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Productivity of cabbage (Brassica oleracea L.) as affected by organic manure and varieties grown in Jos Plateau State. Nigeria

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ABSTRACT

The experiment aimed to evaluate the effect of organic manure and variety on the growth and yield of cabbage (*Brassica oleracea* L.) grown in Jos, Plateau State, Nigeria. The experiment is laid in a randomized complete block design with three replications. The treatments used are organic manure sources (Poultry dropping, Cow dung, goat manure, dung site, and control), a varieties used where (Copenhagen and Gloria) and the spacing of 50cm by 50cm was adopted for the experiment. During the investigation, some physiological variables, such as growth, plant height and the number of leaves were measured. Other characteristics like dry weight, plant girth, root length, head diameter, head length and overall yield were also recorded. The results of the investigation revealed that cabbage (Brassica oleracea L.) generally responded to nutrient sources. All the parameter studies have significantly ($P \leq 0.05$) responded to the nutrient source with poultry dropping been superior in both growth and yield-related character such, as plant height (10.00), the number of leaves(20.11), dry weight (10.17), girth weight (48.22), root length (8.61), head diameter (15.40), head length (28.71) and yield (30.10). On verities Gloria out performed Copenhagen in both growth, yield and yield related characters such as plant height (9.45), the number of leaves(20.91), dry weight (10.92), girth weight (42.27), root length (10.23), head diameter (14.91), head length (31.71) and yield (32.22). Based on the results obtained it can be suggested that the use of poultry dropping which is better in both growth and yield characteristics will lead to optimum yield in cabbage cultivation in the study areas.

Keywords: Cabbage, Organic nutrient and Variety

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INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata* L.) belongs to the *cruciferae* family. It is an important vegetable crop in most countries of the world. The marketable head of cabbage is an excellent source of vitamins, minerals and dietary fibers and is consumed fresh as salad and cooked as a vegetable or utilized as a processed product. It contains a range of essential vitamins (Vitamin C & B) and minerals such as potassium and calcium to the diet, as well as a small amount of protein and good caloric value, which was 250 mL of raw cabbage, contains 21 kilocalories and cooked, 58 kilocalories (Haque, 2006). Cabbage is easily grown under a wide range of conditions and is adaptable to most areas of Africa (Smith, 1995). According to Grubben and Denton (2004), it can be grown throughout the year in most parts of Africa. Good performance has been reported in places like Jos Plateau and Kaduna State, Nigeria to have the highest cabbage production in Africa (Jim and Tony, 2006). The food and Agricultural Organisation (FAO, 1988) has identified cabbage as one of the top twenty vegetables and an important source of food globally. It has been domesticated and used for human consumption since the earliest antiquity (Smith, 1995). It is a rich source of vitamins A and C. The green outer leaves of cabbage are richer in vitamin A, calcium and iron than the white inner leaves.

Organic fertilizers on the other hand enrich the soil's organic matter, which improves soil structure or workability (soil tilth), making the soil easier to plough (sand and clay soils). Therefore, the application of organic fertilizers assists in the structuring of soil to open and admit air penetration to roots and water drainage, both conditions necessary for satisfactory plant growth (Eimhoit et al., 2005).

Most vegetable crops return small amounts of crop residue to the soil, so manure, compost, and other organic amendments help maintain soil organic matter levels. There is a shift in consumer preference due to the danger caused by chemicals to the human body, consumers tend to use organic products continuously, and this has become a global trend. In response to consumer demand, organic food products are quickly growing (Peng, 2019).

All countries around the world report a trend of continual growth in the organic food and beverage market (Golijan and Dimitrijević, 2018). The demand for organic

Table 1. The effect of organic manure on plant height of cabbage grown in Jos, Plateau State Nigeria Weeks after planting (WAP).

