
Organic manure					
0	4.667	6.72 ^b	8.00 ^c	9.87 ^b	12.94 ^c
CD	4.722	7.06 ^b	8.72 ^b	10.39 ^b	13.66 ^{bc}
PM	4.778	8.11 ^a	9.56 ^a	11.61 ^a	14.83 ^a
RH	4.556	7.94 ^a	9.28 ^a	11.28 ^a	14.44 ^{ab}
SE±	0.12	0.17	0.18	0.15	0.26
LS	NS	**	***	***	***
Year					
2021	4.64	7.22 ^b	8.61 ^b	10.60 ^b	14.53 ^a
2022	4.72	7.69 ^a	9.17 ^a	10.97 ^a	13.42 ^b
SE±	0.09	0.12	0.13	0.11	0.18
LS	NS	**	**	*	***
Interaction					
OM*year	NS	NS	NS	NS	NS
UF*year	NS	NS	NS	NS	NS
OM*UF	NS	NS	NS	NS	NS
OM*UF*year	NS	NS	NS	NS	NS

Means followed by the same letter are statistically similar by DMRT, LS = Level of significance NS = Not significant, *, **, & *** = significant @ 0.05, 0.01 & 0.001 probability level.

Key: CD=Cow dung, PM= Poultry manure, RH= Rice husk, OM= Organic manure, UF= Urea fertilizer

Leaf Area

Result of the application of organic manure sources and urea fertilizer rate on leaf area is presented in Table 3. The result revealed a significant difference among the treatments used throughout the study period. The result further indicated that, except at 4 WAS where no significant ($P \leq 0.05$) difference was observed, application of 60 and 120 kg N/ha through deep placement produced statistically ($P \leq 0.05$) similar result but significantly ($P \leq 0.05$) better than the control. In terms of organic sources, except at 10 WAS where poultry produced significantly ($P \leq 0.05$) wider leaves than the other sources, poultry manure and rice husk consistently produced statistically ($P \leq 0.05$) similar leaf area but significantly ($P \leq 0.05$) better than the other sources throughout the study period. Year of study on the other hand, 2021 produced significantly ($P \leq 0.05$) wider leaves than 2022.

The significant increase in leaf area with respect to urea fertilizer application up 120 kg N/ha might be due to sufficient supply of nutrients. This is in conformity with the results obtained by Ayub *et al.* (2002) who observed that growth parameters were influenced by application of higher doses of nitrogen and Sarkin *et al.*, (2019) who reported that application of N fertilizer increased the assimilatory leaf area and the photosynthetic productivity.

Organic matter on the other hand, poultry manure produced the highest mean leaf area; this is possibly because of delivery of crucial macro and micronutrients in high content. This agrees with the finding of Belbase and Bc, 2020 who reported that poultry manure helps in delivering crucial macronutrients like nitrogen, phosphorus, and potassium as well as micronutrients like calcium, magnesium, sulfur, and zinc, chicken manure's high nutrient content can further enhance maize development and yield. This is also in conformity with the findings of Boateng *et al.* (2006) who revealed that poultry manure application increases soil N by more than 53%, while exchangeable cations are also increased significantly upon application. Studies on year revealed that 2021 produced statistically ($P \leq 0.05$) highest leaf area than 2022. This could be due to better climatic condition observed in 2021 than 2022. This agrees with the findings of Abedi *et al.* (2010) who also reported a similar trend. The higher leaf area observed following the combination of urea fertilizer and poultry manure is attributed to increased nutrient use efficiency. It can also be said that application of urea fertilizer with poultry manure aided mineralization of nutrients in poultry manure due to enhanced supply of nutrients, leading to better growth of maize. This study agrees with the findings (Sivaranjani *et al.*, 2018) who reported that the application of urea with organic manure can be a successful strategy for boosting soil fertility and maize yields. Abbasi *et al.* (2018) also reported better performance of maize at the application of urea fertilizer and poultry manure. Similarly, Vasanthi and Kumaraswamy (2000) reported that poultry manure plus one-half the recommended inorganic fertilizer rate yielded a much greater amount of green fodder from corn.

