RESEARCH ARTICLES

EFFECT OF RATES OF COW DUNG AND NPK ON THE GROWTH AND YIELD OF CUCUMBER (*CUCUMIS SATIVUS*) IN SOUTHERN GUINEA SAVANNA, NIGERIA

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ABSTRACT

This study evaluates the effects of various application rates of cow dung and NPK fertilizer on the growth and yield of cucumber (*Cucumis sativus*) in the Southern Guinea Savanna region. The experiment was laid in a Randomized Complete Block Design (RCBD), the experimental treatment included five levels of cow dung (control, 3, 6, 9 and 12tons/ha) and five levels of NPK fertilizer (control, 50, 100, 150 and 200 kg/ha) with three replications. Data were collected on growth attributes such as vine length, leaf area, number of branches, and on fruit characteristics such as number for fruits, fruit length, fruit diameter and fruit yield. Results indicated that the application of NPK at 200 kg/ha significantly enhanced most growth parameters, including vine length, leaf area, and fruit yield, owing to the immediate nutrient availability it provides. Cow dung, particularly at 12 tons/ha, also positively influenced growth and yield, though its effects were more gradual due to its slower nutrient release. The study concludes that while NPK fertilizer offers rapid growth and yield improvements, cow dung presents a sustainable alternative by enhancing soil fertility and supporting long-term productivity. Recommendations suggest a balanced application of both NPK and cow dung to optimize cucumber growth while maintaining soil health.

Keywords:, Cow Dung, Cucumber, Growth, NPK, Yield

INTRODUCTION

Cucumber (*Cucumis sativus*), a member, of cucurbitaceous family, is native of Asia, and Africa, where it has been consumed by people for 3,000 years, may be one of our oldest crops. Cucumber was being grown in North Africa, Italy, Greece, Asia minor and other areas at the beginning of the Christian era (USDA, 1999). Today Cucumber is grown all over the world for pickling, (pickles) and fresh market (slicers) Cucumber is a creeping tender warm season vegetable plant that produces well when grown under proper management. It is a creeping vine that roots in the ground and grown-up trellising on other supporting frames, wrapping around ribbing with thin, spiraling tendrils (Widders and Price, 2018). The plant has large leaves that forms canopy over the fruit. The fruit roughly cylindrical elongated with tapered ends (Legard, 2000) and may be as large as 60cm long and 10cm diameter. Fruits are rich in vitamin A and calcium, calories, small amount of beta carotene which is found in the green peel, dietary fiber carbohydrate, some trace of iron and 95% water which call for its lowest nutritional content in the cucurbit family (Firbank, 2019). Cucumber grown to be eaten fresh (Slickers) and those intended for pickling (pickers) are similar Cucumber are mainly eaten in the unripe green form (Rao *et al*., 2020).

Despite its widespread cultivation, cucumber production is frequently hindered by inadequate nutrient management. Insufficient nutrient supply can lead to stunted growth, poor fruit quality, and reduced yields (Bokhtiar & Hossain, 2017). Traditionally, cucumber farmers have relied heavily on synthetic fertilizers, particularly NPK (Nitrogen, Phosphorus, and Potassium), to provide essential nutrients required for optimal plant growth. However, excessive use of these fertilizers poses several environmental challenges, including soil degradation, water contamination, and negative impacts on human health (Blenkinsop *et al*., 2018; Gajewska *et al*., 2021). This over-reliance on chemical fertilizers not only threatens the sustainability of farming practices but also compels the need for alternative nutrient management strategies.

As an organic amendment, cow dung offers a rich source of nutrients, enhances soil structure, and increases microbial activity, which collectively supports better plant growth and development (Ojeniyi, 2020). Previous studies have indicated that organic fertilizers, like cow dung, improve soil fertility and can lead to higher yields in various crops (Adeoye & Agboola, 2015). However, the effectiveness of cow dung is highly dependent on its application rate, which remains under-researched in the context of cucumber production (Abdollahzadeh & Shamsi, 2021). Although some studies have explored the effects of cow dung and NPK fertilizers separately, there is a distinct lack of comprehensive knowledge regarding their combined application and the optimal rates that would maximize cucumber growth and yield. Understanding how these two nutrient sources interact when applied at different rates is crucial for developing sustainable farming practices. The aim of this study is to study the rates of cow dung and NPK fertilizer on growth and yield of Cucumber (*Cucumis sativus*).

