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The Effect of Inorganic Fertilizer Micro Dosing on the Growth of Irrigated Pearl Millet (*Penissetum glaucum (L.)R.Br)* in Yola, Adamawa State Nigeria

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Abstract
The study examined the effect of inorganic fertilizer on the growth of irrigated pearl millet. Pot experiment was conducted from March to May 2016 on teaching and research farm, ModibboAdama University of Technology, Yola Adamawa State Nigeria. The objectives of the study were to investigate the effect of different levels of inorganic fertilizer micro dose on growth of Pearl Millet and also to determine the optimum level of NPK fertilizer on growth of Pearl Millet. The parameters that were measured are the plant height, leaf length, leaf breadth, stem diameter, and number of leaves. The result obtained from the experiment indicates that there was significant effect of the application on height of pearl millet at 3 Weeks after sowing, while tallest height of 76.67cm was recorded due to application of half of recommended rate of NPK (30:15:15) kg/ha), Significant effect of the application was also recorded in relation number of leaves at 6 weeks after sowing while largest leaf number of 9.67cm was recorded due to application of ¼ of recommended rate (15:7.5:7.5) kg/ha of NPK. For the stem diameter significant effect was recorded at 9 weeks after sowing with 3.8cm due to application of full recommended rate (60:30:30) kg/ha, while the largest stem diameter was recorded at 9 WAS due to application of NPK full recommended rate. For the leaf length there was significant effect of the application at 9 weeks after sowing with 63.00cm due to application of half of the recommended rate (30:15:15 kg/ha) of NPK. Where the highest length of 76.67cm was recorded due to the application of ½ recommended rate (30:15:15) the result indicate that highest pearl millet height and large number of leaves were recorded due to application of ½ recommended rate of NPK,(30:15:15 kg/ha). Base on the result of the experiment NPK seems to have major impact on the growth of pearl millet on the sandy soils of Adamawa State, further experiments could be recommended so as to ascertain the effect of inorganic materials application on the growth of pearl millet in the same study area.

Keywords: Growth, Inorganic Fertilizer, Irrigated Pearl Millet, Micro Dosing, NPK, Yola

Introduction
Pearl Millet (*Pennisetum glaucum* (L.) R. Br.), known as Bajra in Hindu and Gero in Hausa language of North-Eastern Nigeria is the most important among the millet varieties. It is a robust, quick growing cereal grass with large stems and leaves which are tall and vigorous with exceptional grain and fodder yielding potentials. It is one of the most important dual purpose crop and a staple food for millions of people in arid and semiarid ecologies around the world (Chopra, 2001). Pearl millet is originated in West and Central Africa and widely distributed across the semi-arid tropics of India and Asia (Govindaraj *et al.*, 2009).

According to FAO, (2007) pearl millet is grown in over 40 countries predominantly in Africa and Asia as a staple food grain and source of feed and fodder, fuel and construction material, the crop is well adapted to some extent in production system characterized by drought, low fertility and high temperatures. It could relatively perform better than other crops in saline and acid soils thus can be grown in areas where other cereal crops such as maize or wheat could not survive. (Vanisha *et al.* 2011*).* The crop is grown in Africa as staple cereal supplying 80-90% of the calories for many millions of the poor people in semiarid regions.

According to ICRISAT (2006), the crop residues are used as fodder, building material and fuel for cooking to most countries including Africa and Asia. It is estimated that over 93% of pearl millet grain is used as food, with the

remaining 7% used between animal and poultry feed. Other uses includes bakery product and snacks.The depression on growth and forage yield were detected by several authors (Borrell *et. al., 2000*; Umar, 2006). However, NPK fertilization led to a considerable increase in different crops as mentioned by (Bacci, 1999).

The chemical fertilizers are quite expensive and the small and marginal farmers are unable to use fertilizers in required quantities in the moisture deficit areas. Nitrogen is one of the basic plant nutrients essential for profuse growth; it increases vegetative growth of plant and herbage quality which is highly desirable for the forage yield and dry matter accumulation. Nitrogen is an indispensable element for optimum functioning of the crop and generally nitrogen fertilizer accounts for about half of the cost of cultivation for most crops. Phosphorus fertilizer is essential to provide energy for the growth and development of pearl millet plant. Phosphorus availability helps in increased efficiency of nitrogen use by plant, so pearl millet plant takes phosphorus from seedling stage up to grain-filling stage; phosphorus uptake increases the availability of nitrogen.