Table 3: Effects of urea deep placement and organic nutrient sources on leaf area of maize

Treatment	Weeks after Sowing				
	2	4	6	8	10
Urea Fertilizer					
0	26.02 ^b	165.10	295.80 ^b	472.60 ^b	516.00 ^b
60	24.48 ^a	192.40	397.40 ^a	543.10 ^{ab}	634.20 ^a
120	25.88 ^a	188.40	431.50 ^a	627.40 ^a	670.20 ^a
SE±	1.08	10.50	22.80	27.40	18.60
LS	*	NS	***	**	**
Organic manure					
0	23.67 ^c	124.30 ^b	251.90 ^c	409.00 ^c	527.90 ^b
CD	25.57 ^{bc}	155.50 ^b	356.20 ^b	530.70 ^b	592.70 ^b
PM	25.83 ^a	220.00 ^a	468.80 ^a	656.10 ^a	709.40 ^a
RH	26.78 ^{ab}	228.20 ^a	422.90 ^{ab}	594.90 ^{ab}	597.10 ^b
SE±	1.24	12.10	26.30	31.60	21.40
LS	*	***	***	***	***
Year					
2021	26.77 ^a	202.39 ^a	389.60	586.15 ^a	623.20 ^a
2022	24.16 ^b	161.59 ^b	360.30	509.23 ^b	590.40 ^b
SE±	0.88	8.56	18.60	22.30	15.20
LS	*	**	NS	**	**
Interaction					
OM*year	NS	NS	NS	NS	NS
UF*year	NS	NS	NS	NS	*
OM*UF	NS	NS	NS	NS	**
OM*UF*year	NS	NS	NS	NS	NS

Means followed by the same letter are statistically similar by DMRT, LS = Level of significance NS = Not significant, *, **, & *** = significant @ 0.05, 0.01 & 0.001 probability level.

Key: CD=Cow dung, PM= Poultry manure, RH= Rice husk, OM= Organic manure, UF= Urea fertilizer

Cob Length

Result of the effect of application of organic manure sources and urea deep placement on cob length is presented in Table 4. The result showed that, application of 60 and 120 kg N/ha through deep placement produced statistically ($P \leq 0.05$) similar result but significantly ($P \leq 0.05$) better than the control. This finding is in tune with the work of Ado (2017) who reported that plants under inorganic fertilization had more nutrients and assimilate production which is a key factor in crop yield. Organic manure on the other hand, showed that, the crops receiving poultry manure and rice husk produced statistically similar cob length which was significantly ($P \leq 0.05$) longer than the those grown on soil where cow dung and nothing (control) was applied. The longer cobs exhibited where poultry and rice husk were applied could partly be explained by earlier work of Fiyyaz *et al.*, (2021) who explained that increasing soil fertility and crop productivity can be achieved with the use of poultry manure in the production of maize and partly to the conditioning effect of rice husk in soil. According to studies, adding rice husk to the soil can not only enhance the amount and availability of plant nutrients, but can improve the physical condition of soil which in turn promote growth of crops



(Adebajo *et al.*, 2022). Study on year revealed that the maize crops exhibited significantly ($P \leq 0.05$) higher cob length in 2022 cropping season than in 2021 and can be deduced to differences in the amount and distribution of rainfall. Combined application of urea with poultry manure produced ($P \leq 0.05$) highest cob length followed by rice husk and cow dung. Control plots recorded the lowest cob length throughout the period of the study. This corroborates the findings of Vanlauwe *et al.* (2002) who reported that combination of organic and inorganic nutrient sources results into synergy and improved conservation and synchronization of nutrient release and crop demand, leading to increased fertilizer efficiency and hence higher yields.

