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Effects of ZAI (PIT PLANTING) and Different Manure Rates on the Growth and Yield of Sorghum

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Abstract: ***A field experiment was conducted at Jimtilo village along Maiduguri Jos/Kano road geographically located latitude $11^{o}50^{1}58^{11}$North$12^{o}56^{1}23^{11}$ East above sea level. The experiment was conducted to determine the effect of Zai (pit planting) and different manure rate on growth and yield of sorghum. Randomized Complete Block Design (RCBD) replicated 3 times and consisted of 4 levels of treatments of 0, 1 ton/ha, 2ton/ha and 3ton/ha of manure (cowdung). The result of the experiment indicated that there was significant ($p< 0.05$) difference among and between treatments used. It was further observed that 3ton/ha manure applied gave significantly ($p< 0.05$) higher yield and performed better than all other treatments. The control however,gave the least value as all other treatments performed better than the control. It is therefore recommended that the application of 3 ton/ha should be adopted by farmers practicing pit planting or reclaiming arid land for sustainable agricultural production.***

Keywords: zai (pit planting), manure, cow dung, growth and yield.

I. INTRODUCTION

The semi-arid areas of northern Nigeria are characterized by low and variable rainfall that is concentrated during a short rainy season with remaining period tending to be relatively or absolutely dry. High temperatures during the rainy season cause much of the rainfall to be lost through evaporation and intensity of storms ensures that much of it runs in floods. Aridity variability are two dominant characteristics of this dry land climate, a short rainy season, intensive rainfall interspersed with unpredictable droughts, and highly variable rainfall during the wet season. Low and erratic rainfall its poor distribution within the growing season results in prolonged dry spells leading to reduced water supply to crop plants. Furthermore, the twin problems of soil degradation and nutrient shortage adversely affect crop growth and yield. In these areas, increasing pressure on the natural resources due to high population growth, constrained farmers to cultivate marginal lands, thereby compounding the land degradation problem.

These constrain limit agricultural productivity leading to crop yields that vary enormously from year to year. In addition to the climatic constrains, fertility of the soil also fluctuates from one area or region to another (Fantondji 2002). To address these problems indigenous easy to implement innovations for soil water conservation such as Zai and manure application to provide sustainable means to increase productivity of arable lands that continually degrade due to effects of weather, erosion and continuous cropping. Sorghum is an important crop worldwide used for food (as grain and in sorghum syrup), fodder, alcoholic beverages and bio-fuels. Sorghum is adapted to a wide range of environmental condition but is particularly adapted to drought. Most research work shows that the use of several organic materials especially Cow dung, poultry manure and farmyard manure as soil amendment for increasing crop production particularly among subsistence farmers with inorganic fertilizer. However the benefit derivable from the use of organic materials has not been utilized fully in the semi arid region of Nigeria because of the knowledge gap on the rate that gives maximum yield.

II. MATERIALS AND METHODS

The experiment was conducted at Jimtilo village along Maiduguri - Jos/Kano road geographically located latitude $11^{o}50^{1}58^{11}$North$12^{o}56^{1}23^{11}$ East above sea level. The experiment was conducted to determine the effect of Zai (pit planting) and different manure rate on growth and yield of sorghum. Randomized Complete Block Design (RCBD) replicated 3 times and consisted of 4 levels of treatments of 0, 1 ton/ha, 2ton/ha and 3ton/ha of manure (cowdung). agronomic date collected were plant height, number of plant leaves and leaf area index while growth data collected were number of spike, panicle length,grain weight and grain yield. Analysis of variance (ANOVA) was used in data analysis and Duncan's multiple range test (DMRT) was used to separate the means.

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III. RESULT AND DISCUSSION

Table 1 Physico-chemical properties of soil used for the study

Parameter	Sand (gkg^{-1})
	68.6
Silt (gkg^{-1})	17.5
Clay (gkg^{-1})	13.9
Textural class	Sandy Loam

Parameter	pH
Organic carbon (gkg^{-1})	0.97
Total nitrogen (%)	0.3
Available P ($mgkg^{-1}$)	8.12
Organic matter content	1.67
C:N ratio	0.97
Exchangeable bases ($cmolkg^{-1}$)	
Calcuim	7.44
Magnesuim	18.96
Soduim	0.05
Pottasuim	0.59
Effective CEC ($cmolkg^{-1}$)	27.04
ECEC	27.42
Base saturation	98.42

Table 1 above shows that properties of the soil used for the study. The soil is sandy loam in texture, it is very low in Nitrogen,Organic matter is also low so also sodium, potassium and organic carbon an indication that addition of manure (cow dung) will probably result in increase in soil nutrients.

Table 2 Moisture content

Wt of can	wt of can+soil	wt of can+wet soil	wt of can+dry soil	%MC
23	219.8	226.98	15.82	7.14

Table 3 Bulk Density

Wt of can	wt of can+soil	wt of saturated soil	wt of ovendry soil	BD
23.24	242.68	308	258.62	1.26

Table 2 and 3 shows the %moisture content and the bulk density of the study area the moisture content of the soil is moderate as soil moisture determines the amount of nutrients available to the plants and for soil aeration (Dingman 2002).
Bulk density on the other-hand is an indicator of soil porosity and moisture content as it is dependent on soil texture and structure (Lu et al.;2017) higher bulk density tend to restrict root growth but the result of bulk density of the study area is ideal for infiltration and root penetration.

