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Effect of tillage operations methods of planting and different levels of poultry manure on the productivity of wheat (*triticum aestivum*)

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ABSTRACT: The experiments were carried out during 2013 and 2014 dry seasons under irrigation at Gwallaga Mayaka fadama farm of Bauchi local government area which is located between longitudes 9° 00' and 10° 30' N and latitudes 9° 30' and 10° 30 'E, Bauchi State Nigeria. The study was initiated to evaluate the performance of tillage operations, sowing methods and poultry manure on the growth and yield of spring wheat (*Triticum aestivum*). The treatments comprised of conventional and conservation tillage operation, Three planting methods, (Drilling, Dibbling and Broadcasting) and five different levels of poultry manure (0, 2.5, 5.0, 7.5, 10.0 t/ha). The treatments were laid out in a randomized complete block design (RCBD) replicated three times. The results of the study revealed that, application of poultry manure at the rate of 10.0t/ha were found to be significantly ($P \leq 0.01$) better than all the other treatments and the control was the least in all the characters studied. At different planting methods, dibbling and drilling produced significantly ($P \leq 0.01$) higher number of stems than the broadcasting. The use of dibbling method was significantly ($P \leq 0.01$) better than all other methods and broadcasting was the least on number of productive stems and grain yield (t/ha). It can be concluded that the cultivation of spring wheat with the application of 10 t/ha and dibbling method of planting seems to be better practice and can therefore, be recommended for farmers in the study area. However, any of the tillage method can be adopted for wheat production in the study area, meanwhile more research are recommended in this area to justify the best tillage operation for the production of the crop.

KEYWORDS Tillage operation, methods of sowing, poultry manure, irrigation, spring wheat

Introduction

Wheat (*Triticum aestivum*.) is one of the most important cereal crops in the world that is grown across a wide range of environments around the world and has the highest adaptation among all the crop species. Worldwide more land is devoted to the production of wheat than any other crop. It is the main staple food of nearly 35% of the world population than any other food source. It is the only crop so far reported to produce more than 500 million tonnes of yield in a single year. Wheat is a rich source of protein, minerals, and vitamins amongst all the cereals. It contributes about 60% of daily protein requirement and more calories to world human diet than any other food crops. The assessment on the scientific, technical, and institutional issues associated with wheat crop is urgently needed. For the past 40 years, the growth in the productivity of wheat crop was the result of technological innovations in the form of green revolution. With the result, supply exceeded demand and real prices of food such as cereals went down. However, the yield growth rate of many crops especially cereals have started declining. Reasons for declining in the productivity growth rate are multiple (Naresh et al., 2014).

Wheat is produced in Nigeria entirely under irrigation within latitudes 10 to 14 grade N where night temperatures during most of the growing period (November-March) range from 10-15 degree centigrade. The mean maximum temperature ranges from 30 to 35 degree centigrade. Varieties recommended for cultivation are Samwhit 1 (Tousson), Samwhit 2 (Florence Aurore 8193), Samwhit 3 (Sonora 64), Samwhit 4 (Lee/N10/B/3/GB55/4/GB56), and Samwhit 5 (Siete Cerros). Recently recommended are Samwhit 6 (Pavon F.76), Samwhit 7 (Bulbul), and Samwhit 8 (Sonalika). Resulting from the ban on wheat importation into Nigeria, effective January 1987, local wheat production rose from about 50,000 t/year to an estimated 150,000-180,000 t/year.

Today, Nigeria's wheat import is about 4 million MT per annum and estimated to grow at an alarming rate of 5% per annum. At this rate, the country will be importing 10 million MT of wheat annually by 2030, spending US $15 billion on wheat imports

alone. Such over-dependence on imported wheat will pose significant risks to Nigeria's future growth. Nigeria must grow a lot more of its own wheat and reduce the national, economic and political risks from depending on other nations for our food supply. Today, we are reviving hope for Nigeria to produce its own wheat and free itself from decades of dependence on imported wheat.

