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INTERACTION BETWEEN POULTRY MANURE RATES ON SOME PHYSIOLOGICAL PARAMETERS OF WHEAT VARIETIES IN KURU, NIGERIA

H.S Ali[1] and J.W Wabekwa[2]

1. Cereal Department, Lake Chad Research Institute, Maiduguri, Borno state, Nigeria
2. Department of Crop Production, University of Maiduguri,Borno state, Nigeria.

Email:hyermaali@gmail.com

Corresponding Author Contact:

wasinaninda@gmail.com

ABSTRACT

Field experiments were conducted at the Lake Chad Research Institute, Research and Experimental Farm in Kuru, Plateau State, Northern Guinea Savanna, Nigeria, in 2019 and 2020 rainy seasons. The objective of the study was to identify the wheat variety (ies) (*Triticum aestivum* L.) with genetic ability to adapt to the study area and responds to the application poultry manure at different rates. The field experiment was laid out in a split plot design and consisted of five rates of poultry manure (0, 2.5, 5.0, 7.5 and 10.0 t ha^{-1}) and three wheat varieties (Attila 7, Norman and TeeVee 1) which were replicated three times. Data were collected on plant establishment count, chlorophyll content, leaf area and grain yield. There was no significant difference recorded on plant establishment count between Attila 7 and Norman with the application of poultry manure at 10 t ha^{-1}. Norman on the other hand recorded the highest chlorophyll content (176 g mg^{-1}), leaf area(90.0 cm^2) and grain yield at harvest(4761.5 kg ha^{-1}) with the application of poultry manure at 10 t ha^{-1}.This result therefore indicates that Norman has shown higher superiority to adapt in terms of grain yield performance with the application of poultry manure at 10 t ha^{-1} which out-yielded all other rates under review and can conclusively be the recommended variety and the application rate for poultry manure for optimum wheat production in the Northern Guinea Savanna of Nigeria

Key words: poultry manure, wheat varieties, tonnes ha^{-1}, grain yield

1.0 Introduction

Wheat (*Triticum aestivum* L.**)** is a cereal crop and belongs the Graminae family. It originated from the Levant region of the Near East and Ethiopian highlands, but is now cultivated Worldwide (Belderok *et al*., 2000). Wheat cultivation in Nigeria, dates back to the 16th century when it was cultivated on small plots and pockets of inland valley soils (fadama), using local cultivars that were tall (about 1.2 meters, late maturing of about 150 days after sowing and low yielding (Magaji *et al*., 2012) and its production increased from 6 thousand tonnes in 1970 to 60 thousand tonnes in 2019 growing at an average annual rate of 12.34% (FAO 2020). Wheat grain serves as raw materials for the manufacture of alcoholic drinks and other beverages while

the flour is the major source of the world's bread-making industry. The starch is used for pastries and sizing textiles, the straw is made into mats, carpets, baskets and cattle bedding and paper manufacturing (Iqtidar *et al*., 2006). The bran from wheat milling is used as an important livestock feed, while the germ is a valuable addition to feed concentrate.

The cost and scarcity of inorganic fertilizer which is now out of reach to most peasant farmers who are predominantly the major contributor to the agricultural sector and have therefore limited their productivity in crop production. Among the different sources of organic manure which have been used in crop production, poultry manure was found to be the most concentrated in terms of nutrient content (Lombin *et al.*, 1992). According to Brady and Weil (1999), poultry manure mineralizes faster than other animal manure hence it releases its nutrients for plant uptake and utilization rapidly. Sharply and Smith (1991) reported that poultry manure contains basic nutrients required for enhancing growth and yield of crops. Application of poultry manure increases carbon content, water holding capacity, aggregation of soil, and decreases bulk density (Egerszegi, 1990). It also increases the water soluble and exchangeable potassium and magnesium which enhance crop yield (Jackson *et al*., 1999). It is high in nutrient content, especially nitrogen, phosphorus and potassium.