Cob Girth

Result of the effect of application of organic manure sources and urea deep placement on cob girth is presented in Table 4. The result showed that, application of 60 and 120kgN/ha through deep placement produced statistically ($P \leq 0.05$) similar result but significantly ($P \leq 0.05$) better than the control. The significant difference observed in this study demonstrated the importance of urea fertilizer on cob girth of maize. This conforms to the work of Abubakar *et al.* (2019) who stated that the application of nitrogen fertilizer affected growth metrics such as plant height, number of leaves per plant, stem diameter, leaf area per plant, green fodder yield, dry matter yield, and dry matter percentage. Organic manure on the other hand, showed that, maize crop that were fertilized with poultry and rice husk manure statistically exhibited similar cob girth which was significantly ($P \leq 0.05$) superior than the control and cow dung. The superior cob girth exhibited by maize crops grown in poultry and rice husk amended soils may be ascribe to their ability to enhance nutrient availability and as well as affecting hydro-physical properties of the soils. This corroborates the findings of Asfaw, (2022) who also reported significant increase in growth parameters and yield of maize due to organic and inorganic fertilizer application. Study on year, revealed no seasonal variation. The result also showed that, combine application of 60 and 120 kg N/ha with poultry manure produced ($P \leq 0.05$) highest cob girth followed by rice husk and cow dung. Control plots recorded the lowest cob length throughout the study period. This agrees with the work of Maghfoer *et al.*, (2017) who reported that the adoption of combination fertilization tactics, can improve growth factors and maize grain production.

100 Grain Weight

The result of the impact of application of organic manure sources and urea fertilizer rate on 100 grain weight is detailed in Table 4. The result indicated that the application of 60 and 120 kg N/ha through deep placement yielded statistically similar outcomes, both significantly ($P \leq 0.05$) superior to the control. This finding aligns with the work of Ado (2017), who emphasized that plants subjected to higher fertilizer application displayed increased levels and assimilate production. On the other hand, the result of organic manure demonstrated that all organic sources yielded significantly better results compared to the control ($P \leq 0.05$). Notably, poultry manure fertilization induced heavier grains, akin to rice husk, but significantly differed from the 100-grain weight of maize crops cultivated in the control and cow dung plot. The elevated 100-grain weight observed in maize crops under poultry manure fertilization can be attributed to prior research by Fiyaz *et al.* (2021), which emphasized that the use of poultry manure heightened soil fertility, consequently leading to increased maize production. Additionally, Wang and Zhang (2016) reported that rice husk enriched the soil by adding both macro and microelements, along with enhancing organic matter content and improving the physical, chemical, and biological properties of the soil. Furthermore, study on year revealed a



significant ($P \leq 0.05$) difference in the weight of 100 grains, with the year 2022 yielding the highest weight compared to 2021.

Grain Yield

Results of the effects of application of organic manure sources and urea deep placement on grain yield is presented in Table 4. It was observed that application of 60 and 120 kg N/ha through deep placement yielded statistically similar results, yet significantly ($P \leq 0.05$) outperformed the control. The higher grain yield achieved through urea application at 60 and 120 kg N/kg using the deep placement method can be attributed to its positive agronomic influence and its environmental benefit in reducing N leaching. These findings align with the research by Adekiya *et al.* (2020), which emphasized the significant effect of nitrogen supply through urea deep placement on various growth parameters including plant height, number of grains per cob, 1000 grain weight, grain yield, and harvest index.

The study on organic manure revealed that all three organic sources exhibited significant improvements ($P \leq 0.05$) compared to the control. The higher grain yield observed in the organic source treatments can be attributed to the enhanced physicochemical properties of the soil resulting from the application of organic manure. Specifically, poultry manure demonstrated the highest grain yield when compared to other sources of organic manure. This finding is consistent with the research by Adeniyi and Ojeniyi (2003) and Audu *et al.* (2015), which highlighted that poultry manure application enriches soil organic matter and supplements essential plant nutrients, contributing to increased growth and yield of crop. Additionally, Asfaw (2022) supports this notion by suggesting that poultry manure, due to its higher nitrogen content, plays a vital role in augmenting the growth and yield of maize.