A silent revolution is [now] happening on wheat farms all across Northern Nigeria. The target of the wheat transformation is to increase national production from 300,000 metric tons to about 1.5 million metric tons per annum by 2017. The wheat transformation agenda will generate one million jobs in the rural areas of Nigeria over the next four years of the program and generate over N 42 Billion in incomes annually for farmers and millers. A total of 2,500 hectares of wheat fields were cultivated in 2013. For the 2014/2015 wheat season, a total of 75,000 hectares will be cultivated by 75,000 farmers. The area under wheat production is expected to increase to 150,000 ha by 2015/2016 dry season and to 300,000 hectares by 2016/2017 dry season. At the average yield of 5 MT/Ha, Nigeria will achieve its target of producing 1.5 million metric tons of wheat by 2017 and reduce wheat imports by 50%. (http://www.lcrimaid.gov.ng/index.php/78-featuring/137-nigeria-has-broken-the-wheat-jinx-agric-minister).

Tillage is one of the important processes in agriculture. Tillage and soil processing belong to those basic agro technical measures that significantly contribute to yield formation of cultivated field crops. The mechanical processing of soil is also an important tool when controlling or killing weeds, pests and plant diseases. The main task of tillage is to create favourable conditions for growth and development of plants and for a proper course of various processes taking place in soil. This is done mainly to loosen the top layer of soil to mix the soil with fertilizers and organic residues for weed control and to create a suitable fertile ground for the germination of seeds and growth of plants (Rasmussen, 1999). According to Srivastava *et al.*, (2006), the purpose of tillage process is to develop the desired soil structure or a suitable slope for soil preparation. Tillage is crucial for the establishment of agricultural crops, growth and, ultimately the output enhancement (Atkinson et al., 2007). Good program of soil management protects the soil from water and wind erosion, provides a good weeds free soil for planting, destroys hardpans or compacted layers, which can restrict root development and increase organic matter (Wright et al ., 2008). Tillage systems are site specific and depend on crop, soil type and climate (Rasmussen, 1999). The sequences operations of tillage systems that manipulate soil in order to prepare good seed bed for crop production. The ways in which these operations are implemented affect physical, chemical properties and biological characteristics of the soil which in turn affect plant growth and yield (Lindsay et al., 1999; Carman, 1997; Ozpinar and Kay, 2006; Rashidi and Keshavarzpour, 2009). Scott (2008) described various tillage systems as follow: conventional tillage is any system which attempts to incorporate most residues where less than 30% of the soil surface is covered with residue after planting.

Africa's ongoing economic crisis is to a large extent predicted on the continent's inability to supply enough food to her growing population. One of the most critical natural resources base on which African food security depends is the soil. Yet, African soils are relatively more sensitive and fragile than those found in other continents and have over the years been considerably and consistently been eroded by natural and manmade factors (Adedeji, 2001). Nigeria was observed to be among the African countries that have already lost significant amount of soil to various forms of degradation. The most important factor that causes of soil degradation is tillage, which exposes the soil to the action of erosion. Many areas in the country are said to be losing over 25 tones' of the top soil per hectare per year (Findly, 1998). Another study revealed that African soils have been suffering from degradation for the past 100 years. Most of the soil lost up to half of its native organic matter content along with some plant nutrients. The major contributor to this trend in soil organic matter loss is the tilling of soil with disc, plow and cultivator in preparing the land for seeding (Namaka *et,al.*, 2014). The impacts of these factors have manifested themselves in stagnating and declining crop yields (Adedeji, 2001).

Serious soil erosion from arable land has been a major concern over the past centuries, resulting in the reduction of soil productivity and waste of resources. Conversation tillage, especially no-tillage practice has long been known to curtail erosion and

dust as compared to conventional tillage practices which make the soil surface deficient in plant residues and always leave the soil vulnerable to erosion. For this reason, no-tillage, which is considered as the most promising conservation tillage, becomes one of the important topics in the cropping system research field. No-tillage is a complex system which is highly related to the physical, chemical and biological factors, agricultural machines and no-tillage technology, etc. How to harmonize these factors is a major task, but there are still many disputations at different effects of no-tillage on soil and crop

No-till system left the soil undisturbed from planting to harvest, except for fertilizer incorporation, planting or drilling is accomplished in a narrow seed bed or slot created by coulters, row cleaners, disk openers, in row chisels or rotor tillers. Conservation tillage emphasizes that soil is a living body essential to sustained quality of life on the planet; in particular, it recognizes the importance of the upper 0 to 20 cm of the soil as not only the most active zone, but also the zone that is most vulnerable to erosion and degradation (Namaka *et,al.*, 2014).

