UNIVERSITY OF EDUCATION, WINNEBA

EFFECT OF DIFFERENT METHODS OF STAKING ON THE GROWTH AND YIELD OF CUCUMBER (*Cucumis sativus)*

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(M.ED IN CROP SCIENCE)

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A DISSERTATION IN THE DEPARTMENT OF CROP AND SOIL SCIENCES EDUCATION SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF EDUCATION IN AGRICULTURE (CROP SCIENCE) IN THE UNIVERSITY OF EDUCATION, WINNEBA

October, 2022

DECLARATION

STUDENT'S DECLARATION

I, CLEMENT ENTIH ASAMOAH, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE……………………………

DATE……………………………………

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

SUPERVISOR'S NAME: DR. E.D BORKETEY-LA

SIGNATURE………………………………

DATE……………………………………….

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Last but not least my sincere appreciation to my lovely wife Mrs. Abigail Arthur for her understanding, love and time.

DEDICATION

I dedicated this project work to God Almighty, the creator of everything.

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ABSTRACT

The Experiment was conducted at the experimental field of the crop and soil science Department of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development formerly University of Education Winneba, Mampong –Ashanti. From October to December 2021 to determine the effects of different staking methods on the vegetative growth and yield of cucumber. Randomized Complete Block Design (RCBD) was used with four treatments and three replications. The treatments were No staking, String staking, Anchor staking and Single staking. The Parameters were plant height, plant girth, number of leaves, fruit diameter, fruit length, number of fruit per plant, day to 50% flower. Data collected was analyzed using Analysis of Variance (ANOVA) and The treatment means separated with the Least significant difference (Lsd) at 5% level of probability. The findings indicate that, although staked cucumber performed better than the non-staked cucumber, however, among the three staking methods (Anchor, String, and Single staking), String staking performed best on both vegetative and yield performance of cucumber followed by Single staking and Anchor staking recording low on both vegetative and yield performance of cucumber. It is therefore recommended that farmers should adopt the string staking.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Cucumber is one of the most popular members of the cucumbitacae (vine crop) family. It originated in India and was cultivated there for 3000 years. (Kiragu, 2020), In the global market, about 80% of the word's production of cucumber is in Asian, with China leading production (60%). With respect to economic importance, it is ranked fourth after tomatoes, cabbage, and onion in Asia (Eifediyi *et al.,* 2017). According to Naamwintome *et al*. (2013) growing cucumber for commercial purpose is gaining prominence in Ghana. This is partly due to its export potential as well as public education from health experts and nutritionist on the need to consume more vegetables in the diet to minimizes diseases like; hepatitis B and anemia, cancer, hypertension, coronary disease, diabetes(Status *et al.,*2019) It is also a good source of vitamin A, C, K, B6, potassium, pantothenic acids, magnesium, phosphorus, copper and manganese.

The ascorbic acid contained in cucumber help to reduce irritation and swollen skin. It is used to make stews, salads and sauces. The young leaves are also used as salads or as cooked vegetables particularly in some Asian countries. However, consumers demand good shape and quality fruit. Cucumber is one of the most important market vegetables in the world. It has been observed that poor husbandry practice and management such as staking is among the factors affecting the production in Ghana. Staking is a means of providing support to ensure clean and unblemished fruits which keeps fruits off from the ground, minimizing diseases and rotting whiles increasing marketable yield (Daib *et al*., 2016) It is one of the management practices in producing vine related crops.

Staking facilitates pest and insect control, weeding, harvesting, and other farm operations as compared to those whose vines trial on the ground. When plants are staked, better leaf display occurs. According to Sarkka *et al*. (2017), mutual shading is also reduced so that photosynthetic capacity of the plants becomes greater, thus improving light penetration into the canopy of the crop. Again staking in cucumber improves the yield and quality of the fruits by keeping the fruits off the ground, thus minimizing disease infection which may result in flower abortion and rotting of fruits.

1.2 Problem statement

The vegetable industry is faced with a number of challenges which in turn affect the production of cucumber. The productivity of cucumber in the tropics has been limited by scarcity, partly due to high spoilage of fruit and poor yield as a result of fruit getting in contact with the ground. More so, heavy foliage cover formed by the veining habit of the cucumber plant restricts light penetration to lower leaves therefore reducing photosynthetic activities in the lower leaves. The dense canopy also restricts air movement,cause flower drop and promotes conditions favourable to the growth of fruit rot organisms. Even when plant populations are low, the dense canopy and veining habit prevents effective fungicide application. As a result, the fruit rot disease is a severe deterrent to expanding production in Ghana.

