Integrated Application of Poultry Manure and NPK Fertilizer on Performance of Tomato in Derived Savannah Transition Zone of Southwest Nigeria

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Abstract: Field experiments were conducted in two locations at Owo in early and late crop seasons (2007) to compare the effects of poultry manure at 0, 10, 20, 30, 40 t ha^{-1} and 300 kg ha^{-1} NPK 15:15:15 fertilizer on nutrient uptake and yield of tomato. The sites were located within the forest savannah transition zone of southwest Nigeria. The experiments were replicated three times in randomized complete block design. The test soil was slightly acidic, low in OM, N and P. Application of poultry manure and 300kg ha^{-1} NPK fertilizer significantly ($P<0.05$) increased plant N, P and K. Poultry manure at 20, 30 and 40 t ha^{-1} and NPK 15:15:15 fertilizer significantly ($P<0.05$) increased plant leaf, area height, number of leaves, branches fruits and fruit yield. Application of 10 t ha^{-1} poultry manure gave similar values of plant N, P and K and yield components compared with 300 kg ha^{-1} NPK fertilizer. The cumulative yield for the two seasons at 0, 10, 20, 30, 40 t ha^{-1} and 300kg/ha NPK were 9.6, 12.0, 18.1, 19.3, 14.4 and 13.5 t ha^{-1} respectively. [Nature and Science. 2010;8(2):50-54]. (ISSN: 1545-0740).

Key words: early crop, late crop, nutrient concentration, yield

1. INTRODUCTION

Adequate nutrients supply is essential for optimum production of tomato. Due to high cost and scarcity of mineral fertilizer, most farmers cannot afford the use of chemical fertilizer. This necessitates research into organic wastes that are cheap, readily available and environmentally friendly that can be used as fertilizer.

Recently, there has been boost in poultry production in urban centers in Nigeria which leads to piling of poultry wastes. This constitutes environmental pollution and health hazard to the inhabitants, whereas studies carried out in Nigeria and elsewhere confirm poultry manure as effective nutrient sources for increasing yield and nutrient status of crops such as maize , amaranths, sorghum and pepper (Adeniyan and Ojeniyi 2005, Akanni and Ojeniyi, 2005) and it also improves soil fertility and physical properties. However, research information is scarce on response of tomato, nutrient composition and yield to application of poultry manure in the forest savanna transition zone of Nigeria. Hence, the objective of this work was to determine the optimum rate of poultry manure and its effect on nutrient uptake and yield of tomato relative to the recommended level of NPK 15:15:15 fertilizer in the rain forest-savanna transition zone.

MATERIAL AND METHODS

Field Experiment

Experiments were conducted at Owo (Ehinogbe area and Ondo state Ministry of Agriculture, Zonal office, Owo) on soils that were slightly acidic, skeletal, clay kaolinitic and Oxic tropuldalf Owo lies within the forest savannah transitional zone of southwest Nigeria in the latitude5^0 12^1 N and longitude 5^0 35^1E.

In April 2007 (early cropping season) field trials was sited each at two sites. The poultry manure (PM) treatments were 0, 10, 20, 30 and 40 t ha^{-1} while NPK15:15:15 fertilizer was 300kg/ ha (recommended). The treatments were arranged using randomized complete block design with three replications. Heaps were spaced 1m apart in a plot of 3m x 3m to give a plant population of 10,000 plants / ha. Seeds of local variety of tomato were sowed in the nursery one month before the seedlings were transplanted to the field. Poultry manure was applied at heaping, two weeks before transplanting while NPK fertilizer was applied one week after transplanting. The trials were repeated at both sites in September 2007 (late season) after the harvest of early season crop.

Soil and poultry manure Analysis

Surface (0-20 cm) soil samples were collected before the conduct of the experiment at the two sites bulked, air – dried and 2mm sieved (for routine analysis) (11TA. 1979). Total N was determined by kjedahl method, p was extracted by

bray -1- p. exchangeable. Cations were extracted using normal ammonium acetate. The available K was determined by flame photometer while Ca and Mg were determined by atomic absorption spectrophotometer, Soil pH (1:2 soil-water) was determined by pH meter. Organic matter (OM) was determined by dichromate oxidation method. Soil texture was determined by the hydrometer method.