The use poultry manure as an organic source of fertilizer is now an alternative because it is cheap**,** readily available, littered around homes, roads and other public places in rural communities and many other communities of the Northern Guinea Savanna, and it is environmental-friendly and possesses soil amending properties although its agronomic potentials have not yet been fully utilised. There is therefore the need for increased dependence on the use of organic waste such as poultry manure, for future agriculture. The objectives of this study were to provide the variety(ies) that will be adapted to the study area, to recommend the rate of poultry manure that is optimum for the production and to provide information for further research in poultry manure for wheat production

2. Materials and Method

2.1 Study Area

The experiment was conducted in the 2019 and 2020 rainy seasons on the Research and Experimental Farm of the National Root Crop Research Institute, Sub-station in Kuru LGA of Plateau state (09° 20' N and 09° 36' E) 1238 m above sea level.

2.2 Treatments and Experimental Design

The treatments consisted of five poultry manure rates, 0, 2.5, 5.0, 7.5 and 10 t ha^{-1} which were incorporated in the field two weeks after land preparation and allowed to decomposed before seed sowing and three

varieties of wheat (Attila 7, Norman and TeeVee 1) where obtained from the Lake Chad Research Institute, Maiduguri which were laid out in a split plot design with the varieties allocated to main plots and poultry manure to sub-plots. Soil and poultry manure samples were analyzed for some physiochemical properties using standard laboratory procedures.

2.3 Cultural Practices

Seeds were treated with Apron star 40WS at the recommended rate of one sachet (10 g) to 3 kg of seed before sowing. Sowing was done by drilling at an inter-row spacing of 30 cm at a seeding rate of 100 kg ha^{-1}. Hoe weeding was carried out at 3, 6 and 9 WAS. Harvesting was done manually at 12 WAS and the ripe grains were harvested from the net plots using sickles and sticks; and jute bags were used for threshing while trays were used for winnowing the chaff from grains.

2.4 Data collection

Data on establishment count, plant chlorophyll content and leaf area were all recorded at the peak of vegetative growth of 9WAS except grain yield which was recorded at plant maturity. The data collected were analysed using Analytical software "Statistix" 8.0 and the treatment means were compared using Duncan's multiple range test (DMRT) at 5% level of significance (Duncan,1955).

3.0 Result

Laboratory analysis on soil properties for the 2019 and 2020 rainy seasons are as follows: the textural classes for the study area was sandy-loam with carbon contents of 0.92% and 0.97% in 2019 and 2020 respectively. The percentage N was 0.08 for both years, while K were 59.4 ppm in 2019 and 60.0 ppm in 2020. The organic carbon composition of poultry manure used were 11.6% in 2019 and 11.7% in 2020. Phosphorus (P) compositions were 2.0% and 2.1% in 2019 and 2020 respectively while potassium (K) were 1.0% in 2019 and 1.9% in 2020. Total rainfall during the cropping season (July-October) was 596mm in 2019 and 1203 mm in 2020. Rainfall was at its peaked in August in both years; average relative humidity of 62.1% in 2019 and 71.1% in 2020 was recorded and mean monthly temperature were 20.3^0 C in 2019 and 19.1^0 C in 2020.

The result on table 1 shows that there were highly significant differences recorded with increase in the poultry manure rates on plant establishment count (m^2)in both rainy seasons and the average for the two years. Attila 7 had the highest number of established plants in 2019 (1208.3m^2) 2020 (1385.0 m^2) and 1296.6 m^2 in the average of the two years which was not statistically different with Norman in 2019 (1173.0 m^2),2020 (1194.3 m^2) and the average for the two years(1183.7 m^2) with the application of poultry manure at 10 t ha^{-1} each.

Table 1: Interaction between wheat varieties and poultry manure rates on establishment count(m^{-2}) in Kuru, in 2019, 2020 and the average.