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Table 4 Effects of pit planting and different manure rates on growth characters of sorghum

Treatments			WAS		
Manure(ton/ha)	2	4	6	8	10
0	12.28[c]	39.82[c]	73.36[c]	135.84	203.36
1	12.63[b]	43.90[b]	80.48[b]	134.92	203.94
2	13.98[a]	47.24[a]	83.98[a]	137.84	206.18
3	13.22[a]	47.80[a]	84.69[a]	138.27	207.56
LS	**	**	**	NS	NS
SE+	0.12	0.112	0.98	0.66	7.2

Means followed by the same letter in a column are not significantly different following DMRT. SE= standard error, ** = (P<0.01), LS= level of significance, WAS = Weeks after sowing, NS = Not significant.

Table 4 shows the effect of pit planting and manure on plant height of sorghum which revealed that 3 ton/ha was significantly *($p < 0.05$)* observed to better in terms of plant height throughout the growth period. However other treatment were found have performed better than the control. The 3 ton/ha significantly produced taller plan than all other treatments combined . this conforms with the report of of Feisal et al;(2012) who reported that the quantity of organic matter in the soil has been found to depend on the quantity of organic material which are usually added into the soil by natural return through roots, stubble, root noodles and roots exudates and application of organic manure.

Table 5 Effect of pit planting and different manure rates on number of plant leaves of sorghum

Treatments			WAS		
Manure(ton/ha)	2	4	6	8	10
0	4.98[b]	7.78[b]	9.00[b]	10.25[c]	14.00
1	5.88[a]	7.98[b]	9.50[a]	11.66[b]	14.32
2	5.92[a]	8.27[a]	9.87[a]	14.00[a]	14.57
3	6.08[a]	8.50[a]	10.05[a]	14.38[a]	14.70
LS	**	**	**	**	NS
SE+	0.11	0.21	0.15	0.13	0.09

Means followed by the same letter in a column are not significantly different following DMRT. SE= standard error, ** = (P<0.01), LS= level of significance, WAS = Weeks after sowing, NS = Not significant.

Table 5 shows the results of effect of pit planting and different manure rates on number of plant leaves same as in plant height the results of 3 ton/ha was significantly higher in all data collected during the growth period this further proves the finding of Bendfeldt (2002) who indicated that the soil organic matter plays a key role in maintaining stable soil aggregates and release of nutrients.

Table 6 Effects of pit planting and different manure rates on leaf area of sorghum

Treatments		WAS	
Manure(ton/ha)	4	6	8
0	78.08[c]	210.63	276.99[b]
1	172.54[b]	248.13	332.03[a]
2	187.83[a]	257.28	342.04[a]
3	188.32[a]	262.65	348.62[a]
LS	*	NS	**
SE+	2.73		

Means followed by the same letter in a column are not significantly different following DMRT. SE= standard error, ** = (P<0.01), LS= level of significance, WAS = Weeks after sowing, NS = Not significant.

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Table 6 same as other observed agronomic data 3 ton/ha significantly *(p< 0.05)* produced higher leaf area than all other rates. The other treatments performed better than the control. This revealed the importance of manure and different rates applied as its effect is clearly shown here, the higher the rate applied the higher the results value obtained and this is in consonance with the findings of Shuaibu *et al* (2018)who reported that the manure alone or mixed with NPK results in increased growth rate and yield of sorghum.

Table 7 Effect of pit planting and different manure rates on number of spike, panicle length, grain weight and grain yield of sorghum

Treatments Manure(ton/ha)	No of spike	Panicle length(cm)	Grain weight(g)	Grain yield(ton/ha)	
0	104.34	36.70[b]	25.70[c]	2.28	
1	107.23	38.98[a]	31.28[a]	3.20	
2	108.02	39.86[a]	28.53[b]	3.03	
3	108.19	40.03[a]	28.33[b]	3.38	
LS	NS	*	*	NS	
SE+	2.33	0.84	0.71	0.14	

Means followed by the same letter in a column are not significantly different following DMRT. SE= standard error, ** = (P<0.01), LS= level of significance, WAS = Weeks after sowing, NS = N

A. Number of Spike per Panicle

The results of spike per panicle on table 7 also indicates that 3 ton/ha of manure produced significantly *(p< 0.05)* highest number of spike per panicle and other treatments rates produced higher number of spike than control.

B. Panicle Length

Table 7 indicates the effects of pit planting and different manure rates on panicle lenght of sorghum which revealed that 3 ton/ha produced longer heads than all other treatments rates used while control had the lowest head length which is a clear indication of the importance of manure and its contribution to most plant physiological activities that results in higher yield.

