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Poultry Manure and NPK Fertilizer Application and their Residual Effects on the Yield and Yield Components of Tomato (*Lycopersiconesculentum. Mill)* in two Distinct Ecological zones of Central Southern Nigeria.

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Abstract: *Field experiments were conducted in two ecological zones of Central Southern Nigeria; Agbede (derived savanna) and Obadan (forest) of Edo State to investigate poultry manure and NPK fertilizer and their residual effects on performance of tomato. The treatments consisted of three levels of poultry manure (0, 4 and 6 t PM ha^{-1}) and four levels of NPK fertilizer (0, 50, 100 and 150kg NPK ha^{-1}). Factorial experiment using randomized complete block design was engaged. Plant height and leaf area were significantly increased by the application of 6 t PM ha^{-1} and 6 t PM ha^{-1} plus 50kg NPK ha^{-1} and 6 t PM ha^{-1} plus 100kg NPK ha^{-1} in both locations and years, respectively. The application of 4 t PM ha^{-1} alone in 2005 and its residual effects significantly enhanced plant height and leaf area in both locations. In Obadan soils, optimum fruit yields of 3.42 and 2.85 t ha^{-1} were obtained from the combined application and residual6 t PM ha^{-1} plus 100kg NPK ha^{-1}, while in Agbede soils, optimum fruit yields of 1.44 and 1.55 t ha^{-1} were obtained from the application and residual 6 t PM ha^{-1} plus 50kg NPK ha^{-1} and their residual effects respectively. Responses to manure fertilizer mixtures are higher in the forest compared to the derived savanna ecological zone of Nigeria.*

Key Words*: Application, Fertilizer, Manure, Tomato and Yield.*

I. Introduction

Tomato (*Lycopersiconesculentum. Mill*) is cultivated throughout tropical Africa and South America and southern Italy (1). Most tomatoes grown in West Africa are local cultivars whose resistance to diseases is usually good (2).

Nitrogen, P and K, among others are known to affect yield (3). Deficiency in K affects fruit size and quality rather than numbers. Organic manure has been identified as a potential source of nutrients in vegetable production (4) and has also be studied on other crops such as maize (5,6). Recent studies have shown that the use of commercial fertilizers in Nigeria for crop production is limited by their scarcity and high cost (7). Small farm holders in tropical Africa and Latin America rarely use organic fertilizers on food crops (8). Poultry manure is a source of organic manure from livestock that enriches the soils, it does not only increase the nutrient status of the soil but improves the structure (9).Poultry manure should be managed for its N value(11). Poultry manure may have higher values for P and K (12). About 70% of N in poultry manure can be available to the crop during the first year of application (10).

Many workers in Nigeria had researched extensively on the effects of fertilizers on crop growth and yield. NPK fertilizer application sustains soil fertility and crop production(11). It was also reported that NPK fertilizer increases okra height, leaf area and yield components (13). Lower rates of application were also observed to increase maize yield significantly (14). The application of 300kg ha^{-1} NPK fertilizer to cassava increased dry matter parts (leaves, stem and tubers) in comparison to 10, 100, 200 and 400kg ha^{-1} NPK (15).
It is important for farmers to manage their organic residues alongside mineral fertilizers that are in short supply and scarce (16). Application of 10 t PM ha^{-1} and combinedapplication of 5 t PM ha^{-1} + NPKMg (50:35:55:20kg ha^{-1}) fertilizer gave higher maize crop growth and yield when compared to NPK fertilizer alone(17).

