Effect of Selected Liquid Fertilizer on the Growth and Yield of Cucumber (*Cucumis Sativusl)*

Aluko, K.A.[1], Aderemi, A.M.[2*], Elesho, R.O.[3], Majekodunmi, O.A.[4]

[1,4]*Agricultural Technology Department, Federal College of Forestry, Ibadan, Nigeria*

[2,3]*Horiculture and Landscape Technology Department, Federal College of Forestry, Ibadan, Nigeria*

Correspondence author

Abstract: **This study examined the effect of two different liquid organic fertilizers on the growth of *Cucumis sativus*. The experiment was carried out at the pineapple nursery of the National Institute of Horticultural Research and Training (NIHORT) Idi-Ishin Ibadan. The experiment was laid in a Randomized Complete Block Design (RCBD) with five treatments replicated three times with each block representing a replicate. The liquid fertilizers were applied to stands of *Cucumis sativus* on the field four weeks after planting and the experiment was monitored for nine weeks thereafter for growth and fruiting. The result showed that SuperGrow liquid fertilizer applied at 2ml/L had the best growth in terms of leaf production in block 1(109.00), while the control was best in block 2 having a leaf mean number of 63.2. In block 3 superGrow applied at lml/L was best with mean leaf number of 84.3. The result of the height growth showed that SuperGrow applied at 2m/L performed best. In terms of fruit production, SuperGrow applied at 2m1/L had the best performance across the blocks having 15.6, 13.2 and 12.4 for block, 2 and 3 respectively. The result of the Analysis of Variance (ANOVA) showed that there was no significant difference among the five treatments but a significant difference was observed among the blocks. The overall result indicated that SuperGrow applied at 2ml/L performed best and was therefore recommended for the growth of *C. sativus.***

I. INTRODUCTION

Cucumber (Cucumis sativus L.) is one of the most profitable vegetable crops grown under protected cultivation systems all over the world , and it belongs to the gourd family of curcubitaceace (El-wanis, 2012).

Cucumber (Cucurnis sativus Linn) is one of the most popular members of Cucurbitaceae (vine crop) family. It is cultivated for fresh fruit andpickling which are locally consumed or exported to increase national income. The crop is cultivated in most parts of Northern Nigeria and some parts of Eastern part of Nigeria. Meanwhile, peasant farmers who lack information on some important cultural practice, this has led to low yield in the production of cucumber fruit. (Ekwu et al, 2007). Cucumber is highly medicinal and used in aiding digestion, dysentery control, cosmetics that are applied on the skin to keep it soft and smooth. It is rich in vitamins, calcium, magnesium, and other essential nutrient element. Cucumber can be eaten raw or cooked or baked, it also serves as source of income to the farmer.

Germination, growth and fruiting of crop are influenced by environmental factors most importantly, soil. Meanwhile, due to alarming increase in population more land are required for crop production while continuous use of such soil has resulted in loss of nutrients which has consequently resulted in poor growth and yield. However, over the years there has been continuous use of synthetic manure to enhance the soil nutrient with the intension of improving crop production. In many areas of the world the over application of chemical fertilizers has influenced the soil quality and caused serious envir6nmental problem. Thus, scientists seek an alternative means to enhancing soil nutrient which is environmentally friendly and has no lethal effect on the soil.

Nutrients in liquids are generally in an immediate form for uptake into the plants. The use of liquid fertilizer will not' only enhance the growth of C. sativus but also the yield. Besides, the use of liquid fertilizer will facilitate quick absorption of nutrient and reduce the period thereby the effect will be felt earlier than expected. The objectives of this study is to determine the effect of liquid fertilizer on the phenotypical characteristics and yield of C. sativus.

II. METHODOLOGY

The experiment was conducted during cropping season at the pineapple nursery of National Horticultural Research Institute (NIHORT), Ibadan, Nigeria. The experiment was laid out in a randomized complete block design (RCBD) and there were five treatments which were replicated three times. Experimental plot size is 3m by 2m which comprise of $6m^2$ number of plants per plot.The materials used are as follows; measuring tape, lines pegs and seeds.