Nutrient source (N)	4	6	8	10	12
Control	3.23	4.18	5.50	6.10	7.83
CD	3.58	4.54	6.00	7.55	8.12
PD	4.67	6.02	8.75	9.20	10.00
GM	3.00	4.91	6.88	7.58	8.43
DS	3.91	5.21	7.75	8.98	9.64
LSD (0.05)	0.20	0.32	0.62	0.72	0.89
Variety (V)					
Copenhagen	3.00	3.96	5.79	6.94	8.56
Gloria	3.98	4.27	6.43	7.02	9.45
LSD (0.05)	0.62	1.12	1.01	1.78	1.01
Interaction					
NXV	NS	NS	NS	NS	NS

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

products has been reported to be increasing in both local and international markets (Declaro-Ruedas, 2019), and is expected to continue growing, especially in developed countries, while the supply of organic products is limited and still cannot produce enough organic products to meet the market demand. It was on this background that the field investigation was carried out to study the influence of organic nutrient sources and variety on physiological growth analysis, yield and yield-related characteristics of cabbage.

The aim of the study was to find out which of the organic source of nutrients and cabbage variety will be good for farmers in the study locality.

MATERIAL AND METHOD

The experiment was carried out in Mararaban Jama'a Jos at (9º 50`N 11º 09`E). The experiment aimed to evaluate the effect of organic manure on the growth and yield of cabbage (*Brassica oleracea* L.) grown in Jos, Plateau State. Nigeria during the 2020 and 2021 Rainy Seasons. Spacing (15cm) was used, the variety used was (Copenhagen and Gloria) and Organic source (Poultry dropping, goat manure, Cow dung, dung site and control) was used. Poultry dropping was applied at the rate of 20 tones/ha and poultry dropping (100% Dry Matter, Organic Material 55%, Total Nitrogen 6.2%, Total Phosphorus 2.01% and Total Potassium 2.12%), Goat manure (Dry matter 52%, Organic Material 31%, Total Nitrogen 4.5%, Total Phosphorus 1.0% and Total Potassium 1.3%), Cow dung (Dry matter 22%, Organic Material 21%, Total Nitrogen 11.0%, Total Phosphorus 0.8% and Total Potassium 0.9%) and dung site (Dry matter 32%, Organic Material 20%, Total Nitrogen 18.0%, Total Phosphorus 0.9% and Total Potassium 1.2%). All the organic manure are kept under intensive care and was allowed to undergo partial decomposition for three months following the recommendation of Bello (2015) before it was used for the experiment. Seedlings were raised in the sunken nursery bed. The seeds were raised in a nursery before transplanting to the field, the size of the nursery bed was 2m x 2m. The soil of the nursery was prepared well at a 3:2 ratio of soil and organic manure then it was watered and treated for pathogen by covering it with polythene tightly and kept for 10 days at 20 cm spacing, irrigated twice a day (morning and evening) to ensure good germination and establishment, the seeds germinated in 8-10 days after sowing for days (DAS). The seedlings were transplanted in the main field after 32-35 days after sowing (DAS). The nursery establishment is important because directly sown seeds may not germinate well. The experiment was laid in a randomized complete block design (RCBD) with three replicates, a $4m^2$ plot was laid out with 1m between plots and 1m between blocks. There were 8 plots each within a block which gave the total number of 23 plots for the study, a spacing of 50cm by 50cm was adopted for the research, Agronomic practice such as weeding was done manually at 2 and 6 weeks after planting to ensure weed-free plots, all the data were collected within the net plot of $4m^2$ where a total of 5 plants were tagged for data collection within each net plot. During the investigation, some physiological variables, such as growth, plant height (as taken with the aid of measuring tape from the base of the plant to the tip), the number of leaves (were counted). Other characters like root length (were measured with a tap), Dry weight (weight with digital weighing scale), plant girth, root length (were measured with a tap), head diameter (weight with digital weighing scale), head length (were measured with a tap) and overall yield measured in tonnes per hectare were also recorded. All data collected were subjected to analysis of variance (ANOVA), while the least significant difference (LSD) at a 5% level of probability was used in separating the means.

RESULT AND DISCUSSION

Table 1 shows the effect of organic manure and variety on the plant height of cabbage. A significant difference ($P<0.05$) was recorded in both manure and variety.