Poultry manure, when combined with mineral fertilizer can exhibit long residual effect, which improves growth and yield (18). Poultry manure alone or in combination with mineral fertilizer exert more beneficial effects on fruit yield when compared to fertilizer applied alone(19).A practical approach to poultry manure handlingis to characterize the waste material before it can be appropriately used as soil amendment because variation is introduced by differences in species of animal used, housing systems and age even within a specific operation, the characteristics of the manure will be influenced greatly by the ration, the type of bedding and the handling system (20).Poultry manure alone and its combination with NPK fertilizer in first year of application and their residual effects improved degree of saturation, soil moisture content and lower soil bulk density in both forest and savannah zones, it was significantly better in the forest soils. Better water stable aggregate, porosity, void ratio and air filled porosity due to residual effects of poultry manure and fertilizer

combination were also reported. This was contrary to fertilizer applied alone which reduced some of the above properties (21).Application of 4 and 6 t PM/ha, combined application of 6 t PM/ha plus 50 or 100kg NPK/ha and 4 t PM/ha plus 100 NPK/ha in the year of application and their residual effects in gave higher exchangeable Mg, K, Ca and ECEC when compared to the control in both years.Soil pH, organic carbon, total N and available P were significantly enhanced by poultry manure application and the combined application in the first year (22). Combination of poultry and cattle manures gave better leaf area of 1.445 cm over either of cattle and poultry manure which were 1.191 and 1.215 cm, respectively. Poultry waste alone has the highest yield of 854 kg ha^{-1}. With the manures soil organic matter increased from 438 mg L^{-1} for control plot to 865 mg L^{-1} on poultry and cattle manure plot while the electrical conductivity increased from 66.7-90 dS m^{-1}(23). NPK fertilizer have been reported to increase stem girth and number of leaves more than poultry manure; relative to the control, 2, 4, 6 t ha^{-1} of poultry manure and NPK fertilizer increased number of branches by 6.01, 7.01, 7.23, 7.72 and 6.89%, respectively. The increases in number of leaves were 16.57, 20.17, 20.12, 20.63 and 22.50%. However, the, they recommended application of 6.0 t ha^{-1} manure (Awodun , 2007). It has been reported higher profuse leaves, branches and shoot dry matter yield of *Amaranthuscruentus* due to the application of organic N (poultry manure) when compared to inorganic N (urea) (24). Hence the study was conducted to determine the application of poultry manure and NPK fertilizer and their residual effects on the yield and yield components of tomato.

II. Materials and Methods

The study was carried out in two distinct locations: Agbede (derived savanna) and Obadan (forest) of Edo State, Nigeria. Edo State is located between Latitudes 5^0 4^{II} and 7^0 and 38^{II} and Longitudes 5^0 4^{II} and 7^0 38^{II} of the equator. The State has a mean rainfall of 1300mm around Auchi and about 2300mm in Benin City (25). Agbede soils were earlier classified as RhodicPaleustalfs while Obadan soil as RhodicPaleudult. The physico-chemical properties of the soils before the experiment are shown in Table 1.

Treatments consisted of three levels of poultry manure (0, 4 and 6 ton ha^{-1}) and four levels of NPK 15:15:15 fertilizer (0, 50, 100 and 150kg ha^{-1}) that were combined factorially and fitted into randomized block design. The twelve treatment combinations were replicated three times. Tomato seedlings were transplanted to the field at a spacing of 50cm × 100cm (2). Fertilizer was applied by broadcasting at a week after transplanting by band placement and poultry manure was applied three weeks before transplanting in order to equilibrate with the soils. Data on plant height, leaf area at 3, 6 and 9 WAP, fruit number and yield were collected and subjected to statistical analysis. Means were separated using Duncan Multiple Range Test (26).

III. Results

The results of the analysis of the soil and manure used for the experiment are presented in Table 1. The N, P and K contents of the poultry manure were high, however, available P was highest.Tomato plant height and leaf area are presented in Tables 2 and 3, respectively. Application of 6 ton PM ha^{-1} + plus 50kgNPK ha^{-1} in 2005 resulted in higher plant height of 66.00 and 63.33 and 100cm at 3, 6 and 9 weeks after planting (WAP) in Agbede soils. In 2006, residual treatment resulted in plant height of 27.67 and 42.50cm at 3 and 6 WAP while at 9 WAP, application of 6 t PM ha^{-1}+ 150 NPKha^{-1} resulted in the highest plant height of 53.67cm. In Obadan soils, application of 4 t PM ha^{-1} + 50kg NPKha^{-1} in 2005, resulted in plant heights of 45.57, 67.33 and 103.67cm at 3, 6 and 9 WAP, respectively. But in 2006, its residual effect yielded the highest plant height of 52.22 and 71.79cm at 3 and 6 WAP, respectively. Application of 4 t PM ha^{-1} in 2005 significantly produced taller plants in Obadan soils but in 2006 it was the residual effect of 6 t PM ha^{-1}. Similar results were obtained in Agbede in 2005 and in 2006.

