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Full Length Research Paper

Growth and yield of cucumber (*Cucumis sativus* L.) as influenced by farmyard manure and inorganic fertilizer

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The growth and yield of Ashley variety of cucumber in response to the effect of farmyard manure and inorganic fertilizer NPK 20:10:10 was evaluated at the Teaching and Research Farm of the Ambrose Alli University, Ekpoma, Nigeria Lat 6°45'N and long 6°08'E. The farmyard manure was applied at the rates of 0, 5 and 10 t/ha and the inorganic fertilizer at 0, 100, 200, 300 and 400 kg/ha. The layout was a 3 × 5 factorial scheme with three replicates. The combined rates of farmyard manure at 10 t/ha × 400 kg/ha fertilizer increased the growth characters such as the vine length and the number of leaves. At 8 weeks after planting (WAP), the application of 10 t/ha of farmyard manure × 400 kg/ha of fertilizer gave the longest vine length of 276.93 cm and the highest number of leaves. The fruit length, fruit girth, fruit weight per plant and fruit weight per hectare were significantly influenced by the application of farmyard manure × fertilizer. The highest weight of 2.43 kg per plant and yield per hectare of 43,259 kg/ha were obtained with 10 t/ha farmyard manure and 400 kg/ha of fertilizer which were 166.42% higher than the control.

Key words: Cucumber, farmyard manure, inorganic fertilizer, growth and yield.

INTRODUCTION

Cucumber *(Cucumis sativus* L.) is an important vegetable and one of the most popular members of the Cucurbitaceae family (Lower and Edwards, 1986; Thoa, 1998). It is thought to be one of the oldest vegetables cultivated by man with historical records dating back 5,000 years (Wehner and Guner, 2004). The crop is the fourth most important vegetable after tomato, cabbage and onion in Asia (Tatlioglu, 1997), the second most important vegetable crop after tomato in Western Europe (Phu, 1997). In tropical Africa, its place has not been ranked because of limited use.

Fertile soils are used for the cultivation of cucumber; infertile soils result in bitter and misshapen fruits which are often rejected by consumers. Bush fallowing has been an efficient, balanced and sustainable agricultural system for soil productivity and fertility restoration in the tropics (Ayoola and Adeniran, 2006), but as a result of increase in the population, the fallowing periods have decreased from ten years to three years and this has had an adverse effect on the fertility restoration leading to poor yields of crops. Therefore, the use of external inputs in the form of farmyard manures and fertilizer has become imperative. Farmyard manure has been used as a soil conditioner since ancient times and its benefit have not been fully harnessed due to large quantities required in order to satisfy the nutritional needs of crops (Makinde et al., 2007). The need for renewable forms of energy and reduced cost of fertilizing crops, have revived the use of organic manures worldwide (Ayoola and Adeniran, 2006). Improvement in environmental conditions and public health are important reasons for advocating increased use of organic materials (Ojeniyi, 2000; Maritus and Vleic, 2001). However, because it is bulky, the cost of transportation and handling constitute a constraint to its use by peasant farmers.

Farmyard manure release nutrients slowly and steadily and activates soil microbial biomass (Ayuso et al., 1996; Belay et al., 2001). Organic manures can sustain cropping systems through better nutrient recycling and improvement of soil physical attributes (El-Shakweer et al., 1998). The use of inorganic fertilizer has not been helpful under intensive agriculture because of its high cost and it is often associated with reduced crop yields, soil degradation, nutrient imbalance and acidity (Kang and Juo, 1980; Obi and Ebo, 1995).

The complementary use of organic and inorganic fertilizers has been recommended for sustenance of long

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Table 1. Chemical analysis of soil and farmyard manure.

Parameter	Soil sample	Farmyard manure
pH (in 2: 1 water)	5.80	6.0
Organic matter content	24.15 g/kg	53.73 g/kg
Organic carbon	14.0 g/kg	31.13 g/kg
Nitrogen	1.290 g/kg	2.23 g/kg
Ca	8.80 mg/kg	39.08 cmol/kg
Mg	0.96 mg/kg	4.32 cmol/kg
Available P	10.40 cmol/kg	61.29 mg/kg
Exchangeable K	0.29 cmol/kg	2.53 cmol/kg

term cropping in the tropics (Ipimoroti et al., 2002). Fuchs et al. (1970) reported that nutrients from mineral fertilizers enhance the establishment of crops while those from mineralization of organic manures promoted yield when both fertilizers were combined. Titiloye (1982) reported that the most satisfactory method of increasing maize yield was by judicious combination of organic wastes and inorganic fertilizers. It has been observed that addition of manure increases the soil water holding capacity and this means that nutrients would be made more available to crops where manures have been added to the soil (Costa et al., 1991). Murwira and Kirchman (1993) observed that nutrient use efficiency might be increased through the combination of manure and inorganic fertilizer. This study was therefore conducted to investigate the effects of varying rates of farmyard manure and inorganic fertilizers on the growth and yield of cucumber.

