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The Production of Turmeric (*Curcuma Longa*) as Affected by Variety and Nutrient Source Grown in Jos, Nigeria

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ABSTRACT

The experiment was carried out at Jos at (9° 31'- 9o 50`N Latitude and 10° 41'N-11o 09`E Longitude above sea level in of Nigeria to investigate the productivity of Turmeric (*Curcuma longa*) as influenced by variety and nutrients sources grown in Jos, Plateau State. The experiment was laid in a Randomized Complete Block Design (RCBD) with three replications. Treatment were two varieties (UT25 and UT30) and organic sources of nutrients (compost 10t/ha, dung site 10t/ha, poultry droppings 10t/ha and control. Data collected were plant height, Number leaves, rhizome length, rhizomes diameter, rhizomes weight, number of rhizomes per plant, number of primary rhizomes, number of secondary rhizomes and yield was taken during harvest. The data were analyzed using (ANOVA) which indicated that UT25 outperformed UT30 in all the parameters under consideration and Poultry droppings shows superiority over the other organic nutrient used. Therefore, the use of UT20 and of poultry dropping which is less expensive is more preferable for turmeric farmers in this location for optimum yield.

Introduction

Turmeric is believed to be originated from south Asia around Vietnam, China, and west India (Kew, et al. 2016) the crop has been known as a domestic plant and not found in the wild, it is sterile but grows vigorously from rhizomes. The horizontal roots Is important, rhizome is both planting material and use commercially as source of money to the farmer. The crop is long duration crop 8-9 months and produces different sizes of propagules from the mother (shoot base) to daughter rhizome which are used as spice The daughter rhizomes don't develop at the same time as the shoot base. In the last few years as awareness of its many uses continues to increase, many farmers have begun to grow it as cash crop especially in the ginger growing areas of southern part of Kaduna State. Turmeric is a cross-pollinated, triploid species (2n =3x = 63), which can be vegetative propagated using its underground rhizomes (Sasikumar [1]). Curcuminoids and essential oils are the major active constituents in turmeric, crucial for the quality of both the plant and its processed products (He, et al, [2,3]). The demand for the crop is increasing due to its medicinal and nutritional value hence the need to come up with variety and organic nutrient source in cultivation of turmeric. In Nigeria about 19 States are prominent in turmeric production and it's given many names depending on the locality (Olojede, et al [4]) organic manure remain one of the most effective tool in improving the fertility status tilt and soil productivity, organic manure out weight the inorganic fertilizer in terms of having wide range of essential nutrients and organic matter needed by plants, since nutrients are held in organic form, it is therefore important to supply nutrients most especially organic nutrient to the soil to boost plant growth and yield Akanbi et al. (2015).

Consumers tend to use organic products continuously, and this has become a global trend due to health challenges and cheaper ways to source it. 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

products has been reported to be increasing in both local and international markets (Declaro-Ruedas, 2019), and is expected to continue growing, especially in both developed and developing countries, while the supply of organic products is limited and still cannot produce enough organic products to meet the market demand. The fertility of a soil and the level of acidity or alkalinity play an important role in determining the yield of the crops, which can be affected by intensive farming, hence the reason why proper soil quality management is required to sustain high yield in sorrel production (Talpur, et al. 2013). It is necessary to know the best practice and nutrient source and verity which could help in increasing the production of turmeric hence the need for this work. The objectives of the work therefore are to determine the effects of variety and nutrient source that influences growth and yield of turmeric in study.