Leaf area of 19.77, 20.85, and 22.58 cm^2 (Table 4) were obtained at 3, 6 and 9 WAP, respectively in Agbede soils. Residual 4 ton PM ha^{-1} + 50kg NPK ha^{-1} in 2006 produced plants with the highest leaf area. In both years, poultry manure at 9 WAP produced plants with better leaf area when compared to NPK fertilizer in Agbede soils. In 2005 application of 6 ton PM ha^{-1} + 50kg NPK ha^{-1}resulted in leaf area of 18.16 and 27.23cm^2 (Table 5) when compared to 2.74 and 4.10$cm^2$of the control in Obadan soils at 3 and 6 WAP, respectively. At 9 WAP, the highest leaf area of 30.33cm^2 was obtained from the application of6 ton PM ha^{-1} + 150kg NPK ha^{-1}. Residual 6 ton PM ha^{-1} + 100kg NPK ha^{-1}in 2006 significantly gave higher leaf area in all the weeks after planting. NPK fertilizer alone in both years was least.

In Agbede soils, application of 6 t PM ha^{-1} + 50kg NPK ha^{-1}in 2005 significantly had the highest fruit number (68.33) when compared to 7.67 obtained of the control. Its residual effect gave the highest fruit number of 45.00 in 2006. The effect of poultry manure alone was significantly better in 2005 and also residually better in 2006 when compared to the control in enhancing fruit numbers. NPK fertilizer alone decreased fruit numbers. Application of 50 kg NPK ha^{-1} was significantly better than higher levels. In Obadan soils 6 t PM ha^{-1} + 50kg NPK ha^{-1} application gave higher fruit numbers in 2005 while 6 t PM ha^{-1} + 150kg NPK ha^{-1} was residually more effective in 2006 (Table 7). Poultry manure alone in 2006 was residually better while NPK fertilizer alone in 2005 (50kg NPK ha^{-1}) gave higher fruit numbers when compared to poultry manure alone.

In Agbede soils, the application of 6 t PM ha^{-1} + 50kg NPK ha^{-1} gave better fruit yield in 2006 when compared to 2005 (Table 6). Poultry manure application in both years (6 t PM ha^{-1}) significantly gave higher fruit yield and was better than NPK fertilizer applied in 2005 and its residual effects in 2006.In Obadan soils, application of 6 t PM ha^{-1} + 100kg NPK ha^{-1} in 2005 and its residual in 2006 gave the highest fruit yield of 3.42 and 2.85 t ha^{1}. Application of NPK fertilizer alone gave fruit yield of 2.72 tha^{-1} in 2005. Residually in 2006, application of 4 t ha^{-1} gave slightly higher fruit yield.

IV. Discussion

In both locations, tomato plant height and leaf area increased in 2005 and residually in 2006 with combined application of poultry manure and NPK fertilizer **(**6 ton PM ha^{-1} + 50kg NPK ha^{-1}) in all the weeks after planting. Application of poultry manure alone was significantly better in enhancing growth in both years when compared to NPK fertilizer application. The enhancement of growth over the control irrespective of source (organic and/or inorganic) showed the importance of N contained in both sources. Manure is a possible alternative source of nutrient for crop production (27). This is because organic manure is regarded as a storehouse of primary and trace elements (28). Poultry manure becomes more efficient when combined with other mineral fertilizer (29). Application of poultry manure alone or in combination with N fertilizer exerts much more beneficial effects on plant height and yield when compared to single application of N (30).