The experimental site was cleared and cultivated manually.Soil sample was air dried at room temperature, and passed through 2mm sieve labelled and kept in a polythene bag. The soil was worked on with adequate moisture but not wet soil. Litters from previous crops were chopped and worked into the soil by discing prior to ploughing to speed up break down of organic matter (Halley *et al*, 2000). The field layout done with the use of measuring tape, line and pegs.Cucumber seeds were planted at a spacing of 60cm x 50cm between rows at three seeds per hole and later thinned to two seedlings per stand two weeks after planting. Weeding was done manually at two weeks interval. Insecticide was used three weeks after planting to control insects.Seeds are sown on ridges or mounds in prepared planting holes about 2cm deep. A spacing of 60cm was left within row while a distance of 50cm between rows is used. Lateral shoots were pruned after one fruit has formed. Support was provided for some trailing cultivars. Irrigation was carried out at frequent intervals and a high level of soil was maintained throughout the growing period. NPK fertilizer was applied before sowing followed by application of liquid manure 14-21 days after sowing and was monitored until fruits are formed.

Data collection commenced four weeks after sowing and at two weeks intervals thereafter for subsequent period until the experiment was terminated. Data were collected on plan height, number of leaves, number of fruit, fruit length,fruit girth and fruit weight. Vine length (cm) from the base of the plant to the terminal bud to the first harvesting, number of leaves per plants to the first harvest, number of branches per plant to the first harvest, leaf area (cm^2) per plant using graph method at first harvest, number of fruits per plot at each harvest, fresh fruit weights (kg) per plot at each harvest, length of fruits (cm) per fruit with a measuring rule at each harvest and fruit diameter (cm) at the middle of the fruit where it is thickest using calipers , number of marketable and non - marketable fruits, number of roots and length of roots. All the data collected was statistically analyzed using the analysis of variance (ANOVA) and separation of treatment mean effects was done using the Fishers least significant difference (F-LSD).

III. RESULTS AND DISCUSSION

Table 1: Pre-planting physiochemical properties of soil sample.

Soil Properties	Values
$_P$H (H_20)	5.59
Organic Carbon (g/kg)	0.71
Nitrogen	0.05
Average P (mg/kg)	8.46
Base salt	98.99
Exchangeable bases (cmol/kg)	
Ca	6.88
Mg	L10
K	0.35
Na	0.02
Al+H	0.02
ECEC.	
Micro-nutrient (Mg/kg)	
Mn	53.6
Fe	17.50
Cu	0.30
Zn	6.43
Particle size (g/kg)	
Sand	90.80
Silt	2.80
Clay	6.40

Table 1 showed the physiochemical properties of the soil in the site used for the propagation of the species. The result showed that Nitrogen component of the soil was about 0.05, the soil was slightly acidic with PH value of about 5.59. The exchangeable bases include Ca (6.88), Mg (1.10), Na (0.02), K (0.35), while micronutrient available are Mn (53.6), Fe (17.50), Cu (0.30). The organic carbon content was 0.71g/kg while the average phosphorus was 5.50mg/kg. The result also showed a high base salt content of 98.99%. The soil was rich in sand content of about 90.80%, while silt and clay content had 2.80 and 6.40 respectively, it was found that the active acidity constituted respectively 7.2 and 7.24 units, and total nitrogen content was 3.14 % and 0.10%.