MATERIALS AND METHOD

Study area

The experiment was conducted during the 2024 cropping season in Crop Production, Faculty of Agriculture, Ibrahim Badamasi Babangida University Lapai, Niger State. It has an average monthly temperature of 23°C-34°C with a mean annual rainfall ranging between 1100mm-1600mm. It is located at Latitude of 9.69°N and a Longitude of 6.53°E of the equator. The town is located at the Southern Guinea Savanna zone of Nigeria. The soil is characterized as sandy loam.

Treatments and experimental design

A factorial experiment using a Randomized Complete Block Design (RCBD) is employed to study the differences between cow dung and NPK fertilizer rates. Five levels of cow dung (control, 3tons/ha, 6tons/ha, 9tons/ha, and 12tons/ha). Similarly, five levels of NPK fertilizer (control, 50 kg/ha, 100 kg/ha, 150 kg/ha and 200 kg/ha) with three replications. 50kg of soil was filled into bags. Cow dung was incorporated into the soil two weeks before planting, while NPK is applied in a split form (half at planting, half at four weeks after planting).

Data collection

Growth data should be collected at regular intervals (2, 4, 6 and 8 WAP) to monitor the development of the cucumber plants. Plant Height (cm) measure the height of the plant from the base to the tip of the growing point, this data will be collected at 2, 4, 6, and 8 weeks after planting. Number of Leaves (cm) will be counted by the total number of fully developed leaves per plant. Vine Length (cm), Measure the length of the vine from the base to the farthest point, this parameter is important to assess how well the plant is developing and spreading, it will be collected at 2, 4, 6, and 8 weeks after planting. Weight of Fruits per Plant (g) is weighed be calculating total number of fruits harvested from each plant. And also, the total Number of Fruits harvested per Plant will be counted.

Data analysis

The data collected were subjected to ANOVA (Analysis of Variance) to determine the significant differences between treatments. Duncan Multiple Range Test (DMRT) was used to separate the means at 5% probability level.

RESULTS AND DISCUSSION

Results

Physiochemical properties of experimental soil, cow dung

Table 1 shows the chemical analysis cow dung and physiochemical properties of soil before the experiment. From the result of the physiochemical analysis, the soil particles of the soil sample include: sand (92.08%), clay (6.24%) and silt (1.68), this implies that the experimental soil is sandy hence coarse in texture. However, the experimental soil had a pH of 6.60 which indicates that the soil is neutral while cow dung had a pH of 8.40, which indicates alkalinity.

Effect of NPK and cow dung on the vine length of cucumber

The vine length of cucumber as influenced by NPK and cow dung rates is presented in table 2. The result showed that there were significant ($p<0.05$) differences in the vine length of cucumber as influenced by NPK as application at 200kg/ha significantly produced longer vines at 4 and 8WAP while control had the shorter vines. Similarly, application of cow dung at 12ton/ha significantly supported longer vines at 6WAP but was not significantly different from application at 9ton/ha while control had the least vine length. The result also revealed that there were no significant difference in the vine length at 2, 4 and 8WAP.

Effect of NPK and cow dung on the number of leaves of cucumber

Table 3 presents the effect of NPK and cow dung rates on the number of leaves of Cucumber. The result showed that application of NPK at 200kg/ha significantly had higher number of leaves at 2, 4, 6 and 8WAP but was not significantly different from application at 150kg/ha while control had the least number of leaves throughout the experiment. Moreso, the result revealed that application of cow dung had significant effect on the number of leaves of cucumber at 4WAP as application at 12ton/ha significantly produced higher number of leaves compared to other rates of application but was not significantly different from application at 9ton/ha while control had the least number of leaves at 5% probability level. The result also showed that there were no significant differences in the number of leaves at 2, 6 and 8WAP.

Effect of NPK and cow dung on the number of branches of cucumber

The number of branches of cucumber as influenced by application rates of NPK and Cow dung is shown in Table 4. The result showed that application of NPK at 2WAP, application at 200kg/ha had the highest number of branches but was not significantly ($p<0.05$) different from application at 150kg/ha, however at 4 and 6WAP application of NPK at 150kg/ha significantly had highest number of branches while control had the least, whereas there were no significant different in number of branches at 8WAP. The result also showed the effect of cow dung on the number of branches of cucumber. The result revealed that cow dung has no significant effect on the number of branches of cucumber.