Recent interest in manuring has reemerged because of high prices of inorganic fertilizers. In worldwide, there is growing interest in the use of organic manures due to depletion in the soil fertility. Organic fertilizers including farmyard manure (FYM), sheep manure, urban waste and poultry manure may be used for crop production as substitute of chemical fertilizers or less used of chemical fertilizers because the importance of organic manures that provide long term soil productivity besides meeting nutrient requirements becomes obvious. Poultry manure contains all the essential nutrients required for crop production, moreover, can increase the water infiltration rates of soil and improved the soil structure ((Anonymous, 2006). reported that the use of poultry manure in crop production is on the increase in view of the high price of mineral fertilizers and the difficulty in procuring it at the required time. Anonymous (2007) further reported that, poultry manure, is the most valuable of all manures produced by livestock and that it has historically been used as a source of plant nutrients for soil amendment. In Nigeria today, increasing food production of the country in the next 30 years owing to rapid increase in population growth is a big challenge. In realization of the need to feed the ever – increasing human population's, attention is now focused on the tillage operation, sowing methods and poultry manure. Sustainability and profitability of food crop system in Nigeria farming activity is the lifeline and future of the country economy with more people living in the rural areas. Present study was designed to evaluate the effect of tillage systems, planting methods and poultry manure on the growth, and productivity of spring wheat.

Materials and Methods

The experiment was conducted at outskirts of Bauchi local government area under dry season period, at Gwallagwa Mayaka, Bauchi State, Nigeria, during 2013/2014. Bauchi is located between longitudes 9° 00' and 10° 30' N and latitudes 9° 30' and 10° 30 'E. It is situated in the northern guinea savanna ecological zone of Nigeria. The mean minimum temperature ranges between 10-12 °C in December/January, while the mean maximum is about 30-32 °C in March-May while the dry season starts from late October to May. The variety used was Atilla Gan Atilla high yielding variety. The treatments consisted of two tillage system (conventional and conservational (no-till), three planting methods (Dibbling, Drilling, and Broadcasting) and five levels of poultry manure (0, 2.5, 5.0, 7.5, 10.0 tones per hectares). The treatments were laid out in a Randomized Complete Block Design (RCBD) replicated three times. The experiment field was ploughed and harrowed using a tractor and sunken beds of 4m ×4m size were made in order to retain irrigation water for gradual percolation. Plots were spaced 1m ×0.5m between and within each replication.

The method of sowing for (dibbling, drilling and broadcasting) was used at a uniform inter and intra row spacing of 20 cm, in a groove of 2- 4 cm deep spaced at 20 cm and manually spread using hand and covered lightly with soil for effective germination for dibbling, drilling and Broadcasting respectively, while Seed rate used was 80 kg/ha for all.

Poultry manure was incorporated to depth of 5 cm into the soil according to the treatment and irrigated instantly to stimulate its biodegradation at seven days prior to sowing. The experimental plots was irrigated again two days to sowing, thereafter irrigation was given at seven days interval up to 30 days and later reduced to five days interval up to hard dough stage when irrigation was stopped. Other agronomic practices were adequately carried out. At

full physiological maturity the crop harvested, dried for three days and then threshed.

The soil samples obtained from the experimental site was analyzed to ascertain the content of organic carbon; available phosphorus; exchangeable bases (sodium Na^+, potassium K^+, calcium Ca^{2+} and Magnesium Mg^{2+}); CEC, total nitrogen and pH. Organic Carbon was determined using the Walkley and Black (1934) method. The pH was determined using 1:2 CaCl2 dilution method. Available phosphorus (P) content determination was done using the colorimeter method using sodium hydrogen carbonate extraction. The determination of Exchangeable Bases was done using Flame photometry using the ammonium acetate extraction technique. The CEC was determined using the ammonium acetate saturation method as described by Hesse (1971). Similarly, analysis of nutrient source was also carried out in the laboratory to determine the nutrient contents.

