Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 8 ~ Issue 9 (2021) pp: 09-13
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Influence of Spacing Regimeand Nitrogen Application on Yield of Turmeric Grown in Rainforest - Savanna Transition Zone of Nigeria

[1]Modupeola, T.O., [1]Okafor, B.N.,[2]Oyatokun, O. S. and [3]Ogheneovo, I.E.
[1]National Horticultural Research Institute (NIHORT), Ibadan.
PMB 5432, Idi Ishin, Ibadan.
[2]Department of Crop and Animal Sciences,
Ajayi Crowther University, PMB 1066, Oyo.
[3].Department of Agronomy, Delta State University, Anwai campus, Delta State

ABSTRACT
Turmeric is a common spice in Nigerian diets. Although it is increasingly produced in Nigeria, its production is still below world average. Therefore, the impact of fertilizer application rates and planting density on the itsproduction in the transition zone of rain-forest and savanna agro-ecologies of Nigeria was studied.
A 5 x 3 factorial Field experiment involving five N fertilizer rates (0, 60, 90, 120 and 150 kg/ha) and three spacing regimes (25 x 20, 25 x 25 and 25 x 30 cm) was conducted in Ibadan and Ogbomoso which lies within the transition zone of rain-forest and savanna agro-ecological zone. The experiment was laid out using Randomized Complete Block Design (RCBD) with three replications.
Rhizome length and yield were measured at 9 Month After Planting (MAP). Data was subjected to ANOVA atP < 0.05. Significant means of observation were separated using the least significant difference at 5% level of significance.
The soils of the study sites were moderately acidic, with pH of 5.50 and 5.90,low organic matter contents (3.82 and 4.41g/kg). Rhizome length and yieldwere significantly higher at 120 kg/ha N application rate under all spacing regimes at both locations with higher yield recorded in Ibadan. Yield decline occurred after 120kgN/ha rate, however, at 150KgN/ha rate, Ibadan recorded higher rhizome length than Ogbomoso.
Nitrogen fertilizer and spacing regime influenced the performance of turmeric in the transition zone of the rain-forest and savanna ago-ecologies of Nigeria. Optimal performance was obtained at 120kgN/ha rateat both locations, which can be recommended for turmeric production in the transition zone.
KEYWORDS: *Turmeric, spacing regime, N fertilizer rates, yield, agro-ecological transition zone.*

Received 01 September, 2021; Revised: 12 September, 2021; Accepted 14 September, 2021

I. INTRODUCTION

Turmeric belongs to the family Zingeberaceae comprising 40 genera and 400 tropical species. It is a natural herb that is commonly used as a spice in a wide variety of food.Turmeric originated from Southeast Asia, particularly India, where it is domesticated for uses as spice and herbal treatments of various diseases and nutritional deficiencies. This informed its promotion as a dietary supplements for a variety of conditions.

Turmeric plant has gained a broad recognition in Nigeria owing to its myriads of use as a spice and for medicinal purposes. According to Peter and Kandiannan (1999), it is rich in oil (oleoresin) and nutritional values of moisture (5%), Protein (8.6%), Fat (8.9%), Carbohydrates (63.0%), Fibre (6.9%), Mineral mater (6.8%), Calcium (0.2%), Phoshorus (0.26%), Iron (0.05%), Sodium (0.01%), Potassium (2.5%), Vitamin A (175IU/100g), Vit. B1 (0.09mg/100g), Vit.B2 (0.19mg/100g), Vit. C (49.8mg/100g), Niacin (4.8mg/100g), Calorific value (390 calories/100g).

Turmeric also provides an antioxidant benefit, fighting potential damage from free radicals in the body.