1.3 Justification

The factors that influence the growth and yield of crops can be identified as light, water, and nutrients. In vegetable production such as cucumber, its morphological features and the growth habit affect light penetration which also affects the quality of fruits due to the canopy formation (Albert *et al.,* 2015). It has been observed that poor husbandry practice and management such as staking are among the factors affecting the production of vegetables such as cucumber in Ghana. Staking is a means of providing support to ensure clean and unblemished fruits which keeps fruits off from the ground, minimizing diseases and rotting whiles increasing marketable yield (Gonzalez-Camejo *et al.,* 2019). It is one of the management practices in producing vine related crops. When plants are staked, better leaf display occurs. According to Sarkka *et al*. (2011), mutual shading is also reduced so that photosynthetic capacity of the plants becomes greater, thus improving light penetration into the canopy of the crop. Again staking in cucumber improves the yield and quality of the fruits by keeping the fruits off the ground, thus minimizing disease infection which may result in flower abortion and rotting of the fruit**.** Gonzalez-Comejo *et al*. (2019) further stated that the recommended staking methods differ depending on the availability of the staking materials. Some farmers use the V-shape, T-shape, Single, String, Anchor, Supportive, Protective, etc

1.4 Objectives of the study

1.4.1 Main objective

The main objective of the study is to assess the performance of different methods of staking on the growth and yield of cucumber (*Cucumis sativus).*

1.4.2 Specific objectives of the study

The specific objectives of the study were to:

a. Determine the appropriate method of staking on growth of cucumber.

b. Determine the appropriate method of staking on yield of cucumber.

c. Assess the correlation between vegetative growth and yield characteristics of cucumber.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Origin of Cucumber

The cucumber most likely originated in India (south foot of the Himalayas), or possibly Burma, where the plant is extremely variable both vegetative and in fruit characters. It has been in cultivation for at least 3000 years. From India, the plant spread quickly to China, and it was reportedly much appreciated by the ancient Greeks and Romans. Present forms range from thick, stubby little fruits, three to four inches long, up to the great English greenhouse varieties that often reach a length of nearly two feet (Ramirez-Perez *et al.*, 2018).

2.2 Botany

Cucumber (*Cucumis sativus*) is a creeping vine belonging to the cucubitaceae family. The plant has large leaves that form a canopy over the fruit. It develops thin spiraling tendrils that direct the plant to climb when provided with support. Both male and female flowers are yellow but the female flower can be identified with a swelling at the base and is also borne on a short peduncle as compared with the male on a longer peduncle (Hikosaka *et al.,* 2015). The sex expression of a cucumber plant can make it a monoecious cultivar (bear separate male and female flowers on the same plant), gynoecious cultivar (produce only female flowers) or parthenocarpic cultivar (female flowers require no pollination/fertilization for fruit production) (Kousik *et al.,*2015). Both male and female flowers are yellow but the female flower can be identified with a swelling at the back and is also born on a short peduncle as compared to the male on a long peduncle (Hikosaka *et al.,* 2015). The fruit is roughly cylindrical, elongated, with tapered ends. Different varieties of cucumbers vary in length from about 10 to 76 cm. If the cucumber is allowed to mature, the fruit bulges in the middle, changes in colour from green to yellow, and is not fit to be eaten (Ranjan *et al.,* 2019). Having an enclosed seed and developing from a flower, cucumbers are scientifically classified as fruits. Much like tomatoes and squash, however, their sour-bitter flavor contributes to cucumbers being perceived, prepared and eaten as vegetables.

In Ghana and the part of the world where cucumber is grown, several values are attached to its production. The 'Roman' was used to treat scorpion bites, bad eyesight and to scare away mice. Wives wished for children to wear them around their waists. They were also carried by the midwives and thrown away when the child was born (Hoppenbrouwers *et a*l., 2017). Generally, there are three types of cucumber varieties and they are Slicing, Pickling and Burpless. Within these cultivars are several different cultivars have emerged. Examples of such cultivars are Pilmaria, Ambassador, Bituin, General Lee,Poinsett76, Puma, Darina Mix, Thalia, Thunder, Diva etc.(Zhang *et al*.,2020)

2.3 Growth habit and stages

2.3.1 Growth habit

The cucumber plant is a tender, herbaceous, annual bristly vine. The main shoot starts with a climbing (erect) habit but soon adopts a prostrate trailing or running characteristic manner. When the plant begins to 'run' it assumes a branching growth pattern. The main shoot or growing point produces side shoots from the lateral buds at the base of its leaves. These primary laterals or side shoots can produce their own side shoots or secondary laterals and so on. This type of growth pattern in which the main direction or line of growth is formed by repeated forking of side shoots or laterals is known as a sympodial habit. It results in a branching effect with numerous growing points. The stiff, prickly or spiky-haired stems are angular in cross-section and can become hollow when the vine is mature. (Diab *et al.*, 2016).

2.3.2 Growth stages

Vegetative growth consists of 2 Stages: *Stage I* – Upright growth is the initial stage that starts when the first true leaves emerge and it ends after 5-6 nodes.

Stage II – Vining - starts after 6 nodes. Then, side shoots begin to emerge from leaf axils, while the main leader continues to grow. Side shoots are also growing, causing the plant to flop over. Leaves are simple and develop at each node. Each flower/fruit is borne on its own stem attached to the main stem at a node. Depending on the variety and environmental conditions, flowers may begin developing at the first few nodes(Diab *et al.*, 2016).