MATERIALS AND METHODS

Field experiment was conducted at the Teaching and Research Farm of the Ambrose Alli University Ekpoma on Lat. 6°45'N and Long.6° 08' E in a forest, savanna transition zone of Nigeria. The area is characterised by a bimodal rainfall pattern with a long rainy season which starts in late March and the short rainy period extends from September to late October after a dry spell in August. The soil order is an ultisol and the site is classified locally as kulfo series (Moss, 1957).

The site was left to fallow for three years after it was cropped to maize (*Zea mays*), yam (*Dioscorea* sp.) and cassava *(Manihot* sp.) for two years prior to the establishment of the experiment. A composite soil sample was collected from 0 - 30 cm depth prior to planting of cucumber before the farmyard manure incorporation to determine the pH and the nutrient status of the soil. Soil pH was analyzed by 1:2 in H_2O, total N content was determined by Kjeldahl method (Bremner, 1965); available phosphorus was analyzed using the modified Walkley and Black (Nelson and Sommers, 1982). The farmyard manure was collected from a deep litter pen of the Poultry Unit of the Teaching and Research Farm of the Ambrose Alli University Ekpoma and left to decompose for three months. The NPK fertilizer was bought from the Edo State Ministry of Agriculture and Natural Resources. Chemical analyses of the soil and farmyard manure used are presented in Table 1. The result indicated a soil pH of 5.86 (slightly acidic), 24.15 g/kg organic matter (medium), organic carbon 14.00 g/kg, nitrogen 1.29 g/kg (low) available P (Bray Pi) 10.40cmol/kg and exchangeable K 1.12 cmol/kg.

The experiment commenced on the 23rd of August, 2007 by planting of two seeds of "Ashley" variety of cucumber at a spacing of 75 by 75 cm and later thinned after two weeks to one seedling per stand to give a population of 17,777.8 plants per ha. This is the current recommended density of planting cucumber in Nigeria. The treatments used were three levels of farmyard manure (0, 5 and 10 t/ha) and five of NPK 20: 10:10 (0,100, 200, 300 and 400 kg/ha). The experiment was laid out in a 3 × 5 factorial scheme with three replicates. The plot size was 3.75 m × 3.75 m with 2 m pathways. The farmyard manure was uniformly spread on the plots and a West Indian hoe was used to turn the manure into the soil two weeks before planting. Two weeks after planting, NPK 20:10:10 was applied at the rate of 0, 100, 200, 300 and 400 kg/ha to the plots; this is the period recommended for the application of NPK fertilizer in this zone. Manual weeding was carried out at 3 and 5 weeks after planting. Insect pests were controlled with lamdacyahalothrin as Karate (2 L per ha.) at biweekly intervals for effective insect control.

Growth parameters were assessed at 4, 6 and 8 weeks after planting. Cucumber vine length was measured by using a flexible tape rule. Number of leaves was assessed by visual count of the green leaves. At every harvest the fruit girth was assessed by using a Vernier calliper, the fruit length was measured by using a flexible tape before the fruits were weighed using a 10 kg scale. The cumulative weights of the entire harvests (10 times) were summed up for data analysis using SAS version 17 software.

RESULTS AND DISCUSSION

Vine length and number of leaves

Cucumber vine length increased significantly ($P < 0.05$) with the application of farmyard manure and fertilizer at 4 weeks after planting (WAP). The application of a combination of 10 t/ha of farmyard manure and fertilizer at the rate of 400 kg/ha gave the longest vine of (28.98 cm) and the control produced the shortest vine length (20.56 cm).

At 6WAP, the longest vine of 142.56 cm was observed in the plot treated with only 400 kg/ha NPK and the control had the shortest vine of (119.20 cm).

The differences between the treatment means at this stage of growth were not significant. The application of fertilizer on cucumber had significant ($P < 0.01$) effect on the vine length but no significant FYM and FYM × fertilizer

Table 2. Effect of farmyard manure and inorganic fertilizer rates on the vine length of cucumber at 4, 6 and 8 WAP.

