EFFECT OF FERTILIZER APPLICATION AND STAKING METHODS ON THE GROWTH AND YIELD OF CUCUMBER (*Cucumis sativus)*.

BY

Blessing Miracle BASSEY (Miss)

AGR1800184

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CERTIFICATION

This is to certify that this project titled "**THE EFFECT OF FERTILIZER APPLICATION AND STAKING METHOD ON THE GROWTH AND YIELD OF CUCUMBER (*CUCUMIS SATIVUS*)"** was a research work carried out by **Blessing Miracle BASSEY (Miss)** with matriculation number **AGR1800184** of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City.

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Dr. (Mrs.) E. J. Falodun
(Project supervisor)

Prof. K. E. Law-Ogbomo
(Head of Department)

Date: _____

Date:_____

DEDICATION

My research work is dedicated to the Almighty God for his love and mercy. Also to my beloved Parents Mr. and Mrs. Bassey for their prayers, support and motivation unto me this very day.

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ABSTRACT

This study was carried out to determine the effect of fertilizer application and staking methods on the growth and yield of Cucumber (*Cucumis sativus*). The experiment was conducted during the 2024 dry cropping season at the Teaching and Research Farm of the Faculty of Agriculture, University of Benin, Benin city. The experiment was laid out as a randomized complete block design in three replicates consisting of four rates of fertilizer application (0kg/ha, 400kg/ha NPK, 20t/ha PM, 200kg/ha NPK+10t/ha PM) and three levels of staking (no staking, single staking and trellis). The parameters measured were vine length, number of leaves, number of tendrils, stem diameter, leaf area, days to 50% flowering, number of flowers, number of fruits, fruit weight per plot and yield(t/ha). The results obtained showed that the effect of fertilizer application using poultry manure influenced the vine length and the number of leaves positively at the vegetative stage, but fruit yield was not insignificant, However best yields were obtained with the combination of poultry manure and NPK 15:15:15. The result of this experiment suggests that cucumber farmers use the combination of poultry manure and NPK with or without staking for a better performance of cucumber crop.

CHAPTER ONE

INTRODUCTION

One of the most well-known and significant vegetables in the Cucurbitaceae family is the cucumber (*Cucumis sativus* L.) (Thoa, 1998). It is believed to be among the earliest vegetables ever grown by humans (Wehner and Gunner 2004). According to Tatlioglu (1997), the crop is the fourth most significant vegetable in Asia after tomatoes, cabbage, and onions. In Western Europe, it ranks second in importance only to tomatoes (Phu, 1997). Cucumbers are rich source of vitamins but it's still low in production, due to factors such as water and nutrient as observed by (Ayotamuno, 2007). Fresh consumption of this crop provides a variety of health benefits including valuable antioxidants, anti-inflammatory and anticancer benefits (Mukherjee *et al*., 2013). Cucumbers plants typically have both male and female flowers (monoecious), with males appearing first and in greater numbers. However, many varieties produce only the female flowers (gynoecious) for easier fruit production. Cucumbers are warm season crops and are sensitive to cold, ideally a pH of 5.5- 6.6 is recommended. The best growing temperature range for cucumbers is between 18.3°c and 35°c. Cucumbers are grown in fertile soils; poor soils produce bitter, malformed fruits that are rejected by consumers due to their undesirable taste. (Eifediyi and Remison 2010).

Cucumber production requires moderate to high nutrient to achieve high yield and fruit quality (Kumar, 2020).

Cucumbers need plenty of nutrients throughout their growth but are sensitive to overwatering. The world's cultivation of cucumbers in 2021 was estimated to 93,528,796 metric tonnes, its production continues to gain attention in Nigeria because of its nutritional and economic value. Although the average yield per hectare is below world average, due to nutrient poor soils and lack of good agronomic practices.