Material and Methods

The experiment was carried out at Jos at (9° 31'- 9o 50`N Latitude and 10° 41'N-11o 09`E Longitude above sea level in of Nigeria to investigate the productivity of Turmeric (*Curcuma longa*) as influenced by nutrients and variety grown in Jos, Plateau State. The experiment was laid in a Randomized Complete Block Design (RCBD) with three replications. Treatment were two varieties (UT25 and UT30) and organic sources of nutrients (compost 10t/ha, (Dry matter 11%, Organic Material 10%, Total Nitrogen 10.0%, Total Phosphorus 0.2% and Total Potassium 0.4%), dung site 10t/ha(Dry matter 34%, Organic Material 12%, Total Nitrogen 3.5%, Total Phosphorus 1.0% and Total Potassium 1.3%), poultry droppings 10t/ha and Poultry dropping (100% Dry Matter, Organic Material 65%, Total Nitrogen 5.9%, Total Phosphorus 1.41% and Total Potassium 2.72%) and control), rhizome size of (2-3cm) where collected from both and cattle that where kept under intensive management, where the organic manure where kept/stored to undergo partial decomposition for five months following the recommendation of (Bello, 2015) with 10tones/ha before incorporation into the soil Agronomic practice such as wedding was done manually at 2weeks after sowing and earthing-up at 6 weeks after planting. Data collected were number of leaves, plant height, Number leaves, rhizome length, rhizomes diameter, rhizomes weight, number of rhizomes per plant, number of primary rhizomes, number of secondary rhizomes and yield weight was taken during harvest all the data were collected within the net plot of 4m2 where a total of 10 plants were tagged for data collection within each net plot.

The data collected were analyzed using (ANOVA) while least significant difference (LSD) at 5% level of probability was used in separating the means. Table 1 presents data on the effect of different varieties and nutrient sources on the plant height of turmeric grown in Jos, Nigeria, at various weeks after transplanting (WAT). Varietal Effect: Varieties (UT25 and UT30) and Nutrient Sources (Compost, Dung site, Poultry dropping, Control) where significant difference was observed ($P<0.05$) Plant height increases as the weeks progress for both varieties at each time point, UT25 consistently shows taller plants compared to UT30. UT25 tends to produce taller plants compared to UT30 across all weeks, this is not far from the assertion of Olojede and Nwokocha [5] who stated that most variation in vegetative growth is caused by genetic make-up, environmental factors and probably cultural practice. On nutrient source effect, plant height tends to increase with weeks for all nutrient sources. Poultry dropping consistently results in the tallest plants at each time point Poultry dropping is the most effective nutrient source for promoting plant height, this could be so because poultry dropping release its nutrient faster than other source of organic source, followed by compost and dung site, with the control group being the least effective. The Control group consistently shows the shortest plants. This findings collaborate with the work of (Miyakoshi, et al. [6]) who stated that poultry dropping releases it nutrient fast and through-out the plant cycle in the field, he added that residual effects could be experience if plant are planted in the same land in subsequent year.

Table 1: Effect of Variety and Nutrient Source on Plant Height of Turmeric Grown in Jos, Nigeria Weeks After Transplanting (WAT).

	4	6	8	10	12
Variety (V)					
UT25	4.23	15.72	30.53	40.53	59.45
UT30	3.14	12.02	28.82	38.62	52.98
F-LSD (0.05)	1.00	1.00	1.13	2.03	2.89
Nutrient (N)					
Compost	4.43	13.73	28.51	38.83	58.78
Dung site	3.78	12.00	27.67	37.45	54.12
Poultry dropping	5.62	16.63	30.73	40.71	60.45
Control	2.70	10.53	25.12	35.62	45.32
F-LSD (0.05)	0.48	0.61	1.23	1.24	2.65
Interaction					
VXN	NS	NS	NS	NS	NS

Note: LSD= Least Significant Differences at 5% Level of Probability.

This study provides valuable insights into the influence of varieties and nutrient sources on turmeric plant height in the given region and can guide farmers in making informed decisions for optimizing crop growth Olojede, et al. [5]. Table 2 investigates the impact of different turmeric varieties and nutrient sources on the number of leaves in turmeric plants grown in Jos, Nigeria. The experiment spans various weeks after transplanting (WAT), providing a comprehensive view of the development of leaves over time. Two turmeric varieties, UT25 and UT30, were subjected to different nutrient sources, including compost, dung site, poultry droppings, and a control group. The analysis of this work incorporates the leaf area as an additional metric for assessing overall plant development according to (Njoku, et al. [7]). The results reveal distinct patterns in leaf development influenced by both variety and nutrient source. Varietal Influence, UT25 consistently exhibits a lower number of leaves compared to UT30 at each WAT point. Leaf area is higher for UT25 than UT30, suggesting a potential trade-off between leaf number and individual leaf size which could be linked to genetic variability as reported by Ukpabi, et al. [8]. Nutrient source effect shows Poultry dropping stands out as the most effective nutrient source, consistently promoting a higher number of leaves across all WAT points. Compost and dung site also positively influence leaf development but to a lesser extent.