2.3.3 Flower types and fruits

There are different flower types:

- staminate (male).
- Pistillate (female). Ovary is located at the base of the female flower.
- Hermaphrodite (both male and female).

2.3.4 Pollination

Since each cucumber flower is open only one day, pollination is a critical aspect of cucumber production. One or more pollen grains are needed per seed, and insufficient seed development may result in fruit abortion, misshapen, curved or short fruit, or a poor fruit set. Hence, 10 - 20 bee visits are necessary per flower on the only day the flower is receptive, for proper fruit shape and size. Therefore, it is important to bring hives into the field when about 25% of the plants are beginning to flower. Bringing in the bees earlier is unproductive because they may establish flight patterns to more abundant and attractive food sources such as legumes or wildflowers. Bringing them in later jeopardizes the pollination of the first female flowers.

It is important to take into consideration that bee activity is greatest during the morning to early afternoon and that wet, cool conditions reduce bee activity and causes poor fruit set. Cucumber varieties can cross pollination with one another but not with squash, pumpkins, muskmelons, or watermelons. Pollination in gynoecious (all female flowers) crops is ensured by blending the seed of a monoecious cultivar (pollenizer) with the seed of the gynoecious hybrid. Typical ratios are 88% gynoecious, to 12% monoecious. Pollenizer seed is often dyed with a different color to distinguish it from that of the gynoecious hybrid. It is difficult to recognize pollenizer seedlings after emergence in the field. Removing 'different looking' seedlings during thinning may leave the field without the pollinizer (Diab *et al.*, 2016).

2.4 Climatic requirements

Cucumber grows best under conditions of high temperature, low humidity, moderate light intensity, good soil structure with an uninterrupted supply of water and nutrients (Guan *et al.,* 2019). The Optimum temperature for cucumber growth is between 20^0C to 25^0C, with growth reduction occurring below 16^0C and above 30^0C (Kousik *et al.,* 2015). The growth and development in cucumber were adversely affected at temperatures less than 5^0C but increasing temperatures up to 40^0C, and above 40^0C decreased drastically (Sarkka *et a*l., 2017). Humidity is dependent on rainfall thus humidity is higher during the wet season than in the dry season. Guan *et al.* (2019) stated that disadvantages of cropping under conditions of high relative humidity include the increased risk of water condensing on the plants development of serious diseases such as Downy and Powdery mildew. The resultant low transpiration rates are blamed for inadequate absorption and transport of certain nutrients, especially calcium to the leaf margins and fruits.

At low relative humidity, irrigation becomes critical, because large quantities of water must be added to the growth medium without constantly flooding the roots and depriving them of oxygen. Furthermore, low relative humidity favours the growth of powdery mildew and spider mites. According to Ando *et a*l. (2019) the incidence of fungal disease is directly related to atmospheric humidity. Zhang *et al.*(2018) also revealed that germination and growth of fungi spores (eg.Conidia) are optimum at 96% relative humidity and temperature range of 22-27^{0}C. Eifediyi and Remison (2010) classified cucumber as a day-neutral crop. Research however indicated that high light intensity tends to increase the number of staminate (male) flowers while lower light levels tend to increase the production of more pistillate (female) flowers.

Leaf production is stimulated under short day length and relatively high night temperatures. *Gonzalez-Camejo et al.*(2019) also reported that high intensity, light bulb of 100 watts accompanied by high temperature example, 40^{0}C is harmful to fruit-set since it affects the internal temperature of the reproductive organ of cucumber. High temperature induced sterility of cucumber and this occurs before or during anthesis. The soil provides a medium in which a proper balance exists between air, water and nutrients. If this balance is ensured, plant roots can easily obtain water and nutrients, resulting in rapid growth. Although cucumber can be grown on a wide variety of soils, the most suitable are those classified as loams, sandy loams, and some silty–loams, all with a high organic matter content Kelly *et al.* (2017) Water, an essential plant constituent for hydration, a medium for biochemical and metabolic reactions and nutrient absorption and translocation is in a continual state of flux. Water stress thus affects photosynthesis, respiration and all the above stated activities (Acquaah, 2008) indicated that continued water deficiency eventually produces irreversible alterations of the plant that result in death. He further stated that under hot dry conditions, water loss may occur quite rapidly in plants that are not structurally adapted to prevent water loss. Anonymous(2012) wrote that the cucumber plant, in spite of its extensive and moderately deep root system which enables it to obtain greater quantities of water from the soil, and tends to lose water rapidly under strong sunlight conditions because of its broad leaves.