There is currently an urgent need to apply sufficient nutrients to maintain crop growth and yield, thus meeting the food demand of a continuously growing population (Cordell, 2009) (Ibraheem, 2020). Cucumber Production is fast becoming popular in most part of Nigeria probably because of its high nutritional and economic value (Nweke *et al*., 2013). The successful cultivation of any crop depends on several factors, which fertilizer has been found to be one of the important factors. Fertilizer is any organic or inorganic substance applied to the soil supplies the required nutrient to enable plant growth. The cost of fertilizers has been enormously increasing to an extent that they are out of reach for the small marginal farmers. In addition to being costly and scarce, the use of the inorganic fertilizer has been associated with increase in soil acidity and nutrient imbalance (Ojeniyi, 2000). High and sustainable crop yield can be obtained with appropriate agronomic practices and judicious NPK fertilization combined with organic matter amendment (Osundare, 2004). Cucumber fruit is usually under foliage, shading

one another, they could still require high staking for good exposure to sunlight and aeration which helps to reduces insect pests and diseases attack.

The trellis staking and creeping on the ground have been recommended in research (Akoroda, 1990). Nweke (2013) suggested that staking reduced overcrowding and enhanced exposure or positioning of cucumber leaves to sunlight for effective photosynthetic activities.

Cucumbers have different staking methods and fertilizer rates, but enough studies have not been conducted to find out the definite types of staking to support the best yield of cucumbers in large farms.

1.1.Objective

The objective of this study is to determine the staking method and fertilizer rates that would increase the growth and yield of Cucumber.

CHAPTER TWO

LITERATURE REVIEW

Cucumber (*Cucumis sativus*) is a widely cultivated vegetable crop known for its high nutritional value and economic significance. Cucumber is rated an important Cucurbit alongside Watermelon (*Citrillus lanatus* L) and Melon (*Cucumis melon* L) (Whener and Guner, 2007). The low yield of Cucumber and insufficient use of the product previously contributed to the ranking of the crop as insignificant in Africa, according to the studies of (Eifediyi and Remison, 2010) on the growth and yield of cucumber. Maximizing cucumber yield is essential for agricultural productivity and food security. The complementary use of organic manure and mineral fertilizer has proven to be a sound soil fertility management strategy in many countries of the world. (Lombin *et al*., 1991). There are different types of fertilizer application including organic fertilizer and the inorganic fertilizer. The organic fertilizer types include cow dung, compost, poultry droppings and farmyard manure. The nutrient contained in organic manure is released more slowly and are stored for a long time. Manure application also increases soil porosity and aggregate stability promotes soil water infiltration and holding capacity, elevates soil organic matter content (Ayoola and Makinde 2006). Similarly, nutrients from inorganic fertilizers enhance the establishment of crops, while those mineralization of organic manures promoted yield when both fertilizers were combined (Fuchs *et al*., 1970).

Furthermore, the benefits of using organic materials have not been fully utilized in the humid tropics, partly due to huge quantities required to satisfy the nutritional needs of crops, transportation and handling costs. (Ayoola and Adeniyan, 2006). Research by (Ahmed, 2017). Found that organic fertilizers, such as compost and vermicomposting, significantly increased cucumber yield compared to chemical fertilizers. Organic fertilizers improve soil structure, enhance nutrient availability, and promote beneficial microbial activity, leading to higher yields and improved fruit quality. However, the use of inorganic fertilizers has not been helpful under intensive Agricultural practice because of its high cost and its association with reduced crop yield, soil degradation and nutrient imbalance (Obi and Ebo, 1995). The complementary use of inorganic and organic fertilizers has been recommended for sustenance of long-term cropping in the tropics. (Ipimoroti *et al*; 2002).