Table 2: Effect of liquid manure on leaf production of C. sativus seedlings for 9 weeks of assessment

Treatment	3rd week	5th week	7th week	9th week
Block I				
TI	15.00	36.00	62.20	94.20
T2	14.33	26.80	47.20	63.00
T3	17.33	41.70	67.70	109.00
T4	14.33	30.30	47.30	55.20
T5	13.83	24.00	43.30	60.20
Block II				
T1	12.33	25.00	50.70	63.20
T2	10.67	19.20	36.20	44.20
T3	12.83	28.30	44.00	56.70
T4	14.33	26.50	42.20	58.00
T5	12.00	22.50	37.80	49.20
Block III				
T1	12.67	27.70	46.30	68.80
T2	14.83	34.00	62.70	84.30
T3	11.83	17.70	31.80	63.30
T4	12.50	23.70	45.20	62.50
T5	10.50	22.80	42.70	63.80
LSD	5.02	13.31	25.28	20.92
%CV	32.80	42.70	46.60	36.10

The effects of liquid manure on the leaf production of C. sativus for nine weeks were presented in table 2. In block I, the leaf production of C. sativus increases significantly ($p < 0.05$) across the week under different levels of liquid manure treatments compared to the control. However, seedlings treated with 2m1/L of the liquid manure (T3) had the best performance with an average production of 17.33 (week 3), 41.70 (week 5), 67.70 (week 7) and 109.00 (week 9). This followed by the control (T1) with mean leaf production of 15.00, 36.00, 62.20 and 94.20 for week 3, 5, 7 and 9 respectively. Meanwhile, T5 had the least leaf production of 13.83, 24.00, 43.30 and 60.20 for week 3, 5. 7 and 9 respectively. The trend changes in block II with treatment 4 having the best performance in the third week (14.33), the trend also changed in week 5 with treatment 3 having the best performance followed by treatment 4 while treatment 2 had the least performance.

In the 9th week treatment 1 had the best leaf production (63.20) followed by treatment 4 (58.00). In block III, leaf production also increases across the week with treatment 2 showing a better performance compared to other treatments in week 9 (table 2). The results of the Analysis of Variance (table 3) shows there is no significance difference in leaf production among the treatment.Pr = 0.274 as well as the interaction (0.073) but a significant difference was observed among the blocks at 5% probability level (<0.001).

Table 3; Analysis of Variance on the effect of liquid manure on leaf production of C. sativus seedlings for 9 weeks of assessment

SV	DF	SS	MS	VR	Pr
Treatment	4	1734.7	433.7	1.31	O.274Ns
Block	2	12305.9	6152.9	18.60	<0.002*
Treatment	X 8	5024.1	628.0	1.90	0.073Ns
Block	75	24814.2	330.9		
Error	89	43878.9			
Total					

Note: ns — not significant at 5%level of probability, * significant at 5% level of probability

Table 4: Effect of liquid manure on height of C. sativus seedlings for 9 weeks of assessment

Treatment	3rd week (cm)	5th week (cm)	7thweek (cm)	9thweek(cm)
Block I				
TI	44.00	89.70	121.20	157.70
T2	43.70	92.70	113.70	144.50
T3	53.50	118.00	165.70	199.80
T4	47.80	102.30	122.70	153.20
T5	38.80	81.50	116.70	144.00
Block 11				
TI	22.60	57.20	84.2	89.00
T2	22.90	63.00	98.8	121.70
T3	33.50	87.80	125.00	153.00
T4	39.00	83.00	110.70	138.00
T5	32.30	71.80	106.20	123.50
Block 111				
TI	28.70	67.20	82.00	103.70
T2	39.00	85.50	122.30	134.50
T3	26.00	56.30	79.80	93.50
T4	31.50	77.50	113.00	127.50
T5	27.50	63.20	95.50	126.70
LSD	18.53	32.76	44.79	54.53
%CV	45.50	35.70	3120	35.40