	4 WAP						6 WAP						8 WAP					
	Fertilizer rates (kg/ha)						Fertilizer rates (kg/ha)						Fertilizer rates (kg/ha)					
FYM rates (t/ha)	0	100	200	300	400	Mean	0	100	200	300	400	Mean	0	100	200	300	400	Mean
0	20.56	24.21	25.74	26.99	27.36	24.97	119.20	126.03	131.19	136.45	142.56	131.08	187.21	219.33	237.48	262.84	269.29	235.23
5	22.00	26.31	26.40	27.19	27.87	25.96	129.06	130.31	125.94	124.53	128.06	216.59	230.79	241.72	246.72	246.17	261.13	239.28
10	25.54	28.17	28.49	28.65	28.98	27.96	129.01	130.82	129.11	127.96	133.16	130.16	225.15	239.01	249.86	256.66	276.93	249.52
MEAN	22.70	28.87	28.87	27.61	28.07		125.75	129.05	130.26	130.12	133.66		209.65	229.71	243.02	225.22	269.12	

LSD: FYM – 0.541* Fertilizer 0.703* FYM × Fert 1.212**; FYM – 4.531^{NS}, Fertilizer 0.707^{NS}, FYM x Fert. 1.213^{NS}; FYM – 13.761^{NS} Fertilizer 17.774** FYM × Fert 7.950^{NS}.

Table 3. Effects of farmyard manure and inorganic fertilizer rates on the number of leaves of cucumber at 4, 6 and 8 WAP.

	4WAP Fertilizer rates (kg/ha)						6WAP Fertilizer rates(kg/ha)						8WAP Fertilizer rates (kg/ha)					
FYM rates (t/ha)	0	100	200	300	400	Mean	0	100	200	300	400	Mean	0	100	200	300	400	Mean
0	5.67	5.98	6.07	6.30	6.43	6.06	30.03	31.08	31.57	34.33	30.39	31.50	42.31	47.58	49.55	59.13	60.12	51.74
5	5.84	6.57	7.02	7.43	7.68	6.91	33.68	33.32	32.19	31.26	32.13	32.52	58.55	59.44	60.32	60.57	61.26	60.03
10	6.28	6.61	7.25	7.73	8.43	7.26	31.03	34.84	35.47	34.75	35.33	31.58	61.26	58.02	59.50	61.22	61.73	60.33
MEAN	5.92	6.39	6.78	7.15	7.51		31.53	33.08	33.08	33.45	32.65		54.04	55.01	56.46	60.31	61.04	

LSD: FYM 6.727*, Fertilizer 0.934**, FYM × Fert NS; FYM NS, Fertilizer NS, FYM × Fert. NS; FYM 2.671* Fertilizer 3.444**, FYM × Fert NS.

interaction at 8 WAP was observed (Table 2).

The mean number of leaves per plant was significantly influenced by farmyard manure ($P < 0.05$) and fertilizer ($P < 0.01$) but no significant FYM × Fertilizer interaction at 4 WAP was observed. The highest number of leaves (8.43) was produced by a combination of farmyard manure at 10 t/ha and 400 kg/ha of fertilizer while the least number of leaves (5.68) was produced by the untreated plots (Table 3). At 6 WAP, the influence of farmyard manure, fertilizer and their interactions was not significant but the highest number of leaves (35.33) was produced by the 10 t/ha farmyard manure × 400 kg/ha fertilizer treated plots and the control produced the least number of leaves (30.03).

At 8 WAP, the mean number of leaves was influenced by farmyard manure ($P < 0.05$) and fertilizer ($P < 0.01$) but no significant FYM × fertilizer interaction. The highest number of leaves was produced by the treatment in which a combination of 10 t/ha of farmyard manure and 400 kg/ha of fertilizer was used and the control produced the least number of leaves (Table 3). The cucumber growth parameters were strongly influenced by the combined application of farmyard manure and fertilizer and yield was highest with the combination. The cucumber plant had enough nutrients for rapid growth and development considering the composition of the farmyard manure which was incurporated into the soil during land preparation. It was observed that the higher the nutrients applied, the higher the values of the vine length and number of leaves produced per plant. The vigorous growth in cucumber which was experienced during the growing period as evidenced in the vine length and number of leaves produced per plant (Tables 2 and 3) was in agreement with Fuchs et al. (1970) who reported that nutrients from mineral fertilizers enhanced the establishment of crops while those from the mineralization of organic matter promoted yield when manures and fertilizers were combined.

Yield and yield components

The fruit length of cucumber was significantly

Table 4. Effects of farmyard manure and inorganic fertilizer rates on the fruit length and girth of cucumber.