It was observed that tomato fruit yield was comparably higher in the forest soils (Obadan) in 2005 and residually in 2006 than in the derived savanna soils (Agbede) with about 55% and 45% increases as a result of the combined application. Moreover, the contribution of poultry manure was similar to that of NPK fertilizer in Obadan soils while in Agbede soils in 2005 and residually in 2006 poultry manure enhanced fruit yield better than NPK fertilizer contribution. The relative increase in yield by combined application NPK and poultry manure of could be attributed to improvement in soil structure, nutrient retention and water for plant use (31). This could possibly explain the superiority of organic sources and combined application. The enhanced performance of combined application when compared to poultry manure or NPK fertilizer alone could be attributed to release of plant nutrient elements and organic matter addition (32, 33). Residual benefits during years of no manure application have been reported (34).

V. Conclusion

Results of the study revealed that application of 4 to 6 ton ha^{-1} of poultry manure and its residual effects appeared to be good for tomato production. Application of fertilizer alone proved less effective when compared to poultry manure alone. However, combined application of NPK fertilizer and poultry manure had shown to be more effective. A combined application of 6 ton PM ha^{-1} + 100kg NPK ha^{-1} is recommended for tomato cultivation in forest zone while 6 ton PM ha^{-1} and 50 kg NPK ha^{-1} is recommended for the derived savanna zone for tomato cultivation.

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Table 1 Properties of the experimental soils and poultry manure used for the experiments.

PARAMETERS	SOILS				Poultry manure
	Agbede		Obadan		
	2005	2006	2005	2006	
pH	5.00	5.53	6.35	5.55	6.00
Organic carbon g/kg	6.81	8.85	10.00	12.15	3.17
Total N g/kg	0.60	0.85	1.70	1.98	2.20
Available P	9.81	8.63	10.52	6.20	61.29
Exch. Cations (cmol/kg)					
Ca	2.98	2.10	4.52	2.20	38.08
Mg	0.51	0.60	2.05	1.10	4.16

K	0.21	0.10	0.18	0.19	2.28
Na	0.25	0.23	0.54	0.20	1.18
H+	0.31	0.18	0.55	0.24	0.60
Al+	-	-	-	-	0.30
ECEC	3.19	3.21	7.91	3.93	47.60
Particle size (g/kg)					
Clay	69.70	40.33	85.00	45.00	
Silt	25.30	20.00	24.00	22.70	
Sand	905.00	939.67	891.00	932.00	
Texture	Sand	Sand	Loamy sand	Sand	

Table 2.Effect of poultry manure and fertilizer on mean plant height in Agbede soils

2005

3 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	29.33	27.33	40.33	30.33	31.83b
4	56.33	51.67	35.00	41.67	46.17a
6	41.33	66.00	47.33	43.67	49.58a
Means	42.33	48.33	40.89	38.56	

LSD = 6.81(PM), 3.94(PM+NPK)

Means followed by the same small letters are not significantly different at 5 % level

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	31.33	20.00	24.33	23.33	24.75
4	22.67	26.33	24.33	24.33	24.42
6	32.67	27.67	27.67	27.00	28.75
Means	28.89	24.67	25.44	24.89	

6 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	41.00	30.00	47.67	39.67	39.58b
4	65.33	63.67	50.00	45.00	56.00a
6	49.67	68.33	64.67	59.67	60.58a
Means	54.22	52.11	53.00	44.78	

LSD = 13.60(PM)

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	36.53	24.13	27.93	28.33	29.33b
4	30.33	34.00	35.67	32.67	33.17b
6	39.67	42.50	36.33	40.33	39.71a
Means	35.51	33.54	33.31	33.78	

LSD = 5.97(PM)

9 WAP

Treatments (tons/ha) Poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	49.00	48.67	71.33	57.00	56.50
4	91.33	75.67	67.00	58.33	73.08
6	75.00	100.00	80.67	60.33	79.00
Means	71.78	74.78	73.00	58.56	

Not significant.