Fertilizer micro dosing application at various times may be an important factor which can be used for exploitation of the yield of pearl millet and is one of the successful ways to elevate the crops drought resistance under dry conditions (Ghosh*et al.,* 2004).Therefore, this study investigated the effect of NPK application under irrigation on the growth and yield of pearl at different growth stages in the School of Agriculture teaching and research farm of the Modibbo Adama University of Technology, Yola as well as to determine the optimum level of NPK for higher yield and to come up with recommendation of NPK rates for the crop in the study area.

Aim and Objectives of the Study

The aim of the study is to investigate the effect of NPK micro dosing on the growth yield of pearl millet in Yola. This aim will be achieved through the following objectives.

i. To investigate the effectiveness of NPK fertilizer on the growth and yield of pearl millet.
ii. To determine the rate of NPK application and in combination with water rate on the growth and yield of pearl millet.
iii. To determine the optimum level of NPK fertilizer for higher yield and come up with recommendations of NPK rates for the crop in the study area.

Materials and Method

Location and Extent of the Study Area

Yola is the capital city of Adamawa state found in the North-Eastern part of Nigeria, lies between latitude $9^0 07^1$ to $9^1 23^1$ N and longitude $12^0 17^1$ to $12^0 23^1$ E, which occupies a land area of about 650017 Sqkm. The teaching and research laboratory of the department of soil science of MAUTECH Yola is located in faculty of Agricultural technology, Yola (latitude $9^0 10^1$N and longitude $11^0 14^1$E and 15.8m above sea level) (Jakusko *et al.* 2015).

Soil Type

In the teaching and research of farm, the soil is generally deep but mostly sandy loam underlain by sand to silty clay. Other areas in the farm are similarly deep loamy sand and underlain by sandy clay. The soil is generally yellowish brown and poorly drain due to prevalence of mottling in the horizon. This could be as a result of gleying caused by fluctuating water table (Mishra & Lihosh, 1995).

Sample Collection

Soil sample was collected randomly to a depth of 0-20cm from the University Teaching and Research Farm of Modibbo Adama University of Technology Yola (MAUTECH). The collected soil samples were grinded and sieved by passing through a 2mm mesh and properly stored in a fresh well labelled polythene bags for analysis on Total Nitrogen, Total Phosphorus, Organic Nitrogen, Organic Phosphorus as well as Carbon.

Data Collection and Parameters

The data was collected at 3 weeks interval and the means were interpreted and compared with simple chart (bar or pie chart).The parameters to be measured are as follows; Number of leaves, Emergence count (including days of germination), Height of the plant, plant diameter, leave breadth, leave length, leave area index. Yield parameters include, panicle length, yield and panicle weight per pot, panicle diameter and biomass.

Experimental Layout and Statistical Tool

The field experiment was laid in a complete randomize design where the N.P.K fertilizers are randomized within the plots excluding the treatment plot. The experiment contained four treatment; no fertilizer (NO), nitrogen (N1),

phosphorus (N2), potassium (N3) treated pots. Each treatment was replicated once in a complete randomize design. The data obtained was analyzed using analysis of variance (ANOVA) and the mean separated using least significance difference (LSD).

Experimental Layout:

REP I

TI	**T4**	**T3**
T2	**T3**	**T2**
T3	**T2**	**T1**
T4	**T1**	**T4**

REPII

T4	**T3**	**T1**
T2	**T1**	**T3**
T1	**T2**	**T4**
T3	**T4**	**T2**

REPIII

T1	**T4**	**T3**
T3	**T2**	**T1**
T2	**T1**	**T4**
T4	**T3**	**T2**

Expected Seed Result

With the application of inorganic micro dosing fertilizer especially N.P.K, it is expected that the result of the growth and yield of pearl millet will be high. Also, it will have positive impact on soil physical and chemical properties such as soil structure, water holding capacity, soil reaction (pH) and organic matter content of soil will also increase

Results and Discussion

The results of the study are presented below

Physical and chemical properties of soils of the study area

The results of the physical properties of the soils in the study area are presented in Table1.The result indicates that sand; silt and clay percentages of the soil are 92.8, 7.5 and 1.4% respectively. The soil colour of the study area is dark brown (7.5YR 3/2) when wet and brown (7.5YR 5/20) when dry. The dark colour of the soil indicates the possible accumulation of organic matter in the soil. This is similar to what was earlier reported by (Brady and Weil, 2008).