Table 4 shows the growth of C. Sativus in terms of height and also shows a significant increase across the week influenced by the application of liquid manure. In block I, Treatment 3 had the best performance across the week (53.5, 118.00, 165.7 and 199.8cm, while treatment 5 had the least value of 38.80, 81.5, 116.7 and 144.00. The same trend was observed in block 11. Although in week 3 treatments 4 had the best height growth. Meanwhile a change was observed from week 5 to 9 where treatment 3 was observed to show a better performance (87.80, 125.00 and 153.00). In block III, the result showed a different trend with treatment 2 having the best performance among the treatment across the 9 weeks (39.00, 85.50, 122.30 and 134.50) while treatment 3 had the least performance across the week (26.00, 56.30, 79.80 and 93.50) (table 4). No significant difference was observed among the treatments and the interaction, meanwhile, the block effect shows a significant difference at 5% probability level. The implication of this is that the effect of the different levels of liquid fertilizer applied does not differ from one another and the height growth was distinct enough among the blocks (table 5).

Table 5: Analysis of variance (ANOVA) for height development of C. sativus seedlings

SV	DF	SS	MS	VR	Pr
Treatment	4	9952.0	24880	1.11	0.360ns
Block	2	309340	15467	6.88	0.002*
Treatment	X8	23871.0	29840	1.33	0.243
B1ock	75	168576	2248.0		
Error	89	233333.0			
Total					

Note: ns — not significant at 5%level of probability, * significant at 5% level of probability

Treatment	Block I	Block II	Block III
TI	12.3	11.4	13.5
T2	10.5	8.5	11.2
T3	15.6	13.2	12.4
T4	8.5	6.5	7.5
T5	7.2	5.8	8.3
LSD	2.32	3.13	4.54
%CV	18.4	24.7	30.6

Table 6: Effect of liquid manure on fruit production of C. sativus seedlings for 9 weeks of assessment

Table 6 showed the effects theapplication of liquid manure had on fruit production of C. sativus.Treatment 3 had the highest mean number of fruit across the block, this is closely followed by treatment I with 13.5, 12.3 and 11.4 mean number of fruit in block 3, 1 and 2 respectively, while treatment 5 had the least value across the blocks II.

IV. DISCUSSION

Plant growth stimulation under organic management has been previously reported (Martinez, 2016). The application of liquid fertilizers on the seedlings of *Cucumis sativus* significantly influenced leaf production with seedlings treated with 2ml/L having the best leaf number (109.00) at week 9 after planting. This may be as a result of a more profuse development of new organs and fibrous roots which enhances absorption of more nutrient by the plant root. This result is in line with the findings of Gamal, 2003 and Barakat, 2012 who reported that the application of liquid manure from poultry source had significant influence on the leaf of Citrus sinensis. Besides, the presence of hormone like substance called hemic acids that are present in organic fertilizers has ability to stimulate leaf production (Cacco, 1984, Baldi, 2010). Ata-Ul-Karim, *et al*., (2017) reported that application of nitrogenous fertilizer increases leaf dimensions. This corroborates the findings of this study as both liquid fertilizers influenced leaf production of C. sativus.

Enhancing plant height and number of leaves as a result of liquid fertilizer that may lead to increase in yield. Meanwhile, Zhilin-Li,*et al*. (1997) stated that plant height was increased significantly due to nitrogen fertilizer application. This support the result of this study as plant treated with the two liquid organic fertilizer enhanced height growth of C. sativus when compared with the control. Although, effect of plots was observed as height differences across the plots were conspicuous. Increase in number of leaves and plant height as result of the application of liquid fertilizer had a significant influence on the yield of C. sativus.