On manure, poultry dropping had recorded a progressive increase in higher plant height followed by dung site in all the weeks under consideration, this is not far from the fact that poultry dropping has high and fast mineralization/ decomposition leading to the early release of nutrient when compared with other organic sources, this finding agrees with the work of

Table 2. The effect of organic manure on the number of leaves of cabbage grown in Jos, Nigeria Weeks after planting (WAP).

Nutrient source (N)	4	6	8	10	12
Control	5.13	8.18	12.51	14.90	16.23
CD	7.68	10.12	13.05	15.25	17.12
PD	10.97	13.02	16.71	18.10	20.11
GM	6.30	9.91	14.84	16.78	18.19
DS	9.21	11.21	15.95	17.38	19.81
LSD (0.05)	1.03	1.12	1.62	1.01	1.00
Variety (V)					
Copenhagen	6.72	10.16	15.39	13.99	18.92
Gloria	7.52	12.37	16.23	14.22	20.91
LSD (0.05)	1.02	1.22	3.31	1.18	1.02
Interaction					
NXS	NS	NS	NS	NS	NS

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

Table 3. The effect of organic manure on yield and yield-related characters of cabbage grown in Jos, Nigeria at harvest.

Nutrient source (N)	Dry Weight/plant (g)	Girth (cm)	Root length(cm)	Head diameter(cm)	Head length(cm)	yield (t/ha)
Control	5.43	30.28	3.71	10.10	24.52	17.30
CD	7.46	36.42	5.15	12.32	20.60	20.05
PD	10.17	48.22	8.01	15.40	28.71	30.10
GM	8.24	34.61	4.84	13.41	23.57	23.88
DS	9.61	38.61	6.55	14.28	26.59	27.01
LSD (0.05)	1.01	2.02	1.01	0.92	2.02	3.02
Variety (V)						
Copenhagen	9.12	38.36	9.39	13.13	29.63	28.99
Gloria	10.92	42.27	10.23	14.91	31.71	31.22
LSD (0.05)	1.12	3.12	1.21	1.08	2.03	3.08
Interaction						
NXS	2.32	NS	NS	NS	1.23	1.54

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

Akanbi et al. (2006) who stated that poultry dropping affect plant height positively when compared with goat manure and cow dung. In addition, poultry manure is a fast-feed converter that increases not only plant height, but poultry dropping aids in soil aeration, retains moisture, improves microbial activities, and improves soil structure and colour (Bhardwaj and Koul, 2000).

On variety, Gloria outperformed Copenhagen in plant height, this can be attributed to varietal genetic makeup. Jim and Tony (2006) stated that genetic makeup and environmental condition leads to variability in plant vegetation and can affect the overall yield of the crop.

Table 2 shows the effect of organic manure and variety on the number of leaves of cabbage, with a significant difference ($P<0.05$) was recorded for both manure and variety. Poultry manure had a higher number of leaves in all the weeks under consideration, this could be attributed to the uptake of available nutrients which was fast released by poultry dropping utilized for vegetative growth which leaves is part of it. This is in agreement with the work of Olaniyi (2000) who stated that leave initiation and growth are a function of available nutrients, nutrient uptake and utilization. Knowing fully that manure gotten from birds has high nitric acids, meaning it contains more urea, which plays an important role in photosynthesis and aids the metabolic process and plant growth.

Gloria than in Copenhagen, which could be attributed to

On variety, a higher number of leaves was recorded in climatic conditions, cultural practice and genetic variability. The same finding was recorded by Smith (1995) who reported that adaptation to climatic, genetic variability and cultural practice initiate leaves and overall vegetative growth of plant.

Table 3 shows the effect of organic manure and variety on yield and yield-related characteristics of cabbage, where a significant difference ($P<0.05$) was recorded in both manure and variety.

On the nutrient source, the use of poultry droppings has outperformed all the other organic sources of nutrients used in all yield and yield-related characters considered. This is true because overall yield in cabbage is an attribute of dry matter weight, plant girth, head diameter and head length. This agrees with Olaniyi and Akanbi (2008) who stated that nutrient plays a positive influence on yield and yield-related character in plant. Lecuona (1996) also reported that poultry dropping releases its nutrient slowly throughout the plant growth thereby leading to higher yield and yield related characteristics, organic manure also played a role in increasing dry matter weight, plant girth, head diameter and head length as reported by Shika and Doug (2001).