Table 2: Effect of Variety and Nutrient Source on Number of Leaves of Turmeric Grown in Jos, Nigeria.

Weeks after transplanting (WAT)					
	4	**6**	**8**	**10**	**Leaf area (cm^2)**
Variety (V)					
UT25	2.13	5.12	7.57	10.43	120.12
UT30	3.24	4.42	6.89	8.75	117.92
F-LSD (0.05)	1.01	1.1	1.15	2.01	1.23
Nutrient (N)					
Compost	2.23	4.83	6.65	8.98	118.01
Dung site	2.43	4.1	5.87	7.34	115.12
Poultry dropping	3.18	5.83	6.72	10.41	122.12
Control	2.01	3.73	4.87	6.87	110.12
F-LSD (0.05)	0.22	0.31	1.12	1.12	1.21
Interaction					
VXN	NS	NS	NS	NS	NS

Note: LSD= Least Significant Differences at 5% Level of Probability.

The control group consistently shows the lowest number of leaves, emphasizing the importance of nutrient supplementation this could be related to the ability of poultry dropping having high content of uric acid which in turn lead to leaf initiation and production through the process of photosynthetic activities, assimilation and distribution of absorb solute, this finding agree with the work of Onuoha, et al. [9] who reported same trend in his work on ginger he added that beside fast release of nutrient in poultry dropping it has ability to improve soil organic matter, binding soil colloids for sustainable cultivation of crops . This study contributes valuable insights into the nuanced relationship between turmeric varieties, nutrient sources, and leaf development Madina et al (2023). The findings can inform agricultural practices, guiding farmers in the selection of optimal varieties and nutrient management strategies for enhancing leaf initiation and production in turmeric cultivation (Akinpelu, et al. [10]). The provided data in Table 3 explores the impact of different turmeric varieties and nutrient sources on yield-related parameters of turmeric cultivated in Jos, Nigeria. The parameters analyzed include rhizome length, rhizome diameter, and rhizome weight per plant. The statistical significance is evaluated using the Least Significant Differences (LSD) at a 5% level of probability.

Table 3: Effect of Variety and Nutrient Source on Some Yield Related Parameters of Turmeric Grown in Jos, Nigeria.

Variety (V)	Rhizomes length	Rhizomes diameter (mm)	Rhizomes weight/plant (g)
UT25	6.87	4.54	40.21
UT30	5.78	3.32	36.11
F-LSD (0.05)	1.03	1.01	2
Nutrient(N)			
Compost	5	4.21	34.33
Dung site	5.34	3.12	38
Poultry dropping	6.83	5.01	41.73
Control	4.02	2.87	28.2
F-LSD (0.05)	0.33	0.23	1.41
Interaction			
VXN	NS	NS	*

Note: LSD= Least Significant Differences at 5% Level of Probability.

Rhizome Length

Varietal Effect: UT25 exhibits a longer rhizome length (6.87 mm) compared to UT30 (5.78 mm), on nutrient source Poultry dropping as a nutrient source results in the longest rhizomes (6.83 mm), followed by dung site (5.34 mm), compost (5.00 mm), and control (4.02 mm) this finding correspond with the report of Jiang [3] who stated that variety and nutrients plays an important role in rhizome length and over all yield.