Poultry manure used for the conduct of the experiment was air –dried and milled. Samples were dry ashed at 500^0C for 6 hrs in furnace and extracted with nitric – perchloric acid mixtures (AOAC, 1990). N was determined by Kjedahl method, P by colorimeter, K by flame photometer and Ca and Mg were determined on AAS.

Growth and yield data

Five plants were randomly selected per plot. The number of leaves, branches and tap root length at harvest were determined. Ripe fruits from the randomly selected plants were harvested on plot basis, counted and weighed. Fruit yield was extrapolated to t ha^{-1}.

Plant Analysis

At 50% flowering, leaf samples were selected from 5 plants / plot. The leaf samples were washed with distilled water and oven dried at 65^0C to constant weight and ground. The N, P, K, Ca and Mg were determined as done in poultry manure analysis.

Statistical Analysis

The mean agronomic parameters for each season were subjected to analysis of variance and mean data were compared using least significance difference at 5% level of probability.

Results

Table 1 shows data on the pre treatment soil analysis of the experimental site and the poultry manure used for (Table 1)the experiment. The soils were slightly acidic, deficient in OM, N, and available P (Aune and Lal, 1997). The manure used contained N, Ca, Mg, P and K. The nutrient composition of the poultry manure suggests that it would serve to increase the soil fertility and hence improve the performance of the crop.

Table 1: Initial soil analysis and nutrient composition of poultry

Parameters	**Soil Value**	**Poultry (%)**
pH (H_20)	5.73	-
Organic matter %	1.81	-
Total N%	0.15	0.56
Available P mg kg^{-1}	11.3	1.38
Exchangeable K (c mol k g^{-1})	0.55	1.28
Exchangeable Ca ‘	1.70	0.68
Exchangeable Mg ‘	1.50	2.09
Sand %	68	-
Silt %	14	-
Clay %	18	-
Textural class sandy loam		-

Tables 2 and 3 show the effects of poultry manure rates and NPK 15: 15:15 fertilizer on nutrient concentration in tomato plants in early and late season respectively. Relative to control, poultry manure applications and NPK 15:15:15 fertilizer significantly ($P<0.05$) increased plant N and P in both seasons. In early season, 20 t ha^{-1} poultry manure significantly ($P< 0.05$) increased plant K while 30 t ha^{-1} poultry manure increased K in late season compared with control. Manure significantly increased ($P<0.05$) plant N, P, Ca, and Mg in both seasons. The 30 t ha^{-1} manure gave highest leaf nutrients content in both seasons with exception of K in early season.

Table 2: Effect of poultry manure rates and NPK 15:15:15 fertilizer on nutrient concentration in early (**E**) season tomato plant (%)

Treatment t ha^{-1}	**N**	**P**	**K**	**Ca**	**Mg**
Poultry manure			**%**		
0	1.54	0.29	1.70	0.25	0.40
10	1.68	0.32	1.88	0.43	0.77
20	3.20	0.40	2.08	0.50	0.96
30	5.80	0.48	1.81	0.60	0.99
40	5.89	0.41	1.76	0.49	0.96
NPK 300	1.70	0.35	1.80	0.25	0.38
LSD 0.05	0.08	0.05	0.21	0.14	0.36

Table 3: Effect poultry manure and NPK fertilizer on nutrient concentration in late (**L**) season tomato plant (%).

Treatment t ha^{-1} N	**P**	**K**	**Ca**	**Mg**
poultry manure		%		
0	1.35	0.20	1.50	0.20	0.36
10	1.60	0.30	1.78	0.40	0.69
20.	3.80	0.45	1.80	0.52	0.85
30.	4.90	0.50	2.50	0.65	0.96
40.	5.10	0.30	1.60	0.40	0.60
NPK 300	1.68	0.30	1.62	0.20	0.35
LSD 0.05	1.2	0.07	0.19	0.21	0.39

