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GROWTH AND YIELD OF CUCUMBER (CUCUMIS SATIVA L) AS INFLUENCED BY COMPLIMENTARY USE OF ORGANIC SOURCES AND MINERAL FERTILIZER IN MAKURDI, BENUE STATE NIGERIA.

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ABSTRACT

A field experiment was carried out in 2014 to investigate the effect of different organic manures in combination with NPK 20:10:10 fertilizer on the growth and yield of Cucumber (Cucumis sativa L) at the Teaching and Research Farm of the University of Agriculture, Makurdi Benue State, Nigeria. Treatments and treatment rates used were as follow: Control (0 t/ha), cow dung (2.5, 5.0 t/ha), pig dung (2.5, 5.0 t/ha), crystallizer (2.5, 5.0 t/ha), NPK 20:10:10 (30, 60 Kg/ha). The experiment was laid out in randomized complete block design (RCBD) and replicated three times. The experimental results show that the growth parameters in terms of vine length and mean numbers of leaves as well as fresh fruit yield were significantly ($P<0.05$) increased by the treatments. The combination of 2.5 t/ha pig dung + 30 Kg NPK 20:10:10 produce the longest vine length (255.23 cm) at 8 WAP, the highest mean numbers of leaves (44.67) was obtained from the combination of 2.5 t/ha crystallizer + 30 Kg/ha NPK 20:`10:10. The highest fresh fruit yield (7.05 t/ha) was obtained from the combination of 2.5 t/ha cow dung + 30 Kg/ha NPK 20:10:10 which is 222% yield increase over the control (2.5 t/ha). The result also shows improvement in a few soil nutrient elements after harvest. The organic matter, Available P and Calcium content of the soil were moderately improved. This study advocates complimentary use of organic manures with mineral fertilizers and recommends application of 2.5 t/ha of cow dung + 30 kg/ha NPK 20:10:10 for the production of cucumber in the study area.

Keywords: Cucumis sativa L, Organic sources, NPK 20:10:10.

Introduction

Addition of organic and in organic fertilizer to soil is very essential to improve agricultural productivity and soil fertility. Mangila et al .(2007) and Enweke et al. (2013) indicated that organic manure is not only cheap and effective but essential for establishing and maintaining the optimum soil physical conditions for plant growth and yield. In areas where fertility depletion is already high, inorganic fertilizers are the only meaningful source for building up nutrients in the soil. Bekunda et al., 1997).

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Cucumber is one of the major fruit vegetables that is eaten raw, cooked or used in salad and it serves as a major source of vitamins (Ayotamuno et al., 2007). Cucumber is one of the exotic food materials which production is domicile in the northern Nigeria.
However the quantity produced cannot meet the consumers' demand, hence there is the need to expand the frontier of its production. In spite of the increasing relevance of cucumber in Nigeria, low yield are obtained in farmers' field because of declining soil fertility due to continuous cropping.

Excessive use of agricultural inputs such as chemical fertilizers resulted into problems such as environmental pollution, soil erosion (Greer and Diver, 2000).
Davarainezhad et al., 2004 observed that the application of organic waste including manure, sewage sludge, and municipal compost in soil is a suitable method for the maintenance of soil organic matter, improve soil quality and supply nutrients needed by plants. There are indications that inorganic fertilizer is no longer within the reach of poor- resource farmers due to its high cost hence the alternate usage of organic manure due to its affordability.

Cultivation of cucumber requires fertile soils as infertile soils result in bitter and malformed fruits which are not appreciated by consumers. In order to produce cucumber on a sustainable basis and meet consumers demand due to increase in world's population other sources of nutrient inputs have to continuously explore to meet this target. Therefore this experiment was conducted to investigate the effects of crystallizer (synthesize organic) fertilizer and mineral fertilizers on the performance of cucumber.

MATERIALS AND METHODS

The field experiment was carried out at the Teaching and Research Farms of the University of Agriculture, Makurdi on Lat. 7o 44' N Long. 8o 37'E at an elevation of 97 m above sea level. The location falls within the southern guinea savannah agro – ecological zone of Nigeria. The soil of the area is classified locally as tropical ustropets using FAO, 1990 soil taxonomy .

The soil of the experimental site was sample to the depth of 0-15 cm prior to the planting of cucumber seeds after the experiment and before the organic manures were incorporated into the soil to determine both the physical and chemical nutrient of the soil. Soil pH was determined in 1:2 in H2O Total N Content was determined By Kjeldahl method (Bremner and Mulvaney, 1982) available phosphorus was analyzed using the modified Walkley and Black (Nelson and Sommers, 1982). The cow and pig manures used in the research work were collected from the animal unit of the Teaching and Research Farm of the University of Agriculture, Makurdi and left to decompose for two months. The crystallizer and NPK 20:10:10 fertilizers used were

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obtained from Step B project office (Federal Ministry of Education Project) domicile in the University.