Treatment	2019	2020	Mean
Attila 7 x 0.0 ton ha^{-1}	76.3^{ij}	74.0^{j}	75.5^{h}
Attila 7 x 2.5 ton ha^{-1}	184.7^{hi}	346.7^{g-i}	265.7^{g}
Attila 7 x 5.0 ton ha^{-1}	604.0^{d}	642.0^{ef}	623.0^{d}
Attila 7 x 7.5 ton ha^{-1}	995.3^{b}	901.0^{de}	948.1^{ab}
Attila 7 x 10.0 ton ha^{-1}	1208.3^{a}	1385.0^{a}	1296.6^{a}
Norman x 0.0 ton ha^{-1}	77.7^{j}	79.7^{ij}	780.7^{cd}
Norman x 2.5 ton ha^{-1}	489.7^{e-g}	499.0^{fg}	494.3^{ef}
Norman x 5.0 ton ha^{-1}	596.7^{de}	648.7^{d-f}	622.7^{d}
Norman x 7.5 ton ha^{-1}	873.0^{c}	838.0^{c-e}	855.5^{cd}
Norman x10.0 ton ha^{-1}	1173.0^{a}	1194.3^{ab}	1183.7^{ab}
TeeVee 1 x 0.0 ton ha^{-1}	89.3^{h-j}	78.7^{ij}	84.5^{j}
TeeVee 1 x 2.5 ton ha^{-1}	205.0^{h}	227.3^{h-j}	216.1^{h}
TeeVee1 x 5.0 ton ha^{-1}	382.0^{g}	429.3^{f-h}	405.6^{ef}
TeeVee 1 x 7.5 ton ha^{-1}	561.0^{d-f}	628.3^{ef}	594.5^{e}
TeeVee 1 x 10.0 ton ha^{-1}	884.3^{c}	894.7^{bc}	889.0^{bc}
SE±	**57.07**	**62.25**	**50.48**

Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability accsording to DRMT.

3.2 Chlorophyll Content (g mg^{-1})

Table 2 shows the result for chlorophyll content in 2019, 2020 and the average for the two years. Significant difference was recorded among the treatments. Norman recorded the highest value of chlorophyll content in 2019 (186.1 g mg^{-1}) and the average for the two years (176.1 g mg^{-1}) while in 2020 Attila 7 recorded the highest chlorophyll content (193.5 g mg^{-1}) with application of poultry manure at 10 t ha^{-1}

Table 2: Interaction between wheat varieties and poultry manure rates on plant chlorophyll content (g mg^{-1}) in Kuru , in 2019, 2020 and the average

Treatment	2019	2020	Mean
Attila 7 x 0.0 ton ha^{-1}	29.3^{hi}	30.8^{j}	30.1^{g}
Attila 7 x 2.5 ton ha^{-1}	52.2^{g}	77.3^{g}	64.8^{ef}
Attila 7 x 5.0 ton ha^{-1}	76.2^{f}	120.9^{d}	99.9^{d}
Attila 7 x 7.5 ton ha^{-1}	113.8^{e}	149.2^{c}	131.5^{b}
Attila 7 x 10.0 ton ha^{-1}	136.0^{cd}	193.5^{a}	164.8^{b}
Norman x 0.0 ton ha^{-1}	26.8^{hi}	20.3^{kl}	23.5^{h}
Norman x 2.5 ton ha^{-1}	51.3^{g}	57.0^{h}	54.2^{f}
Norman x 5.0 ton ha^{-1}	123.9^{de}	83.2^{fg}	103.5^{cd}
Norman x 7.5 ton ha^{-1}	161.5^{b}	104.6^{e}	133.0^{b}
Norman x 10.0 ton ha^{-1}	186.1^{a}	166.2^{b}	176.1^{a}
TeeVee 1 x 0.0 ton ha^{-1}	17.0^{i}	15.1^{l}	16.1^{h}
TeeVee 1 x 2.5 ton ha^{-1}	41.5^{gh}	23.8^{kl}	32.7^{g}
Tee Vee1 x 5.0 ton ha^{-1}	76.2^{f}	37.6^{j}	56.9^{f}
TeeVee 1 x 7.5 ton ha^{-1}	84.7^{f}	51.6^{hi}	68.2^{e}
TeeVee 1 x 10.0 ton ha^{-1}	155.0^{bc}	74.9^{g}	115.0^{c}
SE+	**9.37**	**6.43**	**5.45**

Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability according to DRMT.