2.5 Soil requirement

Cucumbers prefer light textured soils that are well drained, high in organic matter and have a pH of 6 - 6.8. Adapted to a wide-range of soils, but will produce early in sandy soils. Cucumbers are fairly tolerant to acid soils (down to pH 5.5). When the pH is too low, add ground calcitic limestone, or an equal amount of dolomitic limestone when the magnesium level in the soil is low, to raise it to a desirable level (Zhou *et al.,* 2017)

2.6 Nutritional Value and uses

Table 2.1 The nutritional composition of 100 g of edible cucumber

ENERGY	**12cal**	**Vitamin A**	**45IU**
Protein	0.6g	Vitamin B1	0.03g
Fat	0.1g	Vitamin B2	0.02g
Carbohydrate	2.2-2.6g	Niacin(Vitamin B3)	0.3g
Dietary fiber	0.5g	Vitamin C	12g
Calcium	14mg		
Magnesium	15mg	Iron	0.3mg
Potassium	124mg	Sodium	5mg
Phosphorus	24mg	Zinc	0.2mg

Abbey et al. (2017).

Cucumber fruit contain about 95% water and is hence recommended as a natural diuretic and for bodybuilding. It is low in vitamin C, and Potassium. The skin contains some amount of vitamin A.

It helps to drop high blood pressure to healthier levels when eaten regularly and also help to cure kidney ailment (Anonymous, 2012). Thus cucumber is not only needed as food for good health but also as raw material in the cosmetic industry. Cucumber peel when eaten by cockroaches is reported to kill them after several night (Slothaak *et al.,* 2013).

Cucumber leaves are sometimes dried and ground into powder for storage. The seed is often used as an edible oil in Asia. Cucumber seed are often used in place of dried peas, beans in rice dishes and soups. In Nigeria, the seeds are eaten as a diet; cooked immature fruits are used to treat dysentery in children in indo-china. Yellow curry cucumber (dosakayi) is used widely in a variety of curry, and stew preparation in South India with added buttermilk and yoghurt. Leaves and immature fruits have long been used in Indochina, Africa where their mixture is applied as a spurge, moisturize skin, induce sweating, prevent scurvy and treats urinary disorders. Its juice is often recommended as a source of silicon to improve the health and complexion of the skin The ascorbic acid contained in cucumber helps to reduce irritation and swollen skin (Eifediyi *et al.*, 2017). Cucumber peel is a good source of dietary fiber that helps reduce constipation, and offer some protection against colon cancers by eliminating toxic compounds from the gut. Cucumber leaves and seed-cake are sometimes used as cattle feed, and the leafy tops are grazed by stock and game.

The high water content makes cucumbers a diuretic and it also has a cleansing action within the body by removing accumulated pockets of old waste material and chemical toxins. Cucumbers help eliminate uric acid which is beneficial for those who have arthritis, and its fiber-rich skin and high levels of potassium and magnesium help regulate blood pressure and help promote nutrient functions. The magnesium content in cucumbers also relaxes nerves and muscles (Slothaak *et al.,* 2013).

2.7 Methods of staking

2.7.1 String method

The string method allows you to create a string trellis on the bed. Place a support beam parallel to the ground about 200cm to 250cm above the plants. Toss a long line of jute over the beam one line per plant. There should be enough string that it carries up to one side of the beam and down the other, plus some extra on the floor. Take the two ends of the twine and tie a loose knot around the base of the plant, and as the plant ascends, wind other tiny knots along the growing cucumber to help encourage its upward growth

Figure 2.1 String method of staking cucumber plant

2.8.2 Anchor staking

This type of staking is when two (2) sticks or poles are tied together over the bar pole that is laid across the center of the tied out cross poles, This practice is also used as a traditional staking method in most yam growing areas. The sticks or poles and as the cucumber vines begin to grow a 200cm to 250cm meter pole is needed to allow the vine to grow up towards the lapping bar.

Figure 2.2 Anchor staking

2.8.3 Single-stake

This method, one of the most straightforward and practical staking systems, involves planting a stake into the soil or mulching a few inches beside a cucumber plant. Once the plant has reached almost a foot in height, use some garden twine to tie the plant to the stake. Stake it every half foot or so. T-posts will be the most durable stakes and will last you into the following year. The single-stake method works best with determinate tomatoes, which only grow to a certain height and produce most of the fruit in a short window of time of Staking.

Figure 2.3 Single staking of cucumber plant

2.8 Effect of staking on the growth of cucumber

Staking is done to give plants support during periods of strong winds thus preventing the movement of the roots which break the root hairs, to enable the plant to grow straight as directed and prevent fruits from touching the ground surface to prevent possible rotting. Staking facilitates spraying for diseases and pests control; weeding, harvesting and other farm operations are easier to do than those in which vines trial on the ground (Sarkka *et al.,* 2017). Mutual shading is reduced so that photosynthetic capacity of the plant becomes greater, thus improving dry matter production into the leaves canopy of the crop. It has also been researched that staking improves dry matter production and leaf area index (LAI). Sroyraya *et al.*(2017) reported that staking cucumber increased the fruit yield because of better light interception. The number of days to 50% anthesis was higher in the staked than in the no-stake treatment. This agrees with the findings of Jansen *et al.* (2013) who observed that staking prolongs vegetative growth and delays fruit formation. The unstaked treatment consistently produced lower values in all the vegetative parameters evaluated except in the number of flowers. Nweke (2013) stated that the staked cucumber plants produced more number of leaves than the no-stake treatment and they were statistically similar showing that staking treatments has no significant effect on the number of leaves. They also found that leaf area value in staked cucumber was found to be higher than the no-stake plants.