Data were collected on number of stems per 0.25 m^2, Number of productive stem 0.25 m^2, and Yield tonnes per hectare. The data collected was subjected to analysis of variance (ANOVA) using SPSS version 22 to study the effect of the treatment. Duncan Multiple Range Test (DMRT) $P \leq 0.05$ was used in separating the treatment means as describe by (Steel *et al.*, 1997).

Results and Discussion

Data obtained in table 1. Shows the physico-chemical properties of the experimental site of Gwallagwa Mayaka fadama farm, Bauchi during the dry season of 2013 and 2014. The results obtained revealed that average percentage of particle size distribution was sand 12.4 %, silt 57.7%, clay-22.2% in 2013 and for 2014 sand (17.2%),silt (63.2%), and clay (23.2%) and the textural class of the soil was clay loam and pH was slightly acidic. The results further indicated that the soil of the experimental site was only marginally fertile, especially as most of the parameters were only within the low to medium range as compared with the rating of Esu (1991) as presented in table 2. Marginal fertility is a characteristic of many tropical soils (Young, 1981), mainly because of the high rate at which organic matter is lost probably attributed to the nature of agricultural practices in the area

Table 3: shows the major Nutrient contents of poultry manure used in the experiment on dry weight basis during 2013-2014. The analysis of poultry manure shows that, Nitrogen content 1.12 kg/ha, Phosphorus 1.17 kg/ha and potassium 1.02 kg/ha was the Nutrients supply in the soil. Application of 2.5 t/ha poultry manure supply 70% of Nitrogen, 76% of phosphorus and 64% potassium. The result shows that supply of nutrient to soil tends to increase with increased doze of poultry manure.

The influenced of tillage operation, planting method and poultry manure on number of stems per 0.25m^2, number productive stem 0.25m^2 and grain yield (kg/ha) is presented in table 4. There was no significant variation between the two methods of tillage operation throughout the period of investigation. However, variation observed among both the planting methods and poultry manure levels. The results indicated that application of 10.0t/ha was found to be significantly ($P \leq 0.01$) than all the other treatments and the control was the least in all the characters studied. At different planting methods, dibbling and drilling methods of planting produced significantly ($P \leq 0.01$) higher number of stems per 0.25m^2. However, dibbling was significantly better than all other methods and the broadcasting was least on productive stems per 0.25m^2 and grain yield (t/ha). Better performance of dibbling method of planting could be attributed to proper spacing which gave enough room for nourishment for photosynthesis and assimilates absorption from the soil due to less competition between adjacent plants as compare to other planting methods. The present findings therefore lend support from the work of Kawure *et al*, (2017) who reported that rice under dibbling had higher number of productive tillers and grain yield than drilling and dibbling.

Table 1: Physico-chemical properties of the soil at gwallagwa mayaka experimental sites at the depth of 0-30 cm

Particle size distribution	Depth (см)			
	2013		2014	
	0-15	15-30	0-15	15-30
Silt, %	63.05	52.17	65.27	61.22
Clay, %	21.64	22.67	22.34	24.14
Sand, %	12.29	12.44	17.32	17.09
Textural class	Clay loam	Clay loam	Clay loam	Clay loam
pH water (1:1)	6.00	5.53	6.31	6.10
pH $CaCl_2$ (1:2)	5.6	5.10	5.40	5.50
Organic carbon (g/kg)	1.76	0.99	1.59	1.34
Total nitrogen (g/kg)	0.30	0.15	0.25	0.20
Available P, (mg/kg)	8.43	5.87	6.23	6.02
C:N	6.32	6.47	6.12	6.36
Humus, %	1.52	0.86	1.71	1.43
CEC (Cmol/kg)	4.60	5.61	4.34	4.50
Exchangeable Bases (Cmol/kg)	Ca^{+2}	3.01	4.02	2.10	2.01
	Mg^{+2}	0.86	1.29	0.97	0.95
	K^{+1}	0.45	0.22	0.30	0.32
	Na^{+1}	0.14	0.25	0.02	0.03

Table 2: Rating for soil fertility in Nigeria as adopted by Esu (1991)