Furthermore, combine application of 60 kg N/ha urea in conjunction with poultry manure produced significantly ($P \leq 0.05$) higher grain yield of maize, surpassing the yields obtained from the application of rice husk and cow dung in conjunction with urea. Conversely, the control plot consistently exhibited the lowest grain yield throughout the study period. The result of this study lend its support from the findings of Abou *et al.* (2006) who emphasized that the most effective approach to augment maize yield involved a synergistic application of organic wastes and inorganic fertilizer. Similarly, Singina and Woomer (2009) corroborated this finding by highlighting that combining high-quality organic inputs, such as manure with inorganic fertilizer led to superior maize yields compared to the sole application of inorganic fertilizer.

Table 4: Effects of urea deep placement and organic nutrient sources on cob length, cob girth, 100 grain weight and grain yield of maize

Treatment	CL	CG	GY(t/ha)	100GW(g)
Urea fertilizer				
0	10.63 ^c	10.75 ^b	2.42 ^b	12.35 ^b
60	13.61 ^b	12.35 ^a	2.28 ^a	14.59 ^a
120	14.54 ^a	12.65 ^a	4.86 ^a	15.83 ^a
SE±	0.23	0.15	0.19	0.42
LS	***	***	***	**
Organic manure				
0	11.86 ^b	10.86 ^c	2.64 ^c	12.48 ^c
CD	12.32 ^b	11.58 ^b	3.46 ^b	13.35 ^{bc}
PM	14.17 ^a	13.03 ^a	5.09 ^a	16.46 ^a
RH	13.36 ^a	12.21 ^b	4.22 ^b	14.73 ^{ab}
SE±	0.27	0.17	0.21	0.49
LS	***	***	**	**
Year				
2021	12.57 ^b	11.90	4.05	9.21 ^b
2022	13.28 ^a	11.93	3.66	19.23 ^a
SE±	0.19	0.12	0.15	0.35
LS	**	NS	NS	**
Interaction				
OM*Year	***	**	NS	NS
UF*Year	NS	NS	NS	NS
OM*UF	***	**	*	NS
OM*UF*Year	NS	NS	NS	NS

Means followed by the same letter statistically similar by DMRT, LS = Level of significance
 NS = Not significant, *, **, & *** = significant @ 0.05, 0.01 & 0.001 probability level.

Key: CD=Cow dung, PM= Poultry manure, RH= Rice husk, OM= Organic manure, UF= Urea fertilizer, CL= Cob length, CG= Cob girth, GY= Grain Yield, 100GW= 100 Grain weight, UF= Urea fertilizer

Table 5: Interaction of Urea and organic manure on grain yield (t/ha) of maize

OM (t/ha)	Urea fertilizer (kg/ha)		
	0	60	120
0	1.46 ^f	2.97 ^{def}	3.48 ^{cde}
CD	1.71 ^{ef}	3.44 ^{cde}	5.24 ^{abc}
PM	4.19 ^{bcd}	6.13 ^a	4.95 ^{abc}
RH	2.32 ^{ef}	4.56 ^{abcd}	5.77 ^{ab}
SE±		0.37	

Means with the same letters are not significantly different at $P \leq 0.05$ using Duncan Multiple Range Test (DMRT).

Key: CD=Cow dung, PM= Poultry manure, RH= Rice husk, OM= Organic manure, UF= Urea fertilizer, LS= Level of significance NS=Not significant.



CONCLUSION AND RECOMMENDATION

Therefore, it can be concluded that urea deep placement application at 120 kg N/ha produced high grain yield of maize in Bauchi. Higher grain yields of maize were obtained from the application of 5 t/ha poultry manure. Also grain yields of maize were highest with combined application of urea deep placement at 60kg N/ha and 5 t/ha poultry manure. Based on the results of this investigation, combine application of 5 t/ha poultry manure with urea at the rate of 60 kg N/ha through deep placement can be used in maize production to achieve higher productivity in study area.

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