Staking methods and fertilizer application are two key factors influencing cucumber yield. Staking is a common practice in cucumber cultivation to support vine growth, improve fruit quality, and increase yield. Several staking methods have been studied for their impact on cucumber production; these staking methods include; the vertical trellis system demonstrated by (Nagase *et al*., 2018), and they reported that the vertical trellis system significantly increased cucumber yield compared to non-staked plants. This method provides better airflow, reduces disease incidence, and enhances light penetration, leading to improved fruit quality and yield. According to the findings of (Yan *et al*., 2020) on the horizontal trellis system, promotes uniform fruit development

and facilitates easier harvesting, resulting in higher overall yield. However, according to the studies by (Lee *et al*., 2019). suggested that the A-frame trellis system improved cucumber yield by minimizing fruit contact with the soil, reducing disease susceptibility, and enhancing fruit quality attributes such as size, shape, and color. While the Un-Staked system had the least effects on parameters measured, and may be due to direct contact of plants with soil and overcrowding of the plant canopy which may hinder effective crop growth (Nweke *et al*., 2013).

Studies by (Wang *et al*., 2018). Demonstrated that foliar fertilization with micronutrients, such as boron and zinc, positively influenced cucumber yield by addressing nutrient deficiencies and enhancing physiological processes related to flowering, fruit set, and development. Recently, Cucumber entered the farming system of Akwaibiom State, Farmers cultivate cucumbers as a sole crop in the flood plains and lowland soils, according to the studies of (Udo and Ibia, 2009). One of the problems the farmers faced in the study was inadequate information to alternative to scarce and high cost mineral Fertilizer.

CHAPTER THREE

MATERIALS AND METHOD

3.1 Experimental Site

The field trial was conducted during the dry season of January 2024 to March 2024 at the Horticultural unit of the Teaching and Research Farm of the Department of Crop science, Faculty of Agriculture, University of Benin, Benin city, Nigeria (6^0 24'3''N 50)

3.2 Sources of Planting Materials

The Seeds were obtained from a Registered Seed Merchant in the open Market. The poultry manure was procured from University Farm Project and analyzed for chemical composition.

3.3 Site Description

The part of the farm that this experiment was conducted had been overgrown with mainly spear grass (*Imperata cylindrical*) and sensitive plant (*Mimosa pudica*).

3.4 Land Preparation

Land was manually cleared and debris worked into the soil. Soil samples were then taken to the Faculty of Agriculture analytical laboratory for the soil physical and chemical analysis. The field was marked and divided into plots each measuring. 1m x 1m with a spacing of 0.5m x0.5m, two weeks before sowing of seeds.

3.5 Experimental Design and Field Layout

The Field was laid as 3x4 factorial combination in a randomized complete block design (RCBD) in three replicates consisting of three levels of staking (no staking, single staking and trellis staking) four fertilizer rates (Control 0 kg/ha, 400 kg/ha NPK 15:15:15, 20t/ha poultry manure and 200 kg/ha NPK 15:15:15 + 10 t /ha poultry manure).

3.5 Fertilizer Application

The poultry manure used for the experiment was incorporated into the respective plots and watered two weeks before sowing. The inorganic fertilizer (NPK 15:15:15) was applied using Split application at three and five weeks after sowing (WAS).

3.6 Sowing Of Seeds

The Cucumber were sown on the 13th of January, 2024. The plots were mulched to conserve moisture and smoother weeds. The plots were watered daily.

3.7 Weeding

The experimental field was hand weeded with hoe. Weeding was carried out at 3,

6, and 8 at weeks. Insects were handpicked when necessary.

3.8 Parameters Measured

Four plants were randomly tagged per plot for data collection. Data were collected on the vegetative growth and reproductive Characters.

Vine length: This was measured with a meter rule from the base of plants to the main shoot apex.

Number of leaves: The Plant leaves were counted starting from 4WAP (Four weeks after planting) and 6WAP (Six weeks after planting).

Number of tendrils: The tendrils were also counted at 4WAP and 6WAP.

Stem diameter: This was done by measuring by measuring the stem using a Vernier Caliper.

Leaf area: This was taken by multiplying the length and breadth of a tagged leaf, and it was recorded.

Days to 50% flowering: This is the number of days from sowing to the day half other plant population per plot had flowered.

Number of flowers: Numbers of flowers per plant were counted on weekly basis starting from the day flower was first observed till the first harvest.

Number of fruit: This was done by counting the numbers of fruits per plant on all the plots.