2.9 Effect of staking on the yield of cucumber

Amati, (2018) observed that staking seemed generally to increase fruit size. Staked plants gave significant higher total yields than un-staked plants but there was no significantly difference in the total yields of marketable fruits owing to greater losses through cracking among fruits from the staked plants. Junping *et al.*(2006) reported that staked tomato plants yielded roughly a total of 20% over no-stake plants. In their experiment, they observed that the highest total yield was obtained by the 'Castelleto' system in which the plants were staked individually. When staking was entirely omitted the yield was slightly but not significantly lower. In South-West Nigeria, Nweke (2013) reported that staking increases fruit yield by 18 to 25%. Experiment conducted at ARS, Malepatan, and Pokhara in Malaysia to evaluate the effects of staking methods on the production of a fresh green pod of pole bean proved that staking was the best in producing the highest fresh pod yield of 6303.8kg/ha than no-staking (81.35kg/ha). Pod production was almost 68% highest in staking as compared to non-staking (Konsens *et al.,* 2016). Also Jansen *et al.*(2013) concluded that, staked cucumber produced fruits that double the quality of the ones on the ground.

The number of non-marketable fruit was higher in the no-stake than in the staked treatment. Unlu *et al*. (2016) reported that staking brings about an increase in colour quality, fruit length and sugar content of the fruits. Musa *et al*. (2021) affirmed that staking improves the color and lower the incidence of yellow bellies in cucumber. The no-staked treatment consistently gave least values in all the yield parameters evaluated except in the number of non- marketable fruit.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Location of Experimental site

The Experiment was conducted at the research field of the crop and soil sciences Department of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development formerly University of Education Winneba, Mampong –Ashanti. Mampong is in the Ashanti region and about 57.6km North of Kumasi, AAMUSTED lies at the transitional zone between the forest and northern savanna zones of Ghana and lies on latitude7.077531^0 N and longitude 1.395209^{0}W of the equator and it is 457.5m above sea level (Nyadzi *et al*., 2020), Mampong –Ashanti has a bimodal rainfall pattern, with annual rainfall between 1094.4 mm and 1200 mm and monthly mean rainfall of about 91.2 mm. The major rainy season occurs from March to July whilst the minor rainy season occurs from September to November. Between the two seasons is a short dry spell in August.

3.2 Soil type and vegetation

The soil at the experimental site is derived from the voltaian sandstone of Afram plains. It belongs to the savannah ochrosol class and is characterized by deep sandy loam: free from pebbles. It is well-drained and contains organic matter. The soil has a good water holding capacity. It has been classified by FAO/UNESCO legend as chromic luvisol and locally as Bediesi series. The pH ranges from 6.5- 7.0 (Sozial forschung 2015).

It is suitable for growing cucumber and many other vegetable crops.

3.3.0 Experimental Design, Treatment and Field Layout

3.3.1 Experimental Design

The experimental design used was a Randomized Complete Block Design (RCBD), with four (4) treatments and three (3) replications. The length of each experimental plot was 2.4m×1.5m with 0.5m between replication.The total area was 12.375 m^2. The site was divided into three (3) replications with four (4) plots given a total of twelve (12) plots. The treatment codes were written on a sheet of paper and selected randomly and assigned on each plot in each replication.

3.3.2 Treatment

The treatments were:

(**T1**) Anchor staking

(**T2**) Single staking

(**T3**) String staking

(**T4**) No staking (Control)