The percentage soil moisture content of the soils in the study area was (6.20%). The particle density of the soil was $2.50g/cm^3$.Bulk density was found to be $1.6g/cm^{-3}$. This value is considered to be higher than $1.4gcm^{-3}$ earlier reported by Hazelton and Murphy (2007) for most agricultural soils.

Chemical Properties of the Soil in the Study Area

The soil of the study area has slightly acidic reaction (6.03). Electrical conductivity (EC) values of 0.19 ds/m indicating that the soils are slightly saline. Brady (1999) reported that soil with EC value ranging from 0.01-8.00 ds/m is saline. Available phosphorus was also observed to be higher compared to most soil of the area. This higher value may be attributed to the higher organic matter content of the soil. Calcium is the dominant cation on the soil surface followed by potassium and magnesium and sodium. Effective cation exchange capacities of the soil are low while ESP and PBS were observed to be high. This shows that the soil is relatively saline.

Table 1: *Physical properties of soil*

Parameters	Results
Soil colour	7.5 YR 5/2 brown
Sand (%)	92.8
Silt (%)	7.5
Clay (%)	1.4
Texture	Sandy loam
Moisture content	6.2
Water holding capacity (%)	19.7
Bulk density (g/cm^3)	1.62
Particle density (g/cm^3)	2.50

Sample depth= 0-20

Table 2: *Chemical Properties of the Soils*

Parameters	Ratings
PH	6.03
EC	0.19 dSm^{-1}
OC	0.20 gkg^{-1}
AVP	5.1 $mgkg^{-1}$
TN	0.6gkg^{-1}
Exchangeable Bases	
Ca^{2+}	5.6 $cmolkg^{-1}$
Mg^{2+}	4.85$cmolkg^{-1}$
K^{+}	0.74$CmolKg^{-1}$
Na^{+}	0.17$cmolkg^{-1}$
Exchangeable Acidity	
H^{+}	1.3$cmolkg^{-1}$
Al^{3+}	1.8$cmolkg^{-1}$
TEB	4.39$cmolkg^{-1}$
ESP	50%
PBS	78.56 %
ECEC	14.46 $cmolkg^{-1}$

Table 3: *Effect of N.P.K micro dose on plant height*

N.P.KLEVELS	WEEKS AFTER SOWING		
	3 WAS	**6 WAS**	**9 WAS**
Control	13.83ab	27.33a	69.67a
Recommended rate	16.67a	28.00a	64.67a
½ Recommended rate	12.33ab	28.67a	76.67a
¼ Recommended rate	10.00b	29.67a	67.00a
SE	2.41	4.47	6.51

The effect of NPK micro dose application on pearl millet height is presented in Table 3. The result indicates that there was no significant effect of the application except at 3 weeks after sowing (WAS): for the 3 WAS tallest height of 16.67cm was recorded due to application of full recommended rate of (60:30:30 kg/ha) while the shorter height of 10.00 was recorded due to application of ¼ recommended rate (15:7.5:7.5 kg/ha) of NPK fertilizer. The result indicates that tallest height recorded due to application of NPK full recommended rate (60:30:30kg/ha).

Table 4*: Effect of N.P.K micro dose on length of leaves*

N.P.KLEVELS	WEEKS AFTER SOWING		
	3 WAS	**6 WAS**	**9 WAS**
Control	24.00a	27.33a	69.67a
Recommended rate	25.00a	28.00a	64.67a
½ Recommended rate	24.33a	28.00a	79.67a
¼ Recommended rate	22.67a	29.67a	67.00a
SE	4.74	4.47	6.51

The effect of NPK micro dose application on length of leaves of pearl millet pearl is presented in table 4. The result indicated that there was no significant effect of the application at 3-9 weeks after sowing (WAS) but the highest leaf length of 79.67cm was recorded at 9 weeks after sowing due to application of NPK ½ recommended rate (30:15:15 kg/ha) and smallest leaf length was recorded as 22.67cm at 3 weeks after sowing due to application of NPK 1/4 recommended rate (30:15:15 kg/ha).