Table 1. Physiochemical properties of experimental soil and cow dung

Sample	pH	Elec-Cond (ppm)	O.C (g/kg)	O.M (g/kg)	Aval. P (mg/kg)	Total N g/kg)	Exchangeable Cations				E.A (Cmol/kg)	CEC (Cmol/kg)	Soil Particle Sizes		
							Na (Cmol/kg)	K (Cmol/kg)	Ca (Cmol/kg)	Mg Cmol kg)			Sand (%)	Clay (%)	Silt (%)
Soil	6.6	80.0	11.97	20.64	43.25	0.42	1.04	0.39	2.44	12.61	0.0	16.55	92.0	6.24	1.68
		Elec. Cond	O.C	OM	Total P	Total N	Na	K	Ca	Mg					
		PPM	(%)	(%)	(%)	%	(%)	(%)	(%	(%					
Cow dung	8.4	11780	29.88	70.	0.125	0.68	2.35	1.96	0.64	0.174					

Effect of NPK and cow dung on the leaf area of cucumber (*Cucumis sativus*)

Table 5 showed the effect of NPK and Cow dung on the leaf area of cucumber. The result showed that NPK had a significant ($p<0.05$) effect on the leaf area of cucumber, at 4 and 6WAP application of NPK at 200kg/ha had wider leaves of cucumber while control had the least, however, there were no significant differences in the leaf area at 2 and 8WAP. Application of cow dung had a significant effect on the leaf area of cucumber. The result showed that application of cow dung at 12ton/ha significantly had wider leaves at 4, 6 and 8WAP but was not significantly different from application at 6 and 9ton/ha while control had the least leaf area.

Table 2. Effect of NPK and Cow dung on Vine Length (cm) cucumber (*Cucumis sativus*)

Treatment	2WAP	4WAP	6WAP	8WAP
NPK				
Control	15.67	30.33ab	47.20	63.00c
50kg/ha	15.67	30.00b	47.87	67.67b
100kg/ha	16.67	31.67ab	49.00	72.67a
150kg/ha	16.67	32.67ab	50.33	75.33a
200kg/ha	16.00	33.00a	50.67	76.33a
SE±	0.538	0.856	1.041	1.445
Cow dung				
Control	15.67	28.67	41.33c	58.00
3ton/ha	15.67	29.33	42.33bc	62.00
6ton/ha	15.33	29.33	44.00ab	47.33
9ton/ha	16.33	32.00	45.67a	69.00
12ton/ha	16.00	32.27	46.00a	70.00
SE±	0.298	0.741	0.683	8.534

Means with same letters are not significantly different at 5% probability using Duncan Multiple Range Test (DMRT). SE = Standard Error

Effect of NPK and cow dung on the numbers of fruit of cucumber

Table 6 showed the effect of NPK and cow dung on the number of fruits of cucumber. The result revealed that application of NPK significantly influenced the number or leaves of cucumber as application at 200kg/ha produced the highest number of fruits while control had the least number of fruits. Moreso, there were no significant ($p>0.05$) difference between application at 100kg/ha and 150kg/ha.

Furthermore, the result showed that application of cow dung had no significant (p>0.05) effect on the number of fruits of cucumber.

Table 3. Effect of NPK and Cow Dung on Number of Leaves of Cucumber (*Cucumis sativus*)

Treatment	2WAP	4WAP	6WAP	8WAP
NPK				
Control	3.67ab	8.67c	13.33b	21.00b
50kg/ha	3.00b	8.00d	13.33b	23.00b
100kg/ha	3.67ab	9.67b	14.67a	23.00b
150kg/ha	4.00a	11.00a	15.67a	25.67a
200kg/ha	4.00a	11.00a	15.67a	26.33a
SE±	0.211	0.211	0.333	0.715
Cow dung				
Control	3.33	8.33c	13.00	20.67
3ton/ha	3.33	8.67bc	13.33	21.67
6ton/ha	3.67	9.33ab	14.00	22.00
9ton/ha	3.67	9.67a	14.33	22.33
12ton/ha	4.00	10.00a	14.00	22.67
SE±	0.298	0.298	0.422	1.075

Means with same letters are not significantly different at 5% probability using Duncan Multiple Range Test (DMRT). SE = Standard Error

Effect of NPK and cow dung on the fruit length of cucumber

Table 6 showed the effect of NPK and cow dung on the fruit length of cucumber. The result showed that application of NPK fertilizer at 200kg/ha significantly had longer cucumber fruits compared to other treatments followed by application at 150kg/ha while control had the least fruit length. The result also revealed that there were no significant (p>0.05) between application at 50kg/ha, 100kg/ha and control. The result further show the effect of cow dung on the fruit length of cucumber, the result revealed that there were no significant (p>0.05) difference in the fruit length of cucumber as influenced by cow dung application rate.