V. CONCLUSION

Organic liquid fertilizers actually have good potentials in influencing the growth and yield of crops. This study revealed that waste from animals and plant which would have caused serious damage to the environment are converted to useful product like liquid fertilizers that are environmentally friendly and yet enhanced plant growth. This type of fertilizers is cheap and can be easily assessed by farmers which will on the long run reduce cost of production while the total output of the farmer is improved. In this study, two sources of liquid organic fertilizers were applied to promote the growth and yield of C. sativus. The application of liquid organic fertilizers significantly promoted the root architecture and plant growth of cucumber compared with the control. Among the two liquid organic fertilizers treatments applied and the control, the liquid fertilizer (SuperGrow applied at 2ml/L) proved to be effective in leaf production, stem height growth and fruit promotion. The addition of T3 liquid organic fertilizer significantly stimulated the soil's microbial activity and functional diversity through the enhancement of the Nitrogen mineralization process at the rhizospheric level which facilitated the increase in growth. Treating with T3 liquid organic fertilizer indicated its potential as an effective fertilizer regime in the C. sativus production system. Moreover, the successful application of liquid organic fertilizers in this study suggested a rational way to reuseagricultural wastes and was effective in sustaining plant growth and the health of the soil system.Based on the result of this study, it was recommended that liquid fertilizers, especially those made from plant and animal source to enhance growth and yield while keeping the environment save should be adopted.

REFERENCES

[1] Ata-Ul-Karim, S. T., Liu, X., Lu, Z., Zheng, H., Cao, W., and Zhu, Y. (2017). Estimation of Nitrogen Fertilizer Requirement for Rice Crop using Critical Nitrogen Dilution Curve. Field Crops Res. 201, 32–40. doi: 10.1371/journal.pone.0104540http://www.nature.com/scientificreports

[2] Baldi E, Toselli M, Marangoni B. (2010c). Nutrient Partitioning in Potted Peach (prunuspersica L.) Trees Supplied with Mineral and Organic Fertilizers. J Plant Nutr. 2010; 33: 2050–2061.https://doi:10.1080/01904167.2010.519080

[3] Barakat M.R., Yehia, T.A., Sayed, B.M. (2012). Response of Newhall Naval Orange to bio-organicFertilization under Newly Reclaimed Area Conditions I: Vegetative Growth and Nutritional Status. J HorticSci Ornamental Plants. 2012; 4(1): 18–25.https://idosi.org/jhsop/4(1)12/3.pdf

[4] Cacco G, Dell'Agnola G. (1984) Plant Growth Regulator Activity of Soluble Humic Complex. Can J. Soil Sci. 1984; 64: 225–228.https://cdnsciencepub.com/doi/abs/10.4141/cjss84-023

[5] Ekwu, L.G., Utobo, E.B. and Oyesola, C.A. (2007). Vegetative and Yield Response of Cucumber (Cucwnis sativus L.) to Staking and Nitrogen Fertilizer Application. Journal of Applied Sciences, 19 (4):7509-7519.https://zenodo.org/record/810517/files/Vol%204%20-%20Cont%20J.%20Agronomy.pdf%2023-27.pdf

[6] El -Wanis, A., Mona, M., Abdel-Baky, M. H. and Salman, S. R. (2012), "Effect of Grafting and Salt Stress on the Growth, Yield and Quality of Cucumber Grown in NET System", Journal of Applied Sciences Research, 8 (10): 5059-5067

[7] Gama,l A. M, Ragab, M. A.(2003). Effect of Organic Manure Source and its Rate on Growth, Nutritional Status of the Trees and Productivity of Balady Mandarin Trees. Assiut J.Agr Sci. 2003; 54: 253–264.

[8] Halley, P. Rutgers, R., Coombs, S., Kettels, J., Gralton, J., Christie, G., Jenkins, M., Beh, H., Griffin, K., and Jayasekara, R. (2001): Developing Biodegradable Mulch Films from Starch Based Polymers. Starch. 53:362-367

[9] Martinez-Alcantara, B.; Martinez-Cuenca, M.R.; Bermejo, A.; Legaz, F.; Quinones, A. (2016). Liquid Organic Fertilizers for Sustainable Agriculture: Nutrient Uptake of Organic Versus Mineral Fertilizers in Citrus Trees. PLoS ONE 2016, 11, e0161619

[10] Zhilin, Li., Sarker, R.S.,Nayak, S. K., Ravi, I. and Li, J. L. (1997). Physiological Effect of Nitrogen Application on Aromatic rice. J. South China Agric. Univ. 18: 13–17.