Table 5: *Effect of N.P.K micro dose on leaf width*

N.P.KLEVELS	WEEKS AFTER SOWING		
	3 WAS	6 WAS	9 WAS
Control	0.90a	2.21a	2.23a
Recommended rate	1.10a	2.00a	2.77a
½ Recommended rate	0.97a	2.12a	2.20a
¼ Recommended rate	1.00a	2.10a	3.53a
SE	0.25	0.36	0.83

The effect of NPK micro dose application on leaf width of pearl millet is presented in Table 5. The result indicates that there was no significant effect of the application between 3-9 weeks after sowing (WAS): but the highest leaf breadth was recorded as 3.53cm at 9 WAS due to application of NPK ¼ recommended rate of (15:7.5:7.5kg/ha) while the smallest leaf breadth was recorded as 0.90cm at 3 WAS with NPK0 (no fertilizer).

Table 6: *Effect of N.P.K micro dose on stem diameter*

N.P.KLEVELS	WEEKS AFTER SOWING		
	3 WAS	6 WAS	9 WAS
Control	1.37a	2.10b	3.20b
Recommended rate	1.47a	2.33ab	3.80a
½ Recommended rate	1.01a	2.13ab	3.37ab
¼ Recommended rate	1.63a	2.63a	3.77a
SE	0.32	0.22	0.19

The effect of NPK micro dose application on stem diameter of pearl millet is presented in Table 6 above. The result indicated that there was no significant effect of the application at 3weeks after sowing (WAS): but for 6 and 9 weeks after sowing, highest stem diameter of 3.80cm was recorded at 9 WAS due to application of NPK full recommended rate of (60:30:30kg/ha) while the least diameter of 1.01cm due to application of NPK ½ recommended rate (30:15:15 kg/ha) was recorded.

Table 7: *Effect of N.P.K micro dose on number of leaves*

N.P.KLEVELS	WEEKS AFTER SOWING		
	3 WAS	6 WAS	9 WAS
Control	4.67a	8.67a	7.33a
Recommended rate	5.00a	5.00b	9.00a
½ Recommended rate	4.00a	4.00b	9.00a
¼ Recommended rate	4.33a	8.00a	9.67a
SE	0.67	0.94	1.20

The effect of NPK micro dose application on number of leaves of pearl millet is presented in Table 7 above. The result indicated that there was no significant effect of the application at 3 and 9 weeks after sowing (WAS): butthere was significant effect of the application at 6 weeks after sowing, highest number of leavesof 9.67cm was recorded at 9 WAS due to application of NPK ¼ recommended rate of(15:7.5:7.5 kg/ha) while the lowest number of leaveswith 4.00cm was recorded due to application of NPK ½ recommended rate (30:15:15 kg/ha). Overall of number of leaves of pearl millet at 9 WAS at 9.67cm was recorded and there was significant effect of the application at 6 weeks after sowing.

Conclusion

From the result obtained in the experiment, it can be concluded that; the highest plant height was obtained in Table3. Table 4 also recorded the highest leaf length and width at Table 5 all at 9 WAS, highest stem diameter was recorded at 9 WAS in Table 6, highest number of leaves was obtained at 9 WAS in Table 7, the recommended NPK applied after sowing are full recommended rate, ½ recommended rate and ¼ recommended rate respectively. Ring method is the method of application used for the NPK fertilizer.

Recommendation

Based on the result obtained from the experiment it is revealed that, pearl millet production in sandy soils of Yola, Adamawa state, will require application of inorganic fertilizer at 5ton/ha and 30:15:15, respectively for optimum growth. In view of the above suggestion in the research findings, the following recommendations were proposed.

1. The government should as a matter of urgency provide stable availability of fertilizer, this will improve and faster proliferation of small scale and large scale farmers in the state so that irrigation farming will be common and easier among people in the state.

2. The government should provide easy reversible loans to the farmers with free or little interest charges to be able to get access to irrigation farming system during dry season.
3. The government should establish a permanent skill acquisition centre or schools in which people especially youths and small scale farmers will be receiving some skill on the various method of fertilizer application and different farming system by means of irrigation method. This will help in creating a mass employment and also accelerate economic development in the state and the country as a whole.

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