Table 4. Effect of NPK and cow dung on number of branches of cucumber

Treatment	2WAP	4WAP	6WAP	8WAP
NPK				
Control	0.33b	2.00b	4.00b	6.00
50kg/ha	0.33b	2.33ab	4.33ab	6.33
100kg/ha	1.00ab	2.33ab	4.33ab	6.00
150kg/ha	1.67a	3.33a	4.00a	6.67
200kg/ha	1.67a	3.00ab	4.67ab	6.33
SE±	0.298	0.365	0.258	0.258
Cow Dung				
Control	0.67	2.00	4.00	6.00
3ton/ha	1.33	2.67	4.67	6.33
6ton/ha	1.00	2.67	4.67	6.33
9ton/ha	1.67	2.67	4.67	6.00
12ton/ha	1.00	2.33	4.33	6.00
SE±	0.365	0.298	0.298	0.211

Means with same letters are not significantly different at 5% probability using Duncan Multiple Range Test (DMRT). SE = Standard Error

Effect of NPK and cow dung on the fruit diameter of cucumber

The fruit diameter of cucumber as influenced by application of NPK and cow dung is presented in table 6. The result showed that application of NPK significantly influence the fruit diameter of cucumber. Application at 200kg/ha had the highest fruit diameter but was not significantly different from application at 150kg/ha followed by application at 100kg/ha while control had the least fruit diameter. Moreso, application of cow dung had a significant effect on the fruit diameter of cucumber as application at 12ton/ha significantly had the highest fruit diameter while control had the least fruit diameter at 5% probability level.

Table 5. Effect of NPK and cow dung on leaf area (cm^2) of cucumber

Treatment	2WAP	4WAP	6WAP	8WAP
NPK				
Control	22.00	36.33d	65.33b	93.67
50kg/ha	22.33	37.00cd	67.00ab	99.00
100kg/ha	22.33	39.00bc	70.33ab	104.67
150kg/ha	22.00	41.33ab	73.67ab	75.67
200kg/ha	22.33	42.00a	74.33a	113.00
SE±	0.856	0.803	2.547	14.989
Cow Dung				
Control	22.67	34.67b	65.00d	91.00b
3ton/ha	22.00	36.00ab	66.67c	98.33ab
6ton/ha	22.00	37.67a	68.00b	99.67a
9ton/ha	21.67	38.33a	71.00a	101.00a
12ton/ha	21.33	38.33a	71.33a	105.00a
SE±	0.633	0.699	0.333	2.391

Means with same letters are not significantly different at 5% probability using Duncan Multiple Range Test (DMRT). SE = Standard Error

Effect of NPK and cow dung on the fruit yield of cucumber

Table 5 showed the effect of NPK and Cow dung on the fruit yield of cucumber. The result revealed that application of NPK had a significant ($p<0.05$) effect on the yield of cucumber.

Application of NPK at 200kg/ha had the highest fruit yield but was not significantly different from the application rate of 150kg/ha followed by application rate of 100kg/ha while control had the least fruit yield of cucumber. Application of cow dung also had a significant ($p<0.05$) effect on the yield of cucumber as application of cow dung at 12ton/ha significantly produced higher fruit yield compared to other application rates. However, application rate at 9ton/ha and 6ton/ha were not significantly different while control had the least fruit yield at 5% probability level.