Parameter	Rating		
	Low	Medium	High
Organic C (gkg^{-1})	< 10	10 - 15	>15
Total N (gkg^{-1})	< 1.5	1.5 – 20	> 2.0
Available P ($mgkg^{-1}$)	< 10	10 - 20	>20
Available K ($cmol(+)kg^{-1}$)	< 0.15	0.15 – 0.30	>0.30
Exch. Ca ($cmol(+)kg^{-1}$)	< 2	2 -5	>5
Exch. Mg ($cmol(+)kg^{-1}$)	< 0.3	0.3 1.0	>1.0
CEC ($cmol(+)kg^{-1}$)	< 6	6 -12	>12

Table 3: Nutrient contents of poultry manure used in the experiment (percentage of dry matter form) during 2013-2014

Poultry manure t/ha	Percentage of NPK nutrients supply in the soil, in kg/ha		
	Nitrogen, 1,12	Phosphorus, 1,17	Potassium, 1,02
2,5	70	76	64
5,0	140	152	128
7,5	210	229	192
10,0	280	305	254

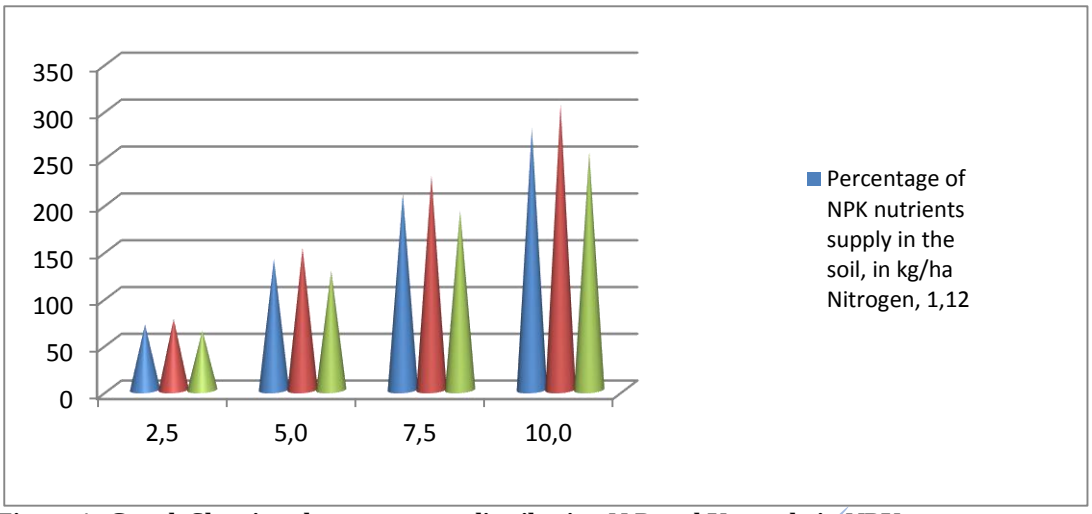

Figure 1: Graph Showing the percentage distribution N,P and K supply in NPK

Table 4: Effect of Tillage operation, planting methods and levels of poultry manure on the number stems per, number of productive stems per 0.25 cm^2 and yield of spring wheat during 2013-2014

Treatment	No of stems per 0.25 m^2	No of productive stems 0.25m^2	Yield (t/ha)
Tillage Operation			
Moldboard	370	358	2.85
No till	377	339	3.02
LS	NS	NS	NS
SE±	-	-	-
Planting Methods			
Broadcasting	370^b	335^c	2.93 ^{b}
Drilling	374^a	366^b	3.53 ^{b}
Dibbling	377^a	373^a	3.69 ^{a}
LS	**	**	**
SE±	5.3	5.3	0.15
Poultry Manure (t/ha)			
Control 313c	307^d	1.44^f	
2,5	377^b	371^c	2.81^d
5,0	386^b	385^b	3.08^c
7,5	388 ^{b}	385^b	3.50^b
10,0	402 ^{a}	393^a	3.81^a
LS	**	**	**
SE±	13	6	0.18

Means followed by the same letter(s) within a column are not significantly different using Duncan multiple Range Test (DMRT), **= significant at P≤0.01.

Conclusion and Recommendation

From the results obtained in this study, It can be concluded that the cultivation of spring wheat with the application of 10 t/ha and dibbling method of planting seems to be better practice and can therefore, be recommended for farmers in the study area. However, any of the tillage method can be adopted for wheat production in the study area, meanwhile more research are recommended in this area to justify for the best tillage operation for the production of the crop.