Fruit weight per plot: This was done by weighing the fruits using an electronic scale, immediately after harvest and the weight recorded.

3.9 Harvesting

Mature fruits were harvested, harvesting was carried out two to three times in a week according to the treatment.

3.10 Statistical Analysis

Collected data were subjected to analysis of variance (ANOVA). Using SAS (Statistical Analysis Software) and Least Significant Difference (LSD) test at 5% level of probability was used to compare the significant treatment means.

CHAPTER FOUR

RESULTS

4.1 Soil and Fertilizer Analysis

The results from the soil physical and chemical analysis before sowing, show that the soil contained little amount of nutrients, with high percentage of sand, silt and clay at 75.60%, 4.60% and 19.80% respectively Table 1.

Result from the poultry manure analysis shows that it contained nitrate, phosphate and potassium at 0.41, 38.1 and 1.98 cmol/kg Table 2.

Table1: Chemical Analysis of the soil

Parameter	Values
pH (H2O)	5.26
Organic matter g/(100g)	0.73
Total N g/(100g)	0.03
Total P (mg/kg)	14.70
K (cmol/kg)	0.12
Ca (cmol/kg)	0.81
Mg (cmol/kg)	0.51
Sand (%)	75.60
Clay (%)	19.80
Silt (%)	4.60

Table 2: Chemical Analysis of Poultry Manure

Nutrient	Compositions
Ca (cmol/kg)	0.88
Mg (cmol/kg)	0.11
Phosphate (ppm)	38.1
Nitrate (ppm)	0.41
pH (1.1) in water	6.2
Organic carbon (%)	3.48
Organic matter (%)	6.07
Na (cmol/kg)	0.33
K (cmol/kg)	1.98

The Result of the physio-chemical analysis of the soil shows that the soil was deficient of some important nutrients and so the need for soil amendments.

4.2 Vegetative characters.

4.2.1. Days to emergence.

The effect of fertilizer application and staking methods had a significant effect on the days to emergence of cucumber. Table 3 showed that fertilizer application using poultry manure emerged first, which was also followed by the combined application of poultry manure (20 t/ha) and NPK15:15:15(200 kg/ha). However, the fertilizer

application NPK 15:15:15(400 kg/ha) emerged last, followed by the control. No staked plants emerged earlier than the single and trellis staking.

Table 3: Effect of Fertilizer Application and Staking Methods on Days to Emergence of Cucumber (*cucumis sativus*)

Treatments	Days to emergence
Fertilizer application	
Control (0 kg/ha)	7.03[a]
Poultry manure(20 t/ha)	3.89[b]
NPK 15:15:15 (400kg/ha)	8.22[a]
Poultry manure (10 t/ha) + NPK 15:15:15 (200 kg/ha)	5.36[b]
LSD	1.55
Significance	*
Staking Methods	
No staking	4.95[b]
Single staking	6.54[a]
Trellis	6.88[a]
L.S.D	1.34
Significance	*

4.2.2 Vine length and number of leaves

The effect of fertilizer application on the vegetative characters at four weeks after sowing were significant. There was an increase in vine length in plants treated with fertilizer, compared to the control. Poultry manure (20 t/ha) resulted in the highest vine length and number of leaves, while the NPK15:15:15(400 kg/ha) recorded the

least value for vine length and number of leaves. However, staking methods had no significant difference on vine length and the number of leaves. No staking had the highest value in the vine length and number of leaves compared to single staking and trellis staking.

Table 4: Effect of Fertilizer Application and Staking Methods on the Growth of Cucumber (*cucumis sativus*) at 4(WAS).