	Fruit length (cm) Fertilizer rates (kg/ha)						Fruit girth (cm) Fertilizer rates (kg/ha)					
FYM rates (t/ha)	**0**	**100**	**200**	**300**	**400**	**Mean**	**0**	**100**	**200**	**300**	**400**	**Mean**
0	14.20	14.27	14.54	15.18	15.39	14.72	4.16	4.28	4.42	4.49	4.62	4.39
5	14.76	14.93	15.30	15.40	15.42	15.16	4.74	4.97	5.02	5.06	5.48	5.08
10	15.40	15.55	15.53	15.55	15.71	15.55	5.49	5.59	5.64	5.70	5.59	5.60
Mean	14.79	14.91	15.12	15.38	15.51		4.80	4.95	5.03	5.08	5.23	

LSD: FYM 0.282*, Fertilizer 0.331**, FYM × Fert NS; FYM 0.171*, Fertilizer NSFYM × Fert. NS.

Table 5. Effects of farmyard manure and inorganic fertilizer rates on fruit weight per plant and yield/ha of cucumber.

	Fruit wt. (kg/plant) Fertilizer rates (kg/ha)						Fruit yield (kg/ha) Fertilizer rates (kg/ha)					
FYM rates (t/ha)	**0**	**100**	**200**	**300**	**400**	**Mean**	**0**	**100**	**200**	**300**	**400**	**Mean**
0	0.91	1.17	1.47	1.65	1.62	1.36	16237.01	20740.73	26133.32	29392.57	28859.24	24272.57
5	1.21	1.47	1.61	2.22	2.23	1.75	21511.10	226192.58	28681.46	39466.65	39644.43	31099.24
10	1.19	2.06	2.27	2.30	2.43	2.05	21155.54	36681.46	40414.79	40888.87	43259.24	36479.24
Mean	1.10	1.57	1.78	2.30	2.09		19634.55	27871.59	31743.19	36582.70	37254.30	

LSD FYM 0.234 LSD FYM 633.252* Fertilizer 0.251** Fertilizer 817.520* FYM × Fertilizer 0.408** FYM × Fert 1415.981**.

enhanced by the application of farmyard manure ($P < 0.05$) and fertilizer ($P < 0.01$) but no significant farmyard manure × fertilizer interaction. The longest fruit of 15.71 cm was observed in the 10 t/ha farmyard manure × the 400 kg/ha fertilizer combination and the shortest fruit of 14.20 cm was observed in the control (Table 4).

The fruit weight per plant was significantly influenced by farmyard manure ($P < 0.05$), fertilizer ($P < 0.01$) and their interaction ($P < 0.01$). The highest fruit weight (2.43 kg) per plant was observed in the treatments receiving farmyard manure at the rate of 10 t/ha and 400 kg/ha of fertilizer and the least value of 0.90 kg was observed in the control.

The cucumber fruit weight per hectare was significantly influenced by the application of farmyard manure ($P < 0.05$), fertilizer ($P < 0.05$) and their interaction ($P < 0.01$). The highest fruit weight per hectare of 43,259.24 kg/ha was observed in the 10 t/ha farmyard manure and 400 kg/ha fertilizer combination and the least yield of 16237.01 kg/ha was observed in the untreated control. The combination of10 t/ha farmyard manure and 400 kg/ha fertilizer gave a yield of 166.42% over the control. The interaction thus showed that response to FYM was more at higher rates of NPK application. The farmyard manure applied at 10 t/ha combined with 400 kg/ha fertilizer was just enough to satisfy the nutritional requirements of cucumber plant. This was evident in the significant yield experienced in the treatment over the other treatments. The yield (Table 5) from the experiment was in agreement with the report of Murwira and Kirchman (1993) who found increased yield of crops through the combination of farmyard manure and inorganic fertilizer and the findings of Titiloye (1982) who reported that the best way to increase maize yield was by the combination of organic wastes and inorganic fertilizer. The addition of farmyard manure increased the water holding capacity and

reduced the incidence of erosion thereby making more nutrients available to the soil (Costa et al., 1991). The highest grain yield of rice has been obtained when farmyard manure was applied at 10 t/ha combined with 120:60:45 N: P_2O_5 and K_2O ha^{-1} (Satyanaraya et al., 2002). Bayu et al. (2006) also reported that sorghum yield increased when 5 t/ha of farmyard manure was combined with 20 kg N + 10 kg P ha^{-1}. Makinde et al. (2007) reported increased melon growth and optimum yield with organo-mineral fertilizer at 4 t/ha or the application inorganic fertilizer at 41 kg N+ 20kg P. The combination of farmyard manure × inorganic fertilizer significantly influenced cucumber yields compared to farmyard manure and fertilizer alone especially at higher rates of application (Table 5). The increase in yield of cucumber could be attributed to the fact that nutrients were more readily available when organic and inorganic fertilizers were combined.

This study has clearly shown that cucumber growth can be promoted by the combined application of farmyard manure and inorganic fertilizer and farmers will be encouraged to apply the combination in their cropping practices.

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