The result of the soil used in the research work is presented in Table 1. The result indicated a soil pH of 6.60 (moderately neutral), 2.07 % Organic matter (medium), organic carbon 1.2 %, Nitrogen 0.7 % (very low) available P (Bray) 14.0 cmol/kg and exchangeable K 2.50 cmol/kg.
The research work started on the 22nd August 2015 by planting of cucumber at a spacing of 0.7 m x 1.0 m and later thinned after two weeks to two seedlings per stand to give a plant population of 28,571.4 per ha. Treatments used were eight: Control (0 t/ha); Cow dung (5 t /ha), Cow dung + mineral fertilizer NRK 20:10: 10 (5 t/ha+30 kg NPK 20:10:10), Pig dung (5 t/ha), Pig dung + mineral fertilizer (5 t/ ha + 30 kg NPK 20:10:10), Crystallizer (5 t/ ha) ; Crystallizer + mineral fertilizer (5 t/ha +30 kg NPK 20:10:10) and mineral fertilizer (60 kg NPK 20:10:10). The experiment was laid out in randomized complete block design (RCBD). The plot size is 3.0 m x 2.0 m with 1m pathways.
The organic manures were uniformly spread on the plots and a West Indian hoe was used to the manure into the soil two weeks before planting. Two weeks after planting NPK 20:10:10 were applied at the rate of 0, 30 and 60 kg/ha to the plots.
Growth parameters were evaluated at 4, 6 and 8 weeks after planting (WAP). Cucumber vine length was measured by using a flexible tape rule. Number of leaves and number of branches were evaluated by counting.
The cumulative weights of the whole harvest (4 times) were summed up for data analysis using Genstat release discovery edition 3 software.

RESULTS AND DISCUSSION

Vine length, number of leaves and number of branches.
The treatments applied significantly ($P< 0.0\ 5$) increased cucumber vine length obtained in the experiment at 6 weeks after planting (WAP) and at 8 weeks after planting (WAP), Table 2. At 6 WAP the longest vine length (131.67cm) was obtained from the combination of 2.5 t/ ha of cow dung and 30 kg/ha NPK 20:10:10, the control produced the shortest vine length (110.10cm). At 8WAP the longest vine length (255.23cm) was obtained from the combination of 2.5 t/ha of pig dung and 30 kg/ha NPK 20:10:10 and the control still produced the shortest vine length (127.73cm). At 4 WAP there was no significant difference on the vine length due to treatment application.

The mean number of leaves obtained per plant was significant ($P<0.05$) influenced by the treatments applied at 8 WAP Table 2. There was no significant effect observed at 4 and 6 WAP. At 8 WAP The combination of 2.5 t/ha of crystallizer and 30 kg/ha NPK 20:10:10 produce the

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highest mean number of leaves (44.67), while the control produced the least mean number of leaves (27.67), there were obvious differences in the mean number of leaves obtained at 6 WAP, but they were not statistically relevant.

The data collected on the mean number of branches per plant do not show any statistical differences ($P<0.05$) at all the sampling weeks; 4, 6 and 8 WAP Table 2. The mean range number of branches per plant are as follows: 4 WAP (1.0-1.67), 6 WAP (1.67- 4.00) and at 8 WAP (3.0-8.0).

The growth parameters of cucumber plants were positively influenced by the applied organic fertilizers in combination with the inorganic fertilizer (NPK20:10:10) better than the sole application of the organic manures or mineral fertilizer. The trend observed in the study shows that the combination of the NPK 20:10:10 with various organic manures (cow dung, pig dung and crystallizer) influence the growth parameters best at different stages of plant growth, no combination seem to be most dominant. The better development in the growth parameters is as result of improvement of the nutrients supply to the soil system by the

Table 1: Physical and chemical properties of the soil before planting

Properties	Values
Sand (g/kg)	855.2
Silt (g/kg)	113.8
Clay (g/kg)	32.0
Textural	Sandy loam
pH (H_2O 1:1)	6.60
pH (0.01 M $CaCl_2$ 1:2)	5.40
Organic Carbon (%)	1.20
Organic Matter (%)	2.07

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Total Nitrogen (%)	0.07
Available Phosphorus (cmol/kg)	14.00
Magnesium (cmol/kg)	0.60
Calcium (cmol/kg)	2.00
Sodium (cmol/kg)	0.50
Potassium (cmol/kg)	2.50

Table 2: Effect of Animal dung, Crystallizer and NPK fertilizer on vine length (cm), number of leaves and number of branches of cucumber.