Treatments	Vine Length (cm)	No. of Leaves	No. of Tendrils	Stem Diameter (cm)	Leaf Area (cm^2)
Fertilizer application					
Control (0 kg/ha)	13.00^{c}	6.86^{b}	2.53^{b}	0.26^{c}	69.00^{c}
Poultry manure(20 t/ha)	36.45^{a}	15.56^{a}	4.49^{a}	0.72^{a}	186.72^{a}
NPK 15:15:15 (400 kg/ha)	16.78^{bc}	8.13^{b}	1.92^{b}	0.36^{bc}	90.25^{bc}
Poultry manure (10 t/ha) + NPK 15:15:15 (200 kg/ha)	18.83^{b}	8.58^{b}	2.19^{b}	0.44^{b}	105.43^{b}
L.S.D	5.12	1.96	1.26	0.16	29.71
Significance	*	*	*	*	*
Staking Methods					
No staking	22.79^{a}	10.27^{a}	3.19^{a}	0.47^{a}	118.98^{a}
Single staking	20.69^{a}	9.76^{a}	2.75^{a}	0.42^{a}	112.73^{a}
Trellis	20.31^{a}	9.31^{a}	2.40^{a}	0.43^{a}	106.85^{a}
LSD	4.44	1.69	1.09	0.13	25.73
Significance	Ns	ns	ns	ns	ns
F * S	ns	ns	ns	ns	ns

4.2.3 Number of tendrils, Stem diameter (cm) and Leaf area (cm^2)

Plants treated with poultry manure at four weeks after sowing gave the highest value in the number of tendrils, stem diameter and the leaf area, although staking methods were not influenced significantly.

Table 5 shows the effect of fertilizer application and staking methods on the growth of cucumber at six weeks after sowing.

Table 5: Effect of Fertilizer Application and Staking Methods on the Growth of Cucumber (*cucumis sativus*) at 6(WAS).

Treatments	Vine Length (cm)	Number of Leaves	Number of Tendrils	Stem Diameter (cm)	Leaf Area (cm^2)
Fertilizer Application					
Control (0 kg/ha)	56.81^{b}	22.33^{b}	8.27^{b}	0.51^{b}	162.17^{b}
Poultry manure(20 t/ha)	81.75^{a}	39.44^{a}	20.69^{a}	0.87^{a}	257.11^{a}
NPK 15:15:15 (400kg/ha)	61.87^{ab}	23.91^{b}	9.75^{b}	0.53^{b}	182.03^{b}
Poultry manure (10 t/ha) + NPK 15:15:15(200 kg/ha)	75.55^{ab}	29.22^{ab}	13.83^{ab}	0.68^{b}	182.22^{b}
L.S.D	21.42	12.13	6.93	0.17	60.19
Significance	*	*	*	*	*
Staking Methods					
No staking	76.99^{a}	35.08^{a}	16.60^{a}	0.76^{a}	191.37^{a}
Single staking	63.99^{a}	26.13^{a}	11.69^{a}	0.64^{ab}	208.41^{a}
Trellis	65.99^{a}	24.98^{a}	11.13^{a}	0.55^{b}	187.86^{a}
LSD	18.55	10.51	6.00	0.15	52.13
Significance	ns	Ns	ns	*	ns

The effect of fertilizer application on the vegetative characters was significant, plants treated with poultry manure(20 t/ha) had the highest value on the vegetative characters, however the effect of staking methods on stem diameter of cucumber at six weeks after sowing was significant.

4.3 Reproductive characters

4.3.1 Days to 50% flowering

Fertilizer application did not significantly affect the days to 50% flowering. NPK 15:15:15 (400 kg/ha) had the highest numbers, similar to poultry manure (20 t/ha), while the control had the least number to 50% flowering. However, staking did not influence days to 50% flowering, but the single staking gave the highest value to days to 50% flowering.

4.3.2 Number of flowers and number of fruits

The effect of fertilizer application on cucumber was significant to number of flowers, although it was not significant to the number of fruits. Plants treated with poultry manure gave the highest value on the number of flowers and number of fruits. However, staking did not affect the number of flowers and number of fruits significantly.

4.3.3 Fruit weight per plot and yield tons per hectare

It was observed from Table 6, that fertilizer treatments showed no significance influence on the fruit weight per plot. Control had the lowest recorded number of fruit

weight. Sole use of poultry manure (20 t/ha) recorded the highest value in the fruits per plot. Although the effect of staking methods had no significant on the fruits per plot.