The spacing regime, fertilizer application rates, soil properties, land use types, and climate are all indices that affect the performance of crop plants(Akinfasoye and Akanbi, 2005; Fashina*et al.*, 2005). Although, Turmeric is grown and consumed in Nigeria, its production is still highly limited by knowledge on its agronomy, fertilizer requirement, spacing and agroecology. Many works had been conducted on Turmeric agronomy, production and utilisation in Nigeria (Akinpelu*et al.,* 2014; Iheanacho*et al.,* 2016, Adesegun*et al.,* 2015; Olaleye*et al.,* 2017). Despite the aforementioned efforts, there is still need to further study the impact of environment, fertilizer rates and plant spacing on Turmeric production.

II. METHODOLOGY

The experiment was carried out in Ibadan and Ogbomoso, representing the transition zone of the rainforest and savanna agro-ecologies of Nigeria.

The soils of the study sites were sampled at different points on the fields and bulked together to form a composite. A sub-sample of the composite was processed for routine soil analysis.

The experiment was a 5 x 3 factorial laid out in a Randomized Complete Block Design (RCBD) with three replications.

Five N fertilizer (Urea) application rate of 0, 60, 90, 120, 150 kg/ha and Three plant spacing regimes of 20 x 25 cm, 25 x 25 cm and 25 x 30 cm constituted the treatments.The size of an experimental plot is 10 x 15 m.

Rhizomes of turmeric were cut into sett size of 10g and planted out in Ibadan and Ogbomoso, rainforest – savannah transition ecology of Nigeria at 20 x 25cm, 25 x 25 cm and 25 x 30 cm spacing regimes. Fertilizer N (in the form of Urea) was applied at 0, 60, 90, 120 and 150kgN/ha.

Data were collected on rhizome length and yield 9 MAP and subjected to analysis of variance (ANOVA) using Gen-Stat Discovery Edition 4 (2013). Significant means were separated using the least significant difference (LSD) at five percent level of probability ($p \leq 0.05$).

III. RESULTS

The pH of the soils of the two sites are 5.90 and 5.50, while the organic matter contents are 4.41g/kg and 3.82g/kg in Ibadan and Ogbomoso respectively.The available P, Fe, Ca and Mg were higher in Ogbomoso as shown in Table 1. Total N and Exchangeable K were higher in Ibadan. Textural class was sandy loam for both locations having a particle size distribution with over 85 percent sandcomposition.

Effect of spacing and fertilizer application rates on the productivity of Turmeric in both locations is shown in Table 2.As N fertilizer application increases, rhizome length and yield of turmeric increased, peaked at 120kg/ha rate and decreased at 150kg/ha rate across both experimental locations. However, the yield of turmeric was higher in Ibadan than what obtained in Ogbomoso for high population density of turmeric (20 x 25 cm spacing regime). Similar trends were observed for medium population density (25 x 25 cm spacing regime) and low population density (25 x 30 cm spacing regime) with higher yields at Ibadan experimental location. The effect of spacing and fertilizer application rates on the rhizome length of Turmeric in both locations is shown in Fig.1.It is worthy of note that 60kg/ha rate was optimal for rhizome growth at medium population density of turmeric than at high and low plant population densities in Ibadan. Conversely, at Ogbomoso experimental location, 60kg/ha N application rate was directly proportional to rhizome length and yield of turmeric (i.e. rhizome length and yield of turmeric increase across the planting densities). Furthermore, at 150kg/ha rate, rhizome length and yield of turmeric were highest for medium population density of turmeric plants in Ibadan location while rhizome length increases with plant population density and yield was highest at medium population density plot in Ogbomoso experimental location.