	Vine length			number of leaves			number of branches		
Treatment	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
T_1	20.40	110.10	127.73	4.33	18.00	22.67	1.00	1.67	3.00
T_2	24.00	110.70	136.90	4.67	25.00	34.00	1.33	2.33	7.33
T_3	28.87	128.73	135.40	5.33	33.33	44.67	1.67	3.67	6.67
T_4	24.60	115.97	146.50	5.00	22.33	28.33	1.33	2.33	6.33
T_5	28.07	127.50	255.23	5.33	31.67	42.67	1.67	4.00	8.00
T_6	23.10	115.30	181.27	5.33	25.33	28.33	1.33	3.00	6.33
T_7	27.80	131.67	161.77	5.00	31.67	39.00	1.33	4.00	7.33
T_8	26.80	131.07	247.93	5.00	31.67	44.33	1.67	3.00	6.33
F-LSD (0.05)	NS	7.56	38.34	NS	NS	7.12	NS	NS	NS

NS= No Significant difference; WAP= Week after planting, T1- control (0 t/ha), T2- 5 t/ha crystallizer, T3- 2.5 t/ha crystallizer + 30 kg/ha NPK 20:10:10,T4- 5 t/ha pig dung, T5- 2.5 t/ha pig dung + 30 kg/ha NPK 30:10:10, T6- 5 t/ha cow dung, T7-2.5 t/ha cow dung + 30 kg/ha NPK 20:10:10, T8- 60 kg/ha NPK 20:10:10

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combination of organic and inorganic fertilization which agrees with the work of EL- Shafie et al. (2010) that succeeded in reducing the recommended dose of chemical fertilizer without loss in the yield using 50% of chemical fertilizer combination with 50% of bio fertilizer in production.

Yield of cucumber

The fruit obtained from the research work was significantly increased by the application of treatments ($P<0.05$), the fruits were harvested at four times before the termination of the experiment as presented in Table 3. The fruits yield obtained at second and third harvest were significant ($P<0.05$) while the data obtained at first and fourth harvest were not statistically significant ($P<0.05$). However, the mean total harvested data was statistically ($P<0.05$) different. At the second harvest the 60 kg/ha of NPK 20:10:10 produced the highest yield of 3.37 kg closely followed by the yield obtained from the treatment combination of 2.5 t/ha cow dung and 30 kg/ha NPK 20:10:10 (3.33 kg) the least yield at this stage of the harvest was obtained from the contour (1.17kg). At the third harvest however the highest yield (4.23 kg) was obtained from the combination of 2.5 t/ha cow dung 30 kg/ha NPK 20:10:10, while the application of 60 kg/ha NPK 20:10:10 gave the second highest yield (3.77 kg). The least yield was obtained from the control. Considering the total harvest, the combination of 2.5 t/ha cow dung + 30kg/ha NPK 20:10:10 gave the highest yield of (7.05 t/ha) which translate to 222 % yield increase over the control. The second highest yield was obtained from the application of 60 kg/ha NPK 20:10:10 (6.56 t/ha) which also translate to 202 % yield increase over the control. The yield increase obtained in this work is in agreements with report of Eifediyi and Remision, 2010 that obtained a yield increase of 166.42 % over the control with the application of 10 t/ha farmyard manure and 400 kg/ha fertilizer combination. This result also supports the view of Enweke et al.(2013) using organic manure in crop production is not that they are only cheap, and effective but essential for maintenance of plant growth and yield.

Residual effect on the soil chemical properties

The application of the treatments improve some of the nutrient element of the cultivated soil after cucumber harvest as presented in Table 4.

The initial organic matter of (2.07 %) increased to 2.50 % with the application of 5 t/ha cow dung, 2.40 % with the application of 5 t/ha pig dung while with the application of inorganic 60 kg/ha NPK 20:10:10 it decrease to 2.0 %. the combine application of organic manure and mineral fertilizer did not improved the organic matter content of the soil after harvest better than

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the sole application. This observation is in agreement with the report of Enwezor et al. (1989) in their review of residues of fertilizer on succeeding crops , they observed that residues of organic manures last many years since they are less prone to leaching in contrast with inorganic fertilizer that usually last only for a season due leaching and other processes.