Rhizome Diameter

UT25 has a larger rhizome diameter (4.54 mm) compared to UT30 (3.32 mm) this could be as the result inherent trads which had caused the variability, this finding is in line with the work of Ohaeri and Olajede (2001) who reported that growth and yield related character is influence by crop inherent ability, cultural practice and also rainfall pattern, on nutrient source, Poultry dropping leads to the largest rhizome diameter (5.01 mm), followed by compost (4.21 mm), dung site (3.12 mm), and control (2.87 mm) this is a facts that yield character is largerly affected by nutrient absortion and utilization as reported by (Olife, et al. [11]).

Rhizome Weight per Plant

UT25 results in a higher rhizome weight per plant (40.21 g) compared to UT30 (36.11 g) UT25 tends to produce larger and heavier rhizomes compared to UT30, and on nutrient source Poultry dropping as a nutrient source lead to the highest rhizome weight per plant (41.73 g), followed by dung site (38.00 g), compost (34.33 g), and control (28.20 g). Poultry dropping as a nutrient source generally leads to better rhizome development; weight is a product of nutrient assimilation, utilization, and varietal influence same is reported by the finding of Amadi et al. [12] who agreed with the above accretion adding that method and timing of nutrient application influences rhizomes weight and over-all yield. This study provides valuable insights into the combined effects of turmeric varieties and nutrient sources on key yield-related parameters, offering practical implications for farmers in Jos, Nigeria Madina et al., (2023) farmers may consider UT25 and poultry dropping for optimizing rhizome length and weight. Table 4 presents data on the influence of turmeric varieties and nutrient sources on yield and yield-related characteristics of crops cultivated in Jos, Nigeria. The parameters analyzed include the number of rhizomes per plant, the number of primary and secondary rhizomes, and the overall yield per hectare. Statistical significance is determined using the Least Significant Differences (LSD) at a 5% level of probability.

Table 4: Effect of Variety and Nutrient Source on Yield and Yield Related Characters of Turmeric Grown in Jos, Nigeria.

Variety (V)	Number of rhizomes/plants	Number of primary rhizomes	Number of secondary rhizomes	Yield (t/ha)
UT25	5.23	2.07	3.16	4.53
UT30	4.14	1.14	3.00	3.82
F-LSD (0.05)	1.00	1.00	0.12	1.13
Nutrient (N)				
Compost	3.43	1.20	2.23	3.00
Dung site	4.28	2.00	2.28	3.67
Poultry dropping	5.62	1.63	3.01	4.73
Control	3.00	1.40	1.60	2.12
F-LSD (0.05)	0.18	0.61	0.34	0.23

Interaction				
VXN	*	NS	NS	*

Note: LSD= Least Significant Differences at 5% Level of Probability.

Number of Rhizomes per Plant

On varietal UT25 exhibits a higher number of rhizomes per plant (5.23) compared to UT30 (4.14). On nutrient Source Poultry dropping as a nutrient source result in the highest number of rhizomes per plant (5.62), followed by dung site (4.28), compost (3.43), and control (3.00). These findings contribute valuable insights for Turmeric cultivation in the study area emphasizing the need for tailored nutrient management strategies based on specific turmeric varieties and growth stages Onwubiko, et al. [13].

Number of Primary Rhizomes

On varietal UT25 has a higher number of primary rhizomes (2.07) compared to UT30 (1.14). On nutrient Source Poultry dropping as a nutrient source leads to the highest number of primary rhizomes (1.63), followed by dung site (2.00), compost (1.20), and control (1.40), this could be true with poultry droppings due to its ability to release the needed nutrient fast and consistently at every stage of growth, development and initiating rhizomes production as reported by Ravindra, et al. [14].

Number of Secondary Rhizomes

On varietal effect, there is a minor difference in the number of secondary rhizomes between UT25 (3.16) and UT30 (3.00). On nutrient source Poultry dropping as a nutrient source result in the highest number of secondary rhizomes (3.01), followed by dung site (2.28), compost (2.23), and control (1.60). this true because secondary rhizomes are influenced by variety and nutrients source as reported by Nwokocha, et al. [4] that variety and nutrient plays a very important role in both growth, reproductive and yield parameters of plants he added that nutrients gotten from organic source mostly poultry dropping release their nutrient through-out the crop life cycle, improving secondary rhizomes, over all yield and soil organic matter.