However, on the yield tons per hectare, fertilizer application and staking methods had no significant. Although the combined use of poultry manure (10 t/ha) and NPK15:15:15 gave the highest yield value in the yield tons per hectare.

Table 6: Effect of Fertilizer Application and Staking Methods on the Yield of Cucumber (*cucumis sativuis*)

Treatments	Days to flowering	Number of flowers	Number of fruits	Fruit weight per plot	Yield tons per hectare
Fertilizer application					
Control (0 kg/ha)	33.72[a]	8.41[ab]	1.21[a]	167.4[b]	2.74[a]
Poultry manure(20 t/ha)	35.19[a]	9.19[a]	1.52[a]	154.36[a]	2.41[a]
NPK 15:15:15 (400 kg/ha)	35.97[a]	3.44[b]	1.14[a]	113.83[a]	2.31[a]
Poultry manure (10 t/ha) + NPK 15:15:15(200 kg/ha)	35.5[a]	5.37[ab]	1.39[a]	139.82[a]	3.19[a]
L.S.D	3.68	5.12	0.44	59.75	1.37
Significance	ns	*	ns	ns	ns
Staking Methods					
No staking	35.88[a]	6.93[a]	1.39[a]	147.16[a]	2.29[a]
Single staking	34.98[a]	5.81[a]	1.29[a]	150.35[a]	2.95[a]
Trellis	34.46[a]	7.07[a]	1.26[a]	134.10[a]	2.74[a]
LSD	3.19	4.43	0.38	51.75	1.19
Significance	ns	ns	ns	ns	ns

CHAPTER FIVE

DISCUSSION

It was observed that the application of poultry manure had an influence on the vegetative growth of the crop. The highest vine length, number of leaves, number of tendrils, stem diameter and leaf area. Whereas the lowest vine length and number of leaves where found with the control (0 kg/ha) which was similar the value of the NPK15:15:15. These results were in conformity with the findings of (Ahmed *et al.,* 2017) who found that organic fertilizers significantly increased cucumber yield compared to chemical fertilizers. From the data it appeared that staking did not influence the cucumber significantly, this was against the findings of(Nweke *et al.,* 2013) found that un-staked system had the least significant on parameters measured, due to direct contact of plants with the soil and overcrowding of the plant canopy.

From the data fertilizer application had a significant effect on the days to emergence of the cucumber, where poultry manure (20 t/ha) were observed to emerged first, followed by the combined use of the poultry manure (10 t/ha) and NPK15:15:15(200 kg/ha), whereas plants treated with NPK 15:15:15 emerged last. This result was in conformity with the findings o(f Kang *et al.,* 1995) found that inorganic fertilizer has not been helpful under intensive agriculture due to soil degradation and imbalance.

The mean values of days to 50% flowering were not significant. Although, NPK 15:15:15 was recorded to have the highest mean value of days to 50% flowering. The

number of flowers were significantly influenced by fertilizer application using poultry manure (20 t/ha).

The number of fruits, fruit weight per plot and yield tons per hectare did not show any significant difference among the different levels of treatments. Staking had no significant difference.

The plants treated with the combined use of poultry manure 10 t/ha and NPK 15:15:15(200 kg/ha) had the highest mean value compared to the other treatments. This result is in conformity with the findings of (Ipimoroti *et al.,* 2002) found that the complementary use of inorganic and organic fertilizers has been recommended for sustenance of long cropping in the tropics.

Conclusion and Recommendation

From the study, plants treated with 20 t/ha poultry manure had significant increase in the vegetative characters measured, however the fruit yield of cucumber were not significantly influenced. Combine use of poultry manure (10 t/ha) and (200 kg/ha) NPK 15:15:15 gave the highest mean value for the yield tons per hectare.

Since the findings of this result is based on a year data, it is therefore recommended that further studies should be carried out before useful recommendation can be made.

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