C. Grain Weight (1000 seeds)

Grain weight obtained in table 7 showed that 3 ton/ha had a significantly*(p< 0.05)* higher 1000 grain weight than other treatments which is in conformity with the findings of Chaudhary *et a*l.; (2003) who found out that significant increase in grain weight with increase in inorganic fertilizer rates.

D. Grain Yield (ton/ha)

From the above table 7 the grain yield of sorghum was highest with 3 ton/ha of manure applied which was significantly *(p< 0.05)* higher than all other rates . the yield of sorghum increased with increase in manure rates applied. Ibrahim et al., (2002) reported that the higher the manure applied the higher the positive effect on soil fertility and on sorghum production. The higher grain yield obtained during the study can be attributed to improvement in soil fertility. This confirms with the findings of Conley *et a*l.; (2005) who indicated that sorghum responded to manure by increased yield obtained as a result of increased in application rate.

IV. CONCLUSION

In conclusion application of 1 ton/ha and 2 ton/ha produced yield better than what was obtained in control. But 3 ton/ha produced the best results in on the growth and yield parameters throughout the study period.

Based on the findings of the authors the following recommendations are made

1) Sorghum growth and yield increased with increased rate of manure

2) Application of 3 ton/ha of manure (cow dung) is recommended

V. ACKNOWLEDGEMENT

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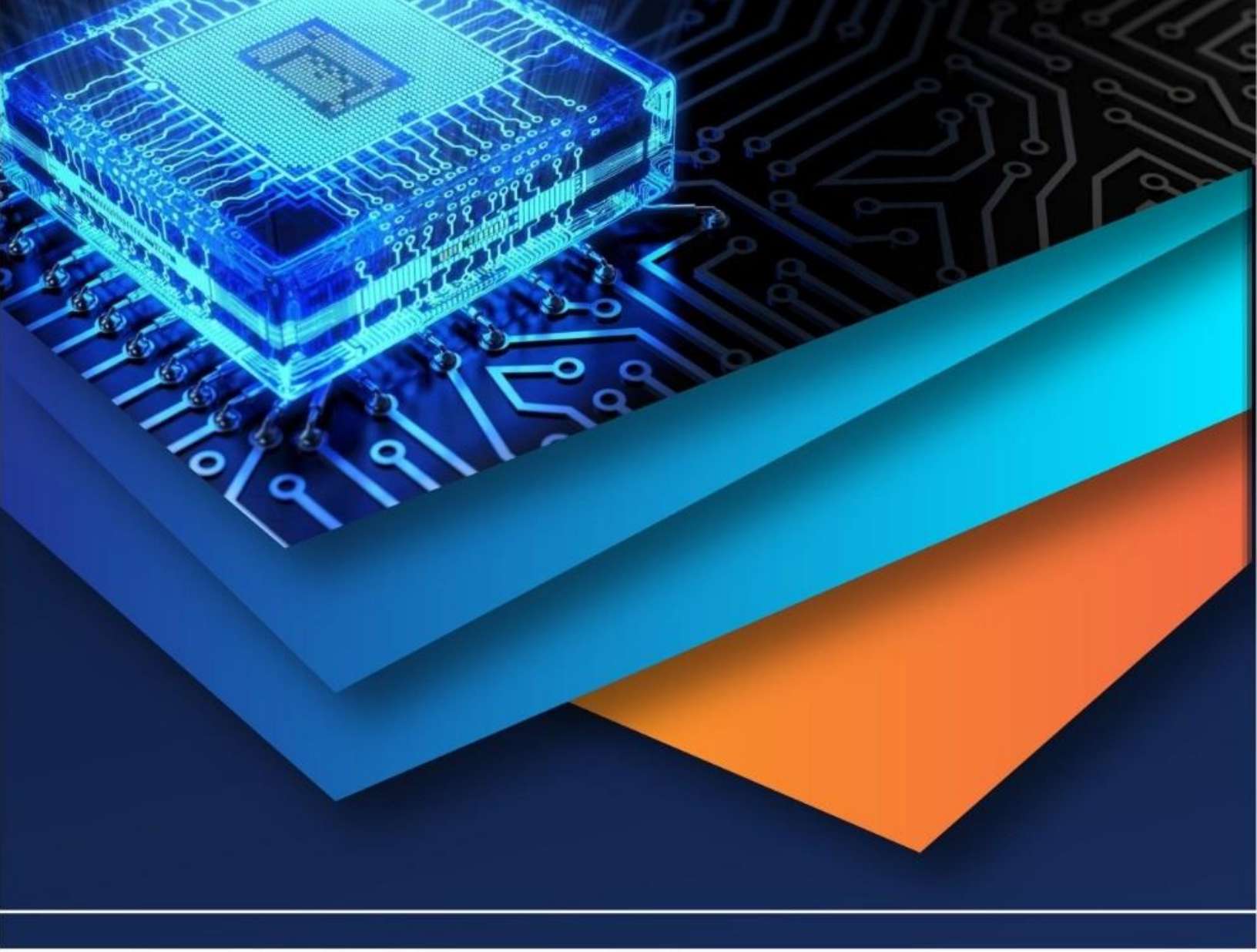

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