REFERENCES

A. Namakka1 *, A. H. Hassan2 , S. M. Ahmad3 , G. A. Lere1 and A. I. Sharifai4 (2014). Effect of tillage system on soil properties and yield of Oba 98 maize variety in Zaria. Net Journal of Agricultural Science Vol. 2(3), pp. 89-93, July 2014 ISSN: 2315-9766

Adedeji A, (2001). Land degradation and food supply. United Nations Economic Commission for Africa and FAO, Issues and options for food self Sufficiency in Africa. pp. 2-6.

Atkinson, H.S., Sparkes, D.L. and Mooney, S.J. (2007). Using selected soil physical properties of seedbeds to predict crop establishment, Soil and Tillage Research. 97(2): 218-228.

Çarman, K. (1997). Effect of different tillage systems on soil properties and wheat yield in Middle Anatolia, Soil and Tillage Research. 40 (3–4): 201–207.

Findly J.B., 1998. Conservation tillage with round up. Agric. Resources; Parklands, 2121, South Africa. pp. 19-21.

Hesse, P. R. (1971); A Text Book of Soil Chemical Analysis; John Murray Publishers Limited, London.**http://www.cimmyt.org http://www.lcrimaid.gov.ng/index.php**/78-featuring/137-nigeria-has-broken-the-wheat-jinx-agric-minister

Kawure S., Garba A.A., Shuaibu Y.M., Sabo M.U. and Bala R.A (2017). Productivity of lowland rice (*Oryza sativa* L.) as influenced by sowing methods. **In**: **Proceedings of the 31st Annual Conference of Farm Management Association of Nigeria (FARMAN)** held at Abubakar Tafawa Balewa University Bauchi, on 09th-12th October, 2017. 17-21Pp

Lindsay et al., 1999; Lindsay JI, Osei-Yeboah S, Gumbs FA, (1999). Effect of different tillage Methods on maize growth on tropical inceptisol with impeded drainage. *Soil and Tillage Research*, **3**(2):185– 196

Naresh[1*], R.K., Tomar, S.S., Purushottam, Singh. S.P., Dipender Kumar,Bhanu Pratap,Vineet Kumar and Nanher A.H. (2014). Testing and evaluation of planting methods on wheat grain yield and yield contributing parameters in irrigated agro-ecosystem of western Uttar Pradesh, India. *African Journal of Agricultural Research*,**9**(1):17-182. AcadmJournalshttp://www.academiournals.og/ AJAR

Ozpinar, S. and kay, A. (2006). Effect of different tillage systems on the quality and crop productivity of a clay–loam soil in semi-arid north-western Turkey, *Soil and Tillage Research*. **88** (1–2): 95–106.

Rashidi, M. and Keshavarzpour, F. (2009). Effect of Different Tillage Methods on Grain Yield and Yield Components of Maize (Zea mays L.), *International Journal of Agriculture and Biology*. **9** (2): 274–277.

Rasmussen, K.J. (1999). Impact of ploughless soil tillage on yield and soil quality: A Scandinavian review, *Soil and Tillage Research*. **53**(1): 3–14.

Scott M, (2008). Tillage system and efficient fertilizer use manual. P 38.Trough E, 1950. The determination of readily available phosphorus of soils. J Am Soc Agron, 22:879.USDA, 1960.,

Srivastava A.K.,Goering C.E., Rohrbach R.P. and Buckmaster D.R. (2006). Engineering Principles of Agricultural Machines. 2nd Edition, American Society of Agricultural Biological Engineers, Michigan.

Walkley, A. and Black, I. A. (1934); *An Examination of the Degtjaroff Method of Determining Soil Organic Matter and Proposed Modification of the Chromic Acid Titration*; ***Soil Science; 37: 29-38***

Wright, D., Marois, J., Rich, J. and Sprenkel, R. (2008). Field Corn Production Guide - SS-AGR- 85. Availableonline:http://edis.ifas.ufl.edu/pdffiles/ AG/AG20200.pdf

Young, A. (1976); Tropicael Soils an