3.3 Leaf Area (cm^2)

Results on Table 3 shows that there was highly significant differences among the treatments on leaf area in the two years rainy seasons and their average. In 2019 and the average for the two years, Norman and the application of poultry manure at 10 t ha^{-1} recorded the highest leaf area (115.0cm^2 and 90.0 cm^2)respectively. In 2020, However, TeeVee 1 recorded statistical increase in leaf area than other interactions in 2019 (78.4cm^2) with the application of poultry manure at 10 t ha^{-1}

Table 3: Interaction between wheat varieties and poultry manure rates on leaf area (cm^2) in Kuru, in 2019, 2020 and the average

Treatment	2019	2020	Mean
Attila 7 x 0.0 ton ha^{-1}	14.2^{l}	11.4^{j}	12.8^{j}
Attila 7 x 2.5 ton ha^{-1}	28.8^{j}	26.5^{g}	27.6^{h}
Attila 7 x 5.0 ton ha^{-1}	35.6^{gh}	37.2^{f}	36.4^{fg}
Attila 7 x 7.5 ton ha^{-1}	52.6^{f}	48.2^{d}	50.2^{e}
Attila 7 x 10.0 ton ha^{-1}	63.3^{e}	53.8^{c}	58.5^{d}
Norman x 0.0 ton ha^{-1}	11.1^{lm}	16.3^{j}	13.7^{j}
Norman x 2.5 ton ha^{-1}	25.2^{hi}	22.9^{h}	24.0^{h}
Norman x 5.0 ton ha^{-1}	65.2^{d}	29.4^{g}	47.3^{e}
Norman x 7.5 ton ha^{-1}	86.3^{b}	55.2^{c}	70.7^{c}
Norman x 10.0 ton ha^{-1}	115.0^{a}	64.9^{b}	90.0^{a}
TeeVee 1 x 0.0 ton ha^{-1}	20.2^{k}	17.9^{i}	18.9^{i}
TeeVee 1 x 2.5 ton ha^{-1}	38.9^{g}	27.6^{g}	33.3^{h}
Tee Vee1 x 5.0 ton ha^{-1}	32.9^{i}	43.5^{e}	38.2^{f}
TeeVee 1 x 7.5 ton ha^{-1}	76.0^{c}	66.1^{b}	71.0^{c}
TeeVee 1 x 10.0 ton ha^{-1}	84.5^{bc}	78.4^{a}	81.4^{b}
SE±	**4.45**	**1.43**	**233.58**

Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability according to DRMT.

3.4 Grain Yield (kg ha^{-1})

Results on Table 4 shows that Norman with the application of poultry manure at 10 t ha^{-1} significantly differed on grain yield from all other treatments in the average of the two years (4761.5 kg ha^{-1}).In 2019, Attila 7 and Norman (3940.9 kg ha^{-1} and 4837.8 kg ha^{-1}) and in 2020 (4775.0 kg ha^{-1} and 4685.2 kg ha^{-1}) did not differ significantly with the application of poultry manure at 10 t ha^{-1} while the unfertilized plot recorded the least grain yield in both years and the mean.

Table 4: Interaction between varieties and poultry manure rates on grain yield (kg ha^{-1}) in Kuru, in 2019, 2020 and the average for the two years