Table 6. Effect of NPK and Cow dung on Fruit Characteristics and Yield of Cucumber

Treatment	Number of Fruits	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Yield (kg/pot)
NPK				
Control	2.00b	20.00bc	14.67d	0.286d
50kg/ha	2.00b	19.67c	17.03c	0.337c
100kg/ha	2.33ab	20.20bc	17.83b	0.362b
150kg/ha	2.67ab	21.33ab	19.00a	0.398a
200kg/ha	3.00a	22.00a	19.00a	0.411a
SE±	0.211	0.451	0.107	0.008
Cow Dung				
Control	1.67	18.50	14.50c	0.280d
3ton/ha	1.67	19.03	16.00b	0.307c
6ton/ha	2.00	19.33	17.00ab	0.322bc
9ton/ha	2.33	19.63	17.50a	0.343b
12ton/ha	2.33	20.07	17.87a	0.377a
SE±	0.298	0.532	0.413	0.007

Means with same letters are not significantly different at 5% probability using Duncan Multiple Range Test (DMRT). SE = Standard Error

Discussion

The results of this study revealed notable effects of both NPK and cow dung on various growth and yield parameters of cucumber (*Cucumis sativus*), highlighting their potential as nutrient sources in cucumber cultivation. The study showed that NPK fertilizer, particularly at the 200 kg/ha application rate, significantly enhanced vine length, number of leaves, branches, and leaf area of cucumber, especially in the later weeks after planting (WAP).

The application of NPK at 200 kg/ha significantly enhanced cucumber vine length, particularly at later growth stages. This improvement is likely due to the balanced nutrient supply provided by NPK, which supports vegetative growth by enhancing cell division and expansion, essential for vine elongation and leaf development. This result aligned with research done by Ayoola and Makinde (2019), who reported that NPK fertilizers, due to their balanced nutrient content, foster substantial vegetative growth by supplying essential elements like nitrogen, which promotes cell division and elongation. Cow dung also improved vine length, especially at 12 tons/ha, although its effect was less immediate compared to NPK. Organic fertilizers such as cow dung gradually release nutrients, improving soil structure and microbial activity over time, which supports vine growth at a steady rate (Moyin-Jesu, 2017). The organic matter in cow dung likely improves soil structure and water retention, thus indirectly supporting growth but at a slower release rate than NPK fertilizer.

Application of NPK at 200 kg/ha resulted in the highest number of leaves and largest leaf area, which is consistent with findings from other studies that emphasize the role of nitrogen in enhancing leaf production and photosynthetic capacity (Adekiya et al., 2020). The broader leaf area observed with higher NPK rates can increase light interception, ultimately improving crop biomass and productivity. Cow dung also positively impacted leaf area, particularly at 12 tons/ha. This effect may be attributed to organic matter improving water retention and nutrient availability in the soil, creating a favorable environment for leaf expansion (Ayeni et al., 2010).

The study also showed that NPK at 200 kg/ha significantly enhanced the number of branches, especially in early growth stages, while cow dung had no significant effect on branching. Branch development is often influenced by nutrient availability, particularly phosphorus, which NPK provides in readily available forms. This finding aligns with previous studies, such as those by Adediran et al. (2014), which highlight the importance of phosphorus in promoting lateral growth and plant robustness.

The result of the study also revealed that application of NPK at 200 kg/ha resulted in the highest fruit yield, number, and size, confirming the role of balanced mineral nutrients in fruiting. This could be attributed to the differences in the nutrient content in the treatments applied. According to Adeoye et al. (2015) inorganic fertilizers enhance fruit development by meeting the high nutrient demands during the reproductive phase. Although cow dung at 12 tons/ha also improved yield attributes, its effect was comparatively moderate, suggesting that its nutrient release may not be as rapid as NPK. Cow dung, while beneficial in improving fruit diameter and yield, had a less pronounced effect than NPK, possibly due to its slower nutrient release rate, which may not meet the rapid nutrient demands during peak fruiting phases. Nonetheless, cow dung's significant impact on yield suggests its role as a sustainable alternative that could enhance soil fertility over time, benefiting long-term productivity (Mbah et al., 2019).

CONCLUSION AND RECOMMENDATIONS

In conclusion, the result from this study showed that that NPK significantly enhances immediate growth and yield attributes in cucumber cultivation, while cow dung supports sustainable productivity by improving soil conditions. Therefore, in sustainable low input agriculture systems in the Southern Guinea Savanna where nutrient depletion is a serious constraint to crop production and despite cultivation preferences by farmers, the alternative organic manure may not meet up plant nutrient demand due to low nutrient composition and release efficiency and limited availability.

Future research could investigate the effects of integrating these fertilizers to develop a balanced approach to maximize growth, yield, and soil health in cucumber farming.

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