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	57.67	43.67	49.00	52.67	50.75
4	41.33	46.50	51.00	57.67	49.13
6	49.83	53.67	45.00	61.67	52.54
Means	49.61	47.94	48.33	57.33	

Table 3 Effect of poultry manure and NPK fertilizer on plant height in Obadan soils

3 WAP

2005						2006					
Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means	Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	26.33	26.00	33.50	28.10		0	20.36	20.37	22.00	25.28	22.01b
4	44.87	47.57	33.33	27.17		4	42.95	52.22	36.02	32.67	40.96a
6	34.87	37.87	40.47	38.20		6	33.93	40.74	45.93	44.34	41.23a
Means	35.36	37.14	35.77	31.16		Means	32.42	37.77	34.65	34.09	
						LSD =3.81(PM) ,2.20(PM+NPK)					

6 WAP

Treatment (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means	Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	15.91	39.00	50.33	42.33	42.83	0	28.01	33.23	30.02	52.27	37.38b
4	67.33	67.33	50.00	40.67	56.33	4	66.52	71.79	56.31	48.81	60.86a
6	47.00	57.33	60.67	57.33	55.58	6	55.05	59.54	60.45	68.44	60.87a
Means	43.41	54.56	53.67	46.67		Means	49.86	54.86	50.93	56.51	
LSD = 16.94(PM)						LSD = 8.66(PM), 5.00(PM+NPK)					

9 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means	Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	45.67	51.00	71.33	69.00	59.25	0	34.43	42.19	45.46	66.22	47.08b
4	84.33	103.67	74.33	64.00	81.58	4	72.12	87.37	68.81	74.23	75.63a
6	67.67	70.33	74.67	73.67	71.58	6	76.01	85.37	71.47	88.31	80.29a
Means	65.89	75.00	73.44	68.89		Means	60.86	71.64	61.91	76.25	
						LSD = 10.26 (PM).					

Means followed by the same small letters are not significantly different at 5% level.

Table 4. Effect of poultry manure and NPK fertilizer on mean tomato leaf area in Agbede soils.

2005

3 WAP

Treatments (tons/ha) poultry manure	Kg/ha fertilizer 0	50	100	150	Means
0	5.40	7.60	12.13	6.57	7.93
4	15.33	13.87	9.57	7.80	11.69
6	11.50	19.77	5.10	10.90	11.82
Means	10.81	13.74	8.93	8.42	
LSD = 2.20(PM+NPK)					

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	7.70	7.73	6.20	8.80	7.61b
4	12.17	9.50	19.23	10.80	12.93a
6	14.83	9.83	10.53	8.73	10.98a
Means	11.57	9.02	11.99	9.44	
LSD = 3.01(PM)					

6 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	8.23	9.27	14.58	10.43	10.63
4	17.37	15.13	11.70	12.28	14.12
6	16.20	20.85	18.75	13.25	17.26
Means	13.94	15.08	15.01	11.99	

Treatments (tons/ha) poultry manure	kg/ha fertilizer	50	100	150	Means
0	8.47	9.30	7.60	10.57	8.98
4	14.33	12.20	23.10	13.57	12.41
6	17.97	12.07	12.83	10.33	13.30
Means	13.59	27.86	14.51	11.49	

9 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	7.89	13.03	13.65	12.89	11.87b
4	12.77	19.44	13.70	17.75	15.92ab
6	17.20	22.58	21.32	13.48	18.65a
Means	12.62	18.35	16.22	14.71	
LSD = 5.33(PM)					

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	10.40	11.33	12.13	13.17	11.76b
4	17.66	15.07	28.13	16.97	19.46a
6	22.40	15.07	16.20	13.33	16.70a
Means	16.82	13.82	18.82	14.42	
LSD = 4.21(PM)					

Means followed by the same letters are not significantly different at 5% level.

Table 5 Effect of poultry manure and NPK fertilizer on tomato leaf area in Obadan soils.