Yield Per Hectare on Varietal Effect

UT25 produces a higher yield per hectare (4.53 t/ha) compared to UT30 (3.82 t/ha) UT25 generally outperforms UT30 in terms of the number of rhizomes, primary rhizomes, secondary rhizomes, and yield per hectare. Cattapedhyay, et al. [15]. On nutrient source, poultry dropping as a nutrient source results in the highest yield per hectare (4.73 t/ha), followed by dung site (3.67 t/ha), compost (3.00 t/ha), and control (2.12 t/ha) Poultry dropping as a nutrient source appears to be highly effective in promoting all measured yield-related parameters, this study provides valuable insights into the combined effects of turmeric varieties and nutrient sources on key yield and yield-related characteristics, offering practical guidance for optimizing turmeric cultivation in the study area. Verma, et al. [16] reported that variety and poultry dropping affects yield and yield related characters he added that poultry dropping affects tumeric reproductive stage positively due to nitric acid availability which translate to reproduction and yield characters, this poultry dropping could be needed in appreciable quantity at the growing stage and also reproductive stage to affect the over-all yield. Table 5 presents the interaction between turmeric varieties (UT25 and UT30) and nutrient sources on various yield and yield-related parameters in Jos, Nigeria. The parameters analysed include the number of rhizomes per plant, rhizome weight per plant, and overall yield per hectare. The statistical significance is determined using the Least Significant Differences (LSD) at a 5% level of probability.

Table 5: Interaction Between Variety and Nutrient Source on the Yield and Yield Related Character of Turmeric Grown in Jos, Nigeria.

Variety	Nutrient	Number of rhizomes/plants	Rhizomes weight/plant (g)	Yield (t/ha)
UT25	Compost	3.83	35.70	3.20
UT25	Dung site	4.78	39.01	3.87
UT25	Poultry dropping	5.72	42.64	4.83
UT25	Control	3.10	30.52	2.22
UT30	Compost	3.03	33.63	2.99
UT30	Dung site	4.00	37.10	3.03
UT30	Poultry dropping	5.10	40.43	4.01
UT30	Control	3.00	27.23	2.00
	F-LSD (0.05)	0.01	2.34	0.02

Note: LSD= Least Significant Differences at 5% Level of Probability.

Number of Rhizomes per Plant

Variety and Nutrient Interaction, For both UT25 and UT30, the number of rhizomes per plant varies with the nutrient source. UT25 generally produces more rhizomes compared to UT30. Amadi, et al. [12] 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

Rhizome Weight per Plant

Variety and Nutrient Interaction: The weight of rhizomes per plant varies between UT25 and UT30 across different nutrient sources. Poultry dropping as a nutrient source tends to result in higher rhizome weights per plant for both varieties. Jiang [3] who reported that rhizomes weight 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.

Yield per Hectare

Variety and Nutrient Interaction: The overall yield per hectare is influenced by both variety and nutrient source. Poultry dropping as a nutrient source consistently leads to higher yields for both UT25 and UT30. Amadi, et al. [17] 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 over all yield. This study emphasizes the significant interaction between turmeric varieties and nutrient sources on crucial yield-related parameters. The findings provide practical insights for farmers, guiding them in selecting optimal combinations of varieties and nutrient sources for enhancing turmeric yield in the specific agricultural context of the study area Ohaeri, et al. [18-23] [24-32].

Recommendations

UT_{25} generally outperforms UT_{30} in terms of the number of rhizomes, rhizome weight, and yield per hectare across different nutrient sources. Poultry dropping emerges as the most effective nutrient source for promoting higher rhizome numbers, weights, and overall yield, irrespective of the variety. Farmers may consider using UT_{25} and implementing poultry dropping as a preferred nutrient source for maximizing turmeric yield in the given region.

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