Treatment	2019	2020	Mean
Attila 7 x 0.0 ton ha^{-1}	247.0^{i}	365.8^{h}	429.9^{i-k}
Attila 7 x 2.5 ton ha^{-1}	996.2^{h}	118.9^{g}	557.5^{i}
Attila 7 x 5.0 ton ha^{-1}	2036.7^{fg}	1894.4^{ef}	1965.5^{gh}
Attila 7 x 7.5 ton ha^{-1}	3425.6^{d}	3928.9^{b}	3677.2^{b}
Attila 7 x 10.0 ton ha^{-1}	3940.9^{ab}	4775.0^{a}	4339.9^{b}
Norman x 0.0 ton ha^{-1}	138.3^{i}	284.9^{h}	219.6^{k}
Norman x 2.5 ton ha^{-1}	1092.8^{h}	1202.4^{g}	144.6^{hi}
Norman x 5.0 ton ha^{-1}	1873.4^{g}	1838.7^{f}	1856.0^{fg}
Norman x 7.5 ton ha^{-1}	3650.0^{cd}	3380.9^{c}	3515.4^{d}
Norman x 10.0 ton ha^{-1}	4837.8^{a}	4685.2^{a}	4761.5^{a}
TeeVee 1 x 0.0 ton ha^{-1}	148.0^{i}	303.5^{h}	225.7^{ij}
TeeVee 1 x 2.5 ton ha^{-1}	1326.0^{ih}	1323.5^{g}	1324.7^{i}
Tee Vee1 x 5.0 ton ha^{-1}	2368.1^{ef}	2247.6^{d-f}	2307.8^{d}
TeeVee 1 x 7.5 ton ha^{-1}	3541.3^{cd}	3434.2^{c}	3487.7^{d}
TeeVee 1 x 10.0 ton ha^{-1}	4397.1^{ab}	4106.3^{b}	4251.7^{c}
SE+	**15.13**	**13.49**	**22.19**

Means in the same column followed by the same letter(s) are not statistically significant at 5% level of probability according to DRMT.

4. Discussion

Early and high germination percentage of seeds is one of the most effective criteria for the establishment of plants as well as high yield of any crops. Application of Poultry manure at the rate of 10 t ha^{-1} recorded increase in the number of established plants because the organic manure improved physical properties of the soil. This work also agree with Badruddin *et al.*,(1999) reported that there were significant increase in number of established plants when organic fertilizers was applied. The significant difference observed among the varieties where related to their various responses to soil and climatic conditions of the study area which attributed to higher establishment counts as reported by Voltas(2005).Higher performances recorded in chlorophyll contents between Attila 7 and Norman suggests the genetic superiorities in

these two varieties in terms of the uptake and utilization of N for chlorophyll synthesis also Poultry manure applied at 10 t ha^{-1} poultry manure increased plant chlorophyll content and this is attributed to the nitrogen and phosphorus supplied through the manure which ultimately play a greater role in chlorophyll formation.

Increase in leaf area is due to enhanced nitrogen availability for cell elongation, growth, photosynthesis and metabolism and accumulation of nitrogen along with other assimilates in leaf and culm (Haberle *et al*., 2008). When there is increased availability of nitrogen, allocation of nitrogen to flag leaf is increased causing its rapid growth while dry matter accumulation makes it stay green for longer period of time (Gaju *et al*., 2014). The leaf area is a function of canopy development and this increase with successive increase in the growth stages. Similar results has also reported by Amujoygbe *et al*.(2007), reported that increased application rate of poultry manure enhanced leaf area, total chlorophyll content, carbon content, water holding capacity and decrease bulk density of soil which culminate and interplay to promote yield. Poultry manure applied at the rate of 10 t ha^{-1} increased leaf area because as a growth component increased poultry manure application influenced increase in growth activities which culminates to leaf surface increase.

The application of poultry manure at the rate of 10 t ha^{-1} recorded the highest grain yield due to the fact that nitrogen enhanced earlier photosynthetic efficiency of the plant which also increased assimilates that were later used for grain production; and phosphorus application which enhanced grain filling. Similar results was found by Hammed *et al*., (2011) who observed that the combination of green manure (GM), Farmyard manure(FYM), poultry litter(PL), press mud(PM) and sewage sludge(SS) each at 10 t ha^{-1} gave maximum economic yield. Poultry manure has high N and P content therefore increase grain yield. These results are in line with Bhandari *et al.*,(2002) who reported that increasing concentration of N increased grain yield. Norman recorded the highest grain yield at 10 t ha^{-1} poultry manure due to its ability to respond better to fertilizer supplied especially at the crop production phase.

5. Conclusion and Recommendation

From the results obtained in this study it can be concluded that the variety Norman with the application of poultry manure at the rate of 10 t ha^{-1} has proved to be more promising

in terms of grain yield performance than all other treatment combinations and this increase out-yielded all other rates and can conclusively be the recommended variety and poultry manure application rate for Northern Guinea Savanna of Nigeria for optimum production.

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