3 WAP

2005

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	2.74	6.64	8.80	5.91	6.02b
4	10.09	9.63	7.84	4.42	8.00b
6	14.51	18.16	10.83	9.97	13.37a
Means	9.11	11.48	9.16	6.77	

LSD = 5.22(PM)

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	3.02	4.44	3.90	5.67	4.26c
4	9.55	10.60	13.60	13.87	11.91b
6	10.79	18.26	21.12	19.25	17.36a
Means	7.79b	11.10a	12.87a	12.93a	

LSD = 1.83(PM), 2.11(NPK), 1.06(PM + NPK)

6 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	4.10	9.97	13.07	8.87	9.00b
4	15.13	14.47	11.77	6.63	12.00b
6	21.77	27.23	22.73	14.97	21.68a
Means	13.67	17.22	15.86	10.16	

LSD = 7.27(PM)

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	3.77	5.67	5.19	7.82	5.61c
4	13.16	14.55	18.48	17.87	16.02b
6	14.63	24.24	27.36	24.05	22.57a
Means	10.52b	14.82a	17.01a	16.59a	

LSD = 2.28(PM), 2.63(NPK), 1.32(PM + NPK)

9 WAP

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	4.92	15.08	23.17	16.12	14.82b
4	24.53	34.26	22.98	19.46	25.31a
6	28.48	29.26	22.84	30.33	27.70a
Means	19.31	26.20	23.00	21.97	

LSD = 6.47(PM)

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	
0	4.35	4.63	5.73	9.88	6.14c
4	17.07	19.79	25.62	23.82	21.58b
6	23.76	29.95	32.81	29.79	29.08a
Means	15.06b	18.13ab	21.39a	21.16a	

LSD = 4.07(PM), 4.70(NPK)

Means followed by the same letters are not significantly different at 5% level.

Table 6 Effect of poultry manure and NPK fertilizer on mean tomato yield in Agbede soils.

Fruit Numbers

2005

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	7.67	2.67	19.67	7.33	9.33c
4	47.00	54.33	40.00	46.00	46.83a
6	38.67	68.33	45.67	30.33	45.75b
Means	31.11c	41.78a	35.11b	27.89d	

LSD = 0.21(PM), 0.23(NPK), 0.12(PM+NPK)

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	4.67	4.33	5.33	9.00	5.83c
4	23.33	23.67	34.33	18.67	24.25b
6	42.00	45.00	35.33	33.00	38.83a
Means	22.33	24.33	25.00	20.22	

LSD = 7.39(PM)

Fruit Yield (tons/ha)

2005

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	0.35	0.22	0.22	1.01	0.45c
4	1.08	0.98	1.31	1.41	1.20b
6	1.75	1.44	1.25	1.53	1.49a
Means	1.06b	0.88c	0.93c	1.32a	

LSD = 0.21(PM), 0.24(NPK), 0.12(PM+NPK)

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	0.19	0.11	0.27	0.60	0.29b
4	0.95	0.97	1.15	1.07	1.04a
6	1.26	1.55	1.21	1.21	1.31a
Means	0.80	0.88	0.88	0.96	

LSD = 0.72(PM)

Means followed by the same small letters are not significantly different at 5% level.

Table7 Effect of poultry manure and NPK fertilizer on mean tomato yield in Obadan soils.

Fruit numbers

2005

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	11.33	12.00	15.33	6.33	11.25ns
4	20.67	32.33	13.33	21.00	21.83ns
6	16.33	33.33	25.33	15.00	22.50ns
Means	16.11	25.89	18.00	14.11	

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	8.00	9.00	11.67	6.00	8.67b
4	12.67	19.33	12.33	19.33	15.92a
6	12.33	9.00	16.67	19.67	14.42a
Means	11.00	12.44	13.56	15.00	

LSD = 5.80(PM)

Fruit yield (tons/ha)

2005

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	0.82	1.42	1.78	0.72	1.18b
4	2.27	2.47	2.97	2.67	2.59a
6	1.83	1.37	3.42	2.30	2.23a
Means	1.64	1.75	2.72	1.89	

LSD = 0.84(PM)

2006

Treatments (tons/ha) poultry manure	kg/ha fertilizer 0	50	100	150	Means
0	0.66	1.14	1.71	0.63	1.04c
4	2.13	2.29	2.65	2.55	2.41a
6	1.69	1.31	2.85	1.93	1.95b
Means	1.49b	1.58b	2.40a	1.70b	

LSD = 0.59(PM), 0.69(NPK)

Means followed by the same small letters are not significantly different at 5% level.