3.3.3 Field Layout

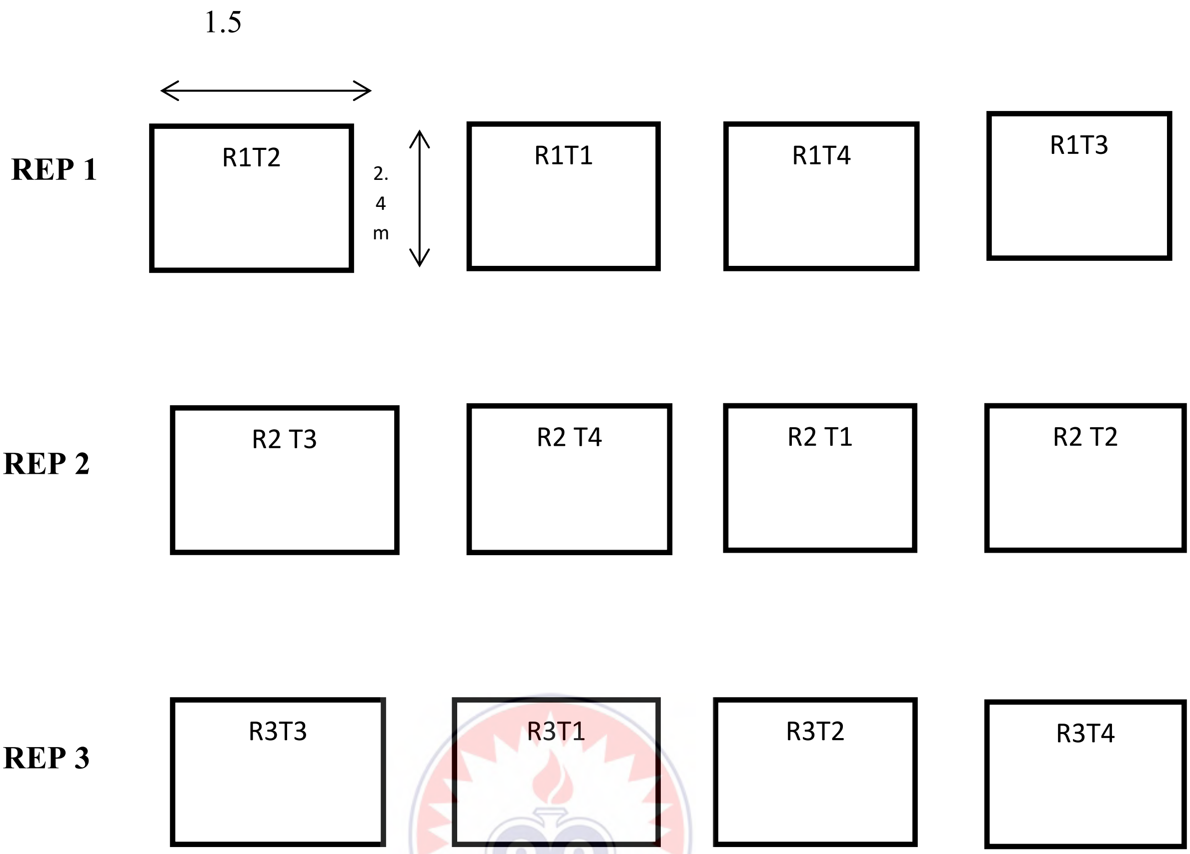

Figure 3.1 Field layout not drawn to scale

3.4 Land preparation

The land were cleared on 10th October, 2021. Lining and pegging was done, and the area was divided into (3) replications and (12) plots. The beds were made on 13th October 2021, with a bed size of 2.4 m×1.5 m.

3.4.1 Sowing

Seeds were purchased from a licensed agro-chemical store at Ashanti Mampong and were treated with seed care to prevent insect and pest attack in the soil. Seeds were sown on 15th October 2021, at three seeds per hole with a planting depth of 2.0 cm with a space of 60 cm × 30 cm

3.5 Agronomic Practices

3.5.1 Watering

The plant was watered twice a day, morning and evening to ensure adequate water supply to the plants. However, it was done when necessary.

3.5.2 Thinning out

Seeds were sown three per hole and were later thinned to one plant per stand at three weeks after planting.

3.5.3 Fertilizer application

Fertilizer was applied at three weeks after planting at rates of 0, 150 and 300 N P K kg ha-1 using the ring method.

3.5.4 Staking

The respective staking (Anchor method, String method and Single method) were done on the 4th week after sowing.

3.5.5 Pests and diseases control

The crops were sprayed three times with Cypermenthrin at a rate of 500 sq. /ft per gallon of water (insecticide) at 5, 6 and 7 weeks after sowing to protect plants against insect pests.

3.6 Data Collection

Five plants on each plot were sampled and tagged. Growth and yield parameters were recorded.

3.7 Vegetative growth parameters

3.7.1 Plant height

The plant height was measured from the ground level to the tip of the vine at 2 and 5 Weeks after sowing (WAS) on five randomly selected tagged plants from the middle rows on each plot. This was done with the use of a meter rule. The average plant height was estimated.

3.7.2 Number of leaves per plant

A number of leaves on each plant was counted from the five randomly selected tagged plants and the mean values was estimated.

3.7.3 Stem diameter

The stem girth was measured with a rope around the main stem and then the rope was placed on meter rule to get the total length of the rope from the five randomly tagged plants on the inner rows on each plot. The average stem girth was estimated.

3.7.4 Leaf Length

The length of the leaves of each of the five (5) taged plant on each bed was measured and the mean was taken.

3.7.5 Leaf Width

The width of the leaves of each of the five (5) tag plants on each bed was measured and the mean was taken.

3.8.0 Phenology

3.8.1 Day to 50% flowering

This was determined when half of the number of plants within the middle row had flowered from the day of emergence.

3.9 Fruit length (cm)

Meter rule was used to measure five harvested fruit from the five tagged plants of each plot and the average computed.

3.9.1 Fruit diameter (cm)

Venire caliper was used to measure diameter five harvested fruit from the five tagged plants of each plot and the average computed.

3.9.2 Average Fruit weight per plot (kg)

An electronic weighing scale was used to weigh five (5) harvested fruits from the five tagged plants of each plot and the average computed.

3.9.3 Statistical Analysis

The data collection was subjected to statistical analysis.The data was analyzed using Genstat statistical package 9th edition. Significant differences between treatment means were delineated by least Significance Difference (SD) at 5% level of probability.