IV. DISCUSSION

Different aspects of crop production respond to soil, climate and management (Ndukwe*et al.,* 2010, Afolayan*et al.,* 2004). This was evident in the yield difference observed at the two experimental locations. Olaiya (2013) and Amadi*et al.* (2015) observed that differences in agro ecologies can affect the performance of crops. Other factors that affect the productivity of turmeric and crops in general, include topographic locations (Babalola*et al.,* 2011); weed interference (Njoku*et al.*2012); tillage systems / rhizome sets sizes (Iheanacho*et al.,* 2016); and agronomic management practices. Better yield performance in Ibadan could be attributed to its soil status with higher organic matter content, total N and exchangeable K. The fertility of soil is very essential for achieving high crop yield (Makinde, 2014; Ikoro*et al.,* 2017). Despite that the two locations fall in the rainforest – savanna transition zone, micro-variability in soil and climate could be responsible for the variation in the performance of turmeric at the two experimental locations. According to Peter and Kandiannan, (1999), turmeric production is suitable in non-gravelly/stony soils having pH of 5 - 7.5. The soils of the study sites recorded a high sand percentage with Ibadan having the higher content. Tola*et al.,* (2017) pointed out that soil variability significantly influenced crop yield and physiological potentials. The requirement for crop production varies considerably between and within soil due to management and ecology (Vas Mondo *et al.,* 2012) and this also affect crops response to fertilizer application (Kihara *et al.,* 2016). At higher fertilizer rates, there was a corresponding increase in yield and rhizome length from 0kgN/ha – 120kgN/ha for high and medium plant population densities (25 x 20cm and 25 x 25cm spacing regimes). Spacing is an important factor in crop production as it affects plant photosynthetic activities and competition for light and water; and eventual plant performance (Pratap and Singh (2007). Lower fertilizer rates favoured rhizome length but higher fertilizer rates favoured overall crop yield. However, at a low plant population density (25 x 30cm), yield decline set in after 120kgN/ha. This indicated that increase in fertilizer rates does not necessarily translate to higher yield, as higher fertilizer rates can lead to reduction in crop performance due to toxification of the soil and luxury consumption by plants (Futuless and Bagale, 2008). Although rhizome length continued to increase at both locations after 120kgN/ha fertilizer application, this is in concordant with findings by Singh *et al.* (1992) who observed that increased N rates enhanced turmeric rhizome yield. Nitrogen is an active part of protoplasm enzyme and it catalyzes cell division and photosynthesis and consequent increase in growth of plant parts. Higher Nitrogen rates may aid rhizome production but not necessarily translate into yield.

V. CONCLUSION

Turmeric performance was significantly affected by plant population and fertilizer application. Fertilizer application rate of 120kgN/ha was optimal at a medium plant population density (25 x 20cm) for economic production of turmeric in the rain-forest - savanna transition zone of Nigeria.

Table 1: Physical and chemical properties of the Soil in Ibadan and Ogbomoso

Properties	Ibadan	Ogbomoso
pH (H_20)	5.90	5.50
Organic matter (g/kg)	4.41	3.82
Total N (g/kg)	9.4	3.82
Available P (mg/kg)	0.53	4.20
Micronutrients (mg/kg)		
Fe	11.	11.40
Cu	3.20	2.70
Zn	2.11	1.96
Exchangeable bases (cmol/kg)		
K	0.34	0.31
Na	0.26	0.26
Ca	3.11	3.42
Mg	0.58	0.70
Exchangeable acidity (cmol/kg)	0.28	0.32
Particle size analysis (g/kg)		
Sand	878	864
Silt	110	122
Clay	12	14
Textural class	Sandy loam	Sandy loam

Table 2: Interaction effect of nitrogen fertilizer and plant spacing on yield of turmeric in Ibadan and Ogbomoso

Spacing (cm)	Fertilizer (kgN/ha)	Ibadan Yield (t/ha)	Ogbomoso
25×20	0	28.0	18.96
	60	37.50	20.58
	90	42.00	23.30
	120	59.33	25.97
	150	56.67	23.37
Mean		44.7	22.44
25×25	0	28.66	19.28
	60	44.00	22.50
	90	52.67	24.52
	120	70.00	35.78
	150	68.60	35.40
Mean		52.79	27.50
25×30	0	28.00	15.99
	60	35.33	20.64
	90	38.00	21.24
	120	54.67	24.22
	150	56.67	23.33
Mean		42.53	21.08
L.S.D. (5%)			
Spacing (S)		0.47	0.60
Fertilizer(F)		0.61	0.78
S × F		1.06	1.35