Table 4 shows the effect of poultry manure (pm) and NPK 15:15:15 fertilizer on plant growth parameters of tomato in the two cropping seasons and Table 5 contains data on fruit yield. Relative to control, poultry manure and NPK 15: 15:15 fertilizer significantly ($P < 0.05$) increased number of fruits; number of leaves, branches and fruit weight, but root length was not increased significantly. The 30 t ha^{-1} Pm gave highest values of the growth and yield parameters. Compared with 300kg ha ^{1} of NPK fertilizer, the 20, 30 and 40 t ha^{-1} had higher values of the measured parameters. Therefore, 20 and 30 t ha^{-1} PM significantly ($P<0.05$) increased number of leaves, branches and fruit yield in both seasons. The percentage increase in fruit yield (weight) in early season was in the decreasing order of 30 t ha^{-1} PM > 20 t ha^{-1} PM > 40 t ha^{-1} PM > 300 Kg / ha NPK fertilizer > 10 t ha^{-1} PM. The late season followed the same trend. The cumulative yield (t ha^{-1}) for the two seasons were: 9.6 t ha^{-1} for control, 12.0 t ha^{-1} for 10 t ha^{-1} PM, 18.1 t ha^{-1} for 20 t ha^{-1} PM, 19.3 t ha^{-1} for 30 t ha^{-1} PM, 14.4 t ha^{-1} for 40 t ha^{-1} PM and 13. 5 t ha^{-1} for NPK 15:15:15 fertilizer.

Table 4: Effect of poultry manure and NPK fertilizer on the growth of early (E) and late (L) season tomato (Trials 1 & 2)

Treatment t ha^{-1}	**No of Branches**		**No of Leaves**		**Tap root length (cm)**	
PM	E	L	E	L	E	L
0	3.1	5.1	29	21	19.9	20.0
10	6.2	8.9	44	31	22.5	21.6
20	10.7	14.6	80	48	25.7	26.2
30.	12.1	17.9	93	64	28.7	29.8
40	8.5	10.2	59	44	24.6	23.9
NPK 300	8.3	11.0	48.0	36	23.0	23.10
LSD 0.05	1.20	1.46	12.0	6.50	NS	NS

Table 5: Effect of poultry manure on yield of early (E) and late (L) season tomato

Treat PM t ha^{-1}	No of fruits/plant E	L	fruit weight /plant (g) E	L	cumulative fruit weight t ha^{-1}	increase in fruit yield %
0	9	11	4.5	5.1	9.6	-
10	14	15	5.9	6.1	12	25
20	14	21	9.0	9.1	18.1	88.5
30	15	20	9.4	9.9	19.3	90.6
40	14	17	7.1	7.3	14.4	50
NPK 300	13	17	6.6	6.9	13.5	41
LSD (0.05)	0.3	0.7	NS	NS		

3. Discussion

The significant increases in yield components of tomato due to poultry manure and NPK fertilizer confirm the deficiency of OM, N and P in the soil and poultry manure as effective source of plant nutrients. Therefore, addition of poultry manure and mineral fertilizer made more nutrients available to tomato plants.

This is in line with the work of Adenawoola and Adejoro (2005) that, poultry manure increased growth and yield of *Corchorus olitorus.* Plant height, number of leaves, leaf area, number of fruits and tomato yield as well as N, P and K were increased with the increase in the level of poultry manure up to 30 t ha^{-1}. The soil treated with 30 t ha^{-1} poultry manure gave highest plant K with corresponding increase in yields. The yield and growth parameters were found to decrease at 40 t ha^{-1} compare to 30 t ha^{-1} poultry manure indicating nutrient imbalance at the highest rate of application. The better performance of 30 t ha^{-1} poultry manure might be as a result of higher nutrient uptake especially N, P and K. It was indicated in the result that 40 t ha^{-1} PM reduced plant P, K, Ca and Mg compared to 20 t ha^{-1} of poultry manure. The least plant N, P and K contents recorded for tomato without poultry manure agrees with the observation that poultry manure supplied N, P and K (Ayeni, 2008, Ayeni *et al*., 2008). 20, 30 and 40 t ha^{-1} poultry manure performed better than 300 kg ha^{-1} NPK 15:15:15 fertilizers. This work shows that increase in poultry manure up to 30 t ha^{-1} maximizes yield than 20 t ha^{-1} of poultry manure earlier recommended by Akanni and Ojeniyi. (2007) as, optimum level for the production of tomato in the rain forest zone of southwest Nigeria.

4. Conclusion

Poultry manure significantly enhanced growth, yield and macronutrients content of tomato in savanna – forest transition zone of southwest Nigeria. The manure at 20 and 30 t ha^{-1} increased nutrient status and yield of tomato compared with 300 kg ha^{-1} N.P.K 15:15:15 fertilizer. The poultry manure at 30t ha^{-1} maximizes yield and N, P, K and Ca content of tomato plan.

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