The residual effect on the Total Nitrogen, Magnesium, Sodium and Potassium were not well pronounced. But there is a better improvement in terms of Available Phosphorus and Calcium content of the soil after harvest, Table 4. The initial soil available Phosphorus (14.00 g/kg) increased to 18.90 g/kg (35 %) with the application of 2.5 t/ha cow dung + 30 kg /ha NPK 20:10:10; 17.20 g/kg (22.85%) with the application 2.5 t/ha pig dung + 30 kg/ha NPK 20:10:10. The initial soil calcium concentration of (2.00 cmol/kg) increased to 2.35 cmol/kg (17.5 %) with the application of 5 t/ha cow dung. 2.34 (17 %) with the application of 30 kg/ha NPK 20:10:10. The increase observed in this work support the work of Akande et al. (2003) that reported an increase in soil available P of between 112 and 115 % and 144 and 153 % respectively for a two year filed trial after applying rock phosphate with poultry manure on okra. The percentage increase observed in this work is less than what Akande et al. (2003) reported in their work perhaps this due to the rate applied

Table 3: Effect of Animal dung, Crystallizer and NPK fertilizer on fresh fruit weight of cucumber at harvest.

Treatment	1st harvest (kg)	2nd harvest (kg)	3rd harvest (kg)	4th harvest (kg)	Total harvest (t/ha)	
T_1	0.60	1.17	0.77	0.47	3.01	1.50
T_2	0.80	1.23	1.60	0.57	4.20	2.50
T_3	1.20	3.20	3.03	1.10	8.53	6.20
T_4	0.70	1.60	1.83	0.73	4.86	3.25
T_5	1.07	3.30	3.67	0.93	8.97	6.48
T_6	0.63	1.53	1.50	0.70	4.36	2.62
T_7	1.00	3.33	4.23	1.10	9.66	7.05
T_8	0.97	3.37	3.77	0.97	9.08	6.56

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F-LSD (0.05)	NS	2.21	2,45	NS	4.68	2.60		

NS= No Significant difference. T1- control (0 t/ha), T2- 5 t/ha crystallizer, T3- 2.5 t/ha crystallizer + 30 kg/ha NPK 20:10:10, T4- 5 t/ha pig dung, T5- 2.5 t/ha pig dung + 30 kg/ha NPK 30:10:10, T6- 5 t/ha cow dung, T7-2.5 t/ha cow dung + 30 kg/ha NPK 20:10:10, T8- 60 kg/ha NPK 20:10:10

Table 4: Residual effect of Animal dung, crystallizer and NPK fertilizer on soil chemical Properties after harvest

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	
pH (H_2O 1:1)	6.70	6.80	6.70	6.80	6.60	6.30	6.40	6.60	
pH (0.01 M $CaCl_2$ 1:2)	5.52	5.54	5.55	5.60	5.70	5.55	5.65	5.00	
Organic Carbon (%)	1.28	1.32	1.30	1.25	1.40	1.32	1.41	1.18	
Organic Matter (%)		2.23	2.32	2.35	2.40	2.28	2.50	2.34	2.00
Total Nitrogen (%)		0.08	0.09	0.07	0.08	0.09	0.07	0.08	0.09
Av. Phosphorus (cmol/kg)		14.70	14.60	16.10	16.20	17.20	16.80	18.90	18.10
Magnesium (cmol/kg)	0.60	0.67	0.64	0.62	0.64	0.69	0.63	0.62	
Calcium (cmol/kg)		2.10	2.23	2.20	2.34	2.34	2.35	2.25	2.30
Sodium (cmol/kg)		0.50	0.55	0.52	0.60	0.58	0.61	0.61	0.65

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Potassium (cmol/kg)	2.30	2.20	2.50	2.70	2.10	2.30	2.00	2.40
CEC (cmol/kg)		2.60	2.50	2.60	2.85	2.95	3.02	3.00	2.30

T1- control (0 t/ha), T2- 5 t/ha crystallizer, T3- 2.5 t/ha crystallizer + 30 kg/ha NPK 20:10:10T4- 5 t/ha pig dung, T5- 2.5 t/ha pig dung + 30 kg/ha NPK 30:10:10, T6- 5 t/ha cow dung, T7-2.5 t/ha cow dung + 30 kg/ha NPK 20:10:10, T8- 60 kg/ha NPK 20:10:10

CONCLUSION

This work has shown the positive effect of organic material use in this work with the combination of mineral fertilizer on the production of cucumber which corroborates the earlier studies in this area. The work of Haug (1993) and Dynes (2003) examined with the industrial compost and NPK fertilizer on growth and yield of cucumber and reported that vermicompost increased plant efficiency. The work of Ahmadi et al. (2003) studies the effects of 50,100 and 150 t/ha manure on cucumber with the other treatments had a greater impact on cucumber yield. In terms of yield of cucumber and soil sustainability the combination of crystallizer, cow dung and pig dung respectively with NPK 20:10:10 fertilizers will be appropriate for the farmers usage rather than sole application of either organic or inorganic fertilizer materials. However, from the result of this study, the combination of 2.5 t/ha cow dung and 30 kg/ha NPK 20:10:10 gave the best yield (7.50 t/ha) it is recommended for the farmers in this study area.

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