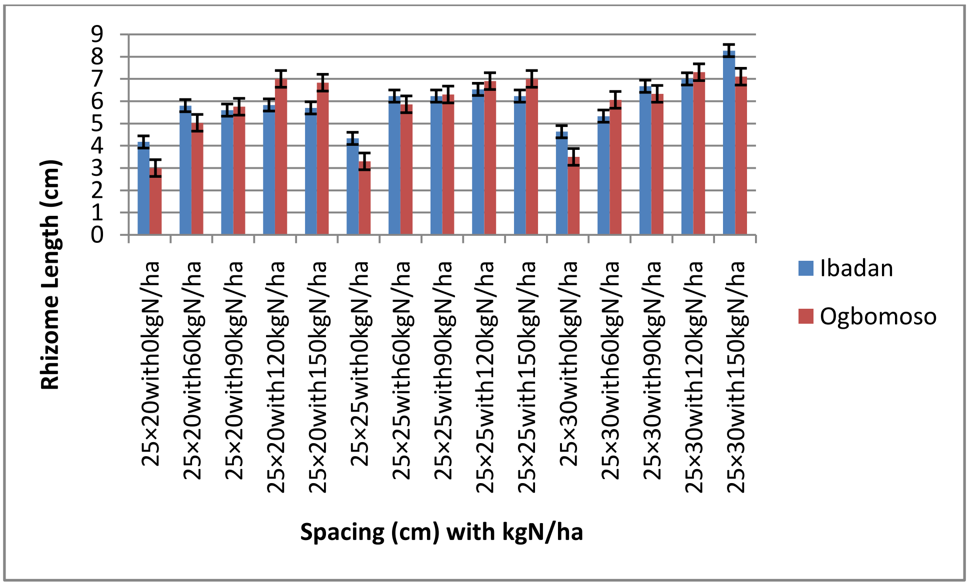

Figure 1: Interaction effect of nitrogen fertilizer and plant spacing on rhizome length of turmeric in Ibadan and Ogbomoso.

References

[1]. Adesegun E.A., Fajinmi O.B., Olaleye O and Fariyike T.A (2015). Antifungal activity of Turmeric (Cucuma longa L) extracts on Fusarium oxysporiumf.sp. Lycoersicicausal agent of Fusarium wilt of Tomato. In:Magaji M.D., Umar U., Muhammad M.B., AraboA.M and Aliyu K (eds). Proceeding of 33rd Annual Conference of Horticultural Society of Nigeria (HORTSON).Eds). Pp 401 -408

[2]. Afolayan S.O., Olaniyan A.A and Ojo T.A (2004). Growth and yield performance of twelve sweet orange varieties under 20 years climatic conditions in South West of Nigeria. In: Olarenwaju J.D., Alegbejo M.D and Showemimo F.A (Eds). Proceedings of 22nd Conference of Horticultural Society of Nigeria. pp 81-84.

[3]. Akinfasoye J.A and Akanbi W.B (2005).Effect of organic fertilizer and spacing on growth and yield of Celosia (Celosia argentea L.)Ikpe F.N and Iyagba A.G (Eds).Proceeding of 20thAnnual Conference of Horticultural Society of Nigeria (HORTSON).Pp 140 - 144.

[4]. Akinpelu C.A., Adebayo O.S., Adewale O.M and Adebisi –Adelani O.O (2014).An analysis of Turmeric utilization in Ekiti State, Nigeria.Nigerian Journal of Horticultural Science20: 68-72.

[5]. Amadi C., Olojede A.O and Obasi M (2015): Growth and yield of Turmeric in a derived Savannah agro ecology of Nigeria. International Journal of Agricultural Policy and Research 3(11): 388-395.

[6]. Babalola T.S., Oloniruha J.A and Peter T (2011).Influence of soil properties on the yield of AmaranthusViridis at two topo locations within Kabba, Nigeria. Ogunwolu E.O., Odiaka N.I and Onekutu A (Eds).Proceedings of 36th conference of Horticultural Society of Nigeria (HORTSON).Pp 486 -489.