CHAPTER FOUR

4.0 RESULTS

4.1 Effect of staking on number of leaves per plant of cucumber

The mean number of leaves per plant ranged from (5.00 – 5.67) at 21DAP, (7.00 – 8.00) at 28DAP, and (8.00 – 9.33) at 35DAP (Table 4.1). There was no significant ($P \geq 0.05$) difference between treatment at 21DAP and 35 DAP however, there were some significant ($P \leq 0.05$) differences between treatment at 28DAP. The significant ($P \leq 0.05$) difference was recorded in string (8.00) and no-staking(7.00) at 28DAP**.**

The highest mean number of leaves per plant was recorded in string staking(9.33) at 35DAP and the least mean value (5.00) was recorded in no staking at 21 DA

Table 4.1 ***Effect of staking on number of leaves per plant of cucumber***

	Number of leaves per plant		
Treatment	**21 DAP**	**28 DAP**	**35 DAP**
Anchor	5.33	7.33	8.00
String	5.67	8.00	9.33
Single staking	5.33	7.33	8.67
No staking	5.00	7.00	8.67
LSD (p=0.05)	**NS**	**0.88**	**NS**
CV (%)	**6.99**	**5.95**	**15.86**

Days after planting (DAP

4.2 Effect of staking on Plant height(cm) per plant of Cucumber

The mean plant height of Cucumber ranged from (2.16 – 2.47cm) at 14DAP, 21DAP (3.87 – 5.05cm), (10.88 – 13.65cm) at 28DAP, and (37.80 – 46.5cm) at 35DAP (Table 4.2). There was no significant(P≥0.05) difference between treatment at 14DAP – 35DAP for the plant height of cucumber.

Table 4.2 Effect of staking on Plant height(cm) of Cucumber

	Plant height (cm)			
Treatment	**14 DAP**	**21 DAP**	**28 DAP**	**35 DAP**
Anchor	2.16	3.89	11.17	37.80
String	2.22	5.05	13.65	46.57
Single staking	2.47	4.87	13.51	41.81
No staking	2.27	3.89	10.88	42.27
LSD(p=0.05)	**NS**	**NS**	**NS**	**NS**
CV (%)	**14.00**	**16.67**	**23.74**	**21.90**

Days after planting (DAP).

4.3 Effect of staking on the Stem diameter(cm) of Cucumber

The mean stem diameter of Cucumber ranged from (0.84 – 0.91cm) at 14DAP, (1.85 – 2.13cm) at 21DAP, (2.71 – 2.95cm) at 28DAP, and (3.36 – 3.55cm) at 35DAP (Table 4.3). There was no significant (P≥0.05) difference between treatment at 14DAP – 35DAP for stem diameter of cucumber although differences exist between treatment.

Table 4.3 Effect of staking on the Stem diameter of Cucumber

Stem diameter(cm)

Treatment	**14 DAP**	**21 DAP**	**28 DAP**	**35 DAP**
Anchor	0.84	1.93	2.71	3.39
String	0.91	2.13	2.95	3.37
Single staking	0.87	1.95	2.75	3.36
No staking	0.87	1.85	2.71	3.55
LSD (p=0.05)	**NS**	**NS**	**NS**	**NS**
CV (%)	**11.17**	**12.96**	**5.61**	**7.84**

Days after planting (DAP).

4.4 Effect of staking on the Leaf length(cm) of Cucumber

The mean Leaf a length of Cucumber ranged from (2.97 – 3.23 cm) at 14DAP, (6.53 – 8.00 cm) at 21DAP, (7.31 – 10.18 cm) at 28DAP, and (10.57 – 11.30 cm) at 35DAP (Table 4.4).There was no significant(P≥0.05) difference between treatment at 14DAP – 35DAP in leaf length.

Table 4.4 Effect of staking on the Leaf length of Cucumber

Leaf length (cm)

Treatment	**14 DAP**	**21 DAP**	**28 DAP**	**35 DAP**
Anchor	2.97	7.45	9.63	11.30
String	3.23	8.00	10.18	10.97
Single staking	3.21	7.76	7.31	10.57
No staking	2.97	6.53	9.32	10.77
LSD(p=0.05)	**NS**	**NS**	**NS**	**NS**
CV (%)	**18.45**	**10.40**	**28.78**	**6.76**

Days After planting (DAP).

4.5 Effect of staking on the Leaf width (cm)of Cucumber

The mean Leaf width of Cucumber ranged from (3.67 – 4.02 cm) at 14DAP, (8.22 – 9.75 cm) at 21DAP, (11.77 – 13.21cm) at 28DAP, and (13.27 – 114.52 cm) at 35DAP (Table 4.5).There was no significant (P≥0.05) difference between treatment from 14DAP to 21DAP and 35DAP. However there was a significant (P≤0.05) difference between string staking and no staking.Again, there was significant (P≤0.05) difference between single staking and no staking at 28DAP in leaf width.