On variety, the cultivation of Gloria had recorded higher dry matter weight, plant girth, head diameter and head length over Copenhagen, this could be highly influenced

Table 4. Interaction between variety and organic manure on the dry weight of cabbage grown in Jos, Plateau State, Nigeria.

Variety	Control	CD	PD	GM	DS
Copenhagen	5.12	6.39	9.59	6.83	7.33
Gloria	6.92	7.17	11.13	7.99	8.61
LSD (0.05)	0.92	1.02	1.81	0.98	1.01

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

Table 5. Interaction between variety and organic manure on head length of cabbage grown in Jos, plateau State, Nigeria.

Variety	Control	CD	PD	GM	DS
Copenhagen	18.12	22.36	29.39	25.33	27.53
Gloria	20.92	25.27	35.23	28.71	30.21
LSD (0.05)	1.32	2.12	1.21	2.01	23.13

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

Table 6. Interaction between variety and organic manure on yield of cabbage grown in Jos, plateau State, Nigeria.

Variety	Control	CD	PD	GM	DS
Copenhagen	19.82	22.36	29.39	23.23	26.43
Gloria	22.32	25.47	32.23	26.01	28.21
LSD (0.05)	2.02	2.62	2.01	2.48	2.03

CD= cow dung, PD=poultry dropping, GM=goat manure, DS=dung site, NS= not significant.

by the genetic make-up of the variety in consideration, this result conforms with the work of IBPGR (1990) who stated that genetic variability, adaptation to the environment and cultural practice, not only affect overall yield but also yield related characters positively. In addition, Sing and Kaik (1990) reported that most cultivars that do well are those that have adapted to the growing environment with available nutrients leading to an increase in dry matter weight (Smith, 1995).

Table 4 shows an interaction between variety and organic manure on dry weight of cabbage grown in Jos. A significant difference exists between variety and organic manure with a perfect interaction between Gloria and poultry droppings.

This shows that poultry dropping might have more nutrients released when compared with other nutrient sources as shown in the nutrient analysis in material and method (100% Dry Matter, Organic Material 55%, Total Nitrogen 6.2%, Total Phosphorus 2.01% and Total Potassium 2.12%), and an adaptable variety with the environment which can utilize the available nutrient gotten from the poultry droppings.

These findings conform with Williams and Peregrine (1991), who reported that dry matter weight in plant is obtainable when variety, nutrient source and the environment favours the plant in terms of uptake of nutrients, utilization of such nutrients for both plant growth, and yield-related components.

Table 5 is an interaction between variety and organic manure on dry head length of cabbage grown in Jos, where a significant difference was reported in a combination of Gloria and poultry droppings, this is not far from the truth that poultry dropping releases its nutrients gradually through-out the growing period thereby affecting both the vegetative stage and the yield related character of the plant couple with a good and adaptable variety. This finding is in agreement with Olaniyi et al (2010) who stated that high nitric acid which is utilized for photosynthetic activities in plants with an adoptable variety, good cultural practice and optimum climatic conditions could lead to heavier and lengthier cabbage head.

Table 6 shows the interaction between variety and organic manure on the yield of cabbage grown in Jos, where a perfect interaction exists between Gloria and poultry droppings. This could be attributed to the fact that yield is a component of yield-related characters, where head length, dry matter weight and head diameter contribute to the overall yield which is linked to the nutrient source and varietal difference, this finding is in agreement with the work of Madina et al (2021), who stated that nutrient and cultivars/varieties influences yield related characters and overall yield positively, the fast mineralization and decomposition of poultry manure released slowly throughout the growing period might have contributed to the overall yield as stated by Grubben and Denton (2004).

CONCLUSION

From the result obtained in this study, it can be seen that the cultivation of cabbage under organic nutrient sources particularly from poultry dropping superseded other organic nutrient sources, and variety, the cultivation of Gloria is better than Copenhagen. Therefore the cultivation of cabbage using poultry manure and in dung site can be recommended to farmers in the study area.

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