[7]. Fashina A.S., Shittu O.S., Adebooye O.C and Omolayo F.O (2005). Yield of Amaranthus and Celosia as affected by different land use types and fertilizer models. Ikpe F.N and IyagbaA.G (Eds).Proceeding of 20th Annual Conference of Horticultural Society of Nigeria (HORTSON).Pp 116 -120.

[8]. Futules K.N and Bagale H.W (2008).The effects of different levels of N fertilizer on growth and yield of Amaranthus(Amaranthuscaudatus) in Mubi, Adamawa State. In: Sajo A.A., Futuless K.N and Shelleng N.J (Eds). Proceeding of the 26th Annual Conference of the Horticultural Society of Nigeria.pp 98-100. Iheanacho L.U., Ibeawuchi F.I., Iwuanyanwu U.P and Ogbuchi H.C (2016).International Journal of Applied and Pure Science and Agriculture 2(11): 29 -32.

[9]. Ikoro J.I., Okafor B.N., Ajayi E.O., Oyewole B.O., Igbegbwu F.C., Oso O.O (2017). Citrus seedling performances in a Citrus – Legume Intercrop.Ekenta C.M., Opoola E and Owolabi J.FProceedings of 36th conference of Horticultural Society of Nigeria (HORTSON).Pp 486 -489.

[10]. Kihara J., Nzigueba G., Zingore S., Coulibaly A., Esilaba A., Kabambe V., Njoroge S., Palm C and Huising J (2016). Understanding variability in crop response to fertilizer and amendments in sub-Saharan Africa.Agriculture, Ecosystem and Environment229:1 -12.http://doi.org/10.1016/j.agee.2016.05.02

[11]. Makinde E.A (2014) Effects of cassava peel compost on growth, yield and fruit size of Okra. Nigerian Journal of Horticultural Science 19: 37-42.

[12]. Ndukwe O.O., Muoneke C.O and Baiyeri K.P (2010).Effect of time of poultry manure application on leave and pulp nutrient concentrations and uptake of plantain.Nigerian Journal of Horticultural Science 15:9-14.

[13]. Njoku S.C., Olojede A.O andMelifonwuA.A (2012).Effect of critical period of weed interference on performance of Turmeric at Umudike, Nigeria.Journal of Agriculture and Social Research 12 (1): 84 -88.

[14]. Olaniya A.O (2015). Agronomic efficiency of biofortified Cassava (ManihotesculentaCrantz) varieties in two ecologies of SouthWest Nigeria.Nigerian Journal of Horticultural Sciences 20: 1- 8.

[15]. Olaleye O., Fagbola O., Oduntan A.O and Olofintoye T.A.J (2017).Quality and yield of Turmeric (Curcuma longa Linn) in response to mycorrhizal and nitrogen application. In: Ekenta C.M., Opoola E and Owolabi J.F (Eds). Proceedings of 35th conference of Horticultural Society of Nigeria (HORTSON).Pp 722-726.

[16]. Peter K.V and Kandiannan K (1999). Turmeric:Cultivation of Horticultural crops: In Bose T.K., Mitra S.K, Farroqi A.A and Sadhu M.K (eds). Naya rakish Publishers.Calcutta India. Pp 683 – 691. ISBN 81-85421-32-3.

[17]. Pratap R and Singh T (2007). Influence of types of rhizome and plant geometry on growth, yield and yield of Turmeric (Curcum longa L.). Progressive Agriculture 7(1/2):110-12.

[18]. Vaz Mondo V.H, Gomes Junior F.G2, Pinto T. L. F, Luis de Marchi J, Motomiya A.V, Molin J.P, Si CiceroS.M (2012). Spatial variability of soil fertility and its relationship with seed physiological potential in a soybean production area.RevistaBrasileira de Sementes, 34(2): 193 – 201.