Table 4.5 Effect of staking on the Leaf width of Cucumber

	Leaf width (cm)			
Treatment	**14 DAP**	**21 DAP**	**28 DAP**	**35 DAP**
Anchor	3.67	8.61	12.47	13.70
String	4.02	9.75	13.21	14.52
Single staking	3.95	9.29	12.77	13.27
No staking	3.77	8.22	11.77	14.33
LSD (p=0.05)	**NS**	**NS**	**0.93**	**NS**
CV (%)	**17.74**	**11.63**	**3.72**	**6.72**

Days after planting (DAP

4.6 Days to 50% flowering of Cucumber

There was no significant(P≥0.05) difference between Anchor, String, Single Staking, and No Staking in days to 50% flowering of cucumber.As indicated by (table 4.6) string and Anchor staking recorded the least mean values (28.00) which was an indication of early flowering and hence maturity.

Table 4.6 Days to 50% flowering of Cucumber

Treatment	**Days to 50% flowering**
Anchor	28.00
String	28.00
Single staking	29.00
No staking	29.33
LSD (p=0.05)	**NS**
CV (%)	**3.03**

4.7 Effect of staking on the Fruit length (cm) of Cucumber

From table 4.7 it indicats the effect of staking on fruit length of cucumber. Significant differences existed between the treatment means. String treatment recorded the highest mean fruit length value of 19.63cm which was significantly($P \leq 0.05$) different from the least mean value of 17.27cm obtained by No staking.

Table 4.7 Effect of staking on the Fruit length (cm) of Cucumber

Fruit length (cm)

Treatment	Fruit length (cm)
Anchor	18.65
String	19.63
Single staking	19.23
No staking	17.27
LSD (p=0.05)	**0.77**
CV (%)	**2.06**

4.8 Effect of staking on the fruit diameter(cm) of Cucumber

The results presented in Table 4.8 indicat the effect of staking on fruit diameter of cucumber. As shown on Table 4.8, no significant differences existed between the treatment means. Although, String treatment recorded the highest mean diameter value of 33.71 which was not significantly ($p \geq 0.05$) different from the least mean value of 16. 30 recorded by single staking.

Table 4.8 Effect of staking on the fruit diameter(cm) of Cucumber

Fruit diameter (cm)

Treatment	**Fruit diameter (cm)**
Anchor	16.80
String	17.22
Single staking	16.30
No staking	33.71
LSD (p=0.05)	**NS**
CV (%)	**10.55**

4.9 Effect of staking on the number of fruits per plot.

The results presented in Table 4.9 indicats the effect of staking on number of fruits per plot of cucumber. There was a significant (p≤ 0.05) difference between the treatment means. The highest number of fruits per plot of 8.17 was recorded by String which was significantly (p≤ 0.05) different from the least mean value of (7.25) recorded by No staking.

Table 4.9 Effect of staking on number of fruits per plot.

Treatment	Number of fruits per plot
Anchor	7.75
String	8.17
Single staking	7.83
No staking	7.25
LSD (p=0.05)	**0.88**
CV (%)	**5.72**

4.9 Effect of staking on Fruit weight (kg) per plot of Cucumber

As presented in Table 4.9 it indicats the effect of staking on fruit weight per plot of cumber. No significant (p≥0.05) difference existed between the treatment means. Although string staking recorded the highest mean fruit weight value of (2.91) with No staking recording the least mean fruit weight value of (2.15).

Table 4.9 Effect of staking on Fruit weight (kg) per plot of Cucumber

Treatment	Fruit weight (kg)
Anchor	2.90
String	2.91
Single staking	2.73
No staking	2.15
LSD (p=0.05)	**NS**
CV (%)	**22.67**

CHAPTER FIVE

5.0 DISCUSSION

5.1 Effect of staking on the vegetative growth of cucumber

The results showed that staking (Anchor, String, and Single staking) had an effect on the vegetative growth of cucumber, although most of the parameters measured for vegetative growth were no significant at P≥0.05. The day to 50% flowering, leaf length, leaf width, a number of leaves, plant height, and stem diameter were higher in the staked parameters (Anchor, String, and Single staking) than the no-staked (Control) treatment. The overall performance of the vegetative growth of cucumber was recorded by String staking. This may suggest that the leaves on the staked plants were all exposed to greater light interception leading to a higher accumulation of photosynthesis for vegetative growth. Musa *et al* (2021) reported that staking cucumber increased the fruit yield because of better light interception. The no-staked (control) treatment consistently produced lower values in all the vegetative parameters evaluated

5.2 Effect of staking on the yield of cucumber

The yield and yield component parameters assessed were found to be higher on the staked (Anchor, String, and Single staking) plants than the vines on the ground (Control). However, the overall performance of staking on yield component was recorded by String staking.Again it was observe that among the yield component parameters assessed (fruit length and number of fruits per plant) there was a significant (p≤0.05) difference between string staking and no-staking. This agreeds with the findings of Abidemi (2021) who observed that the yield and yield compont of staked cucumber was higher than the no-stake treatment. Musa *et al.* (2021) reported that staked cucumber gave an average marketable yield of 25 tons/acre as against 16.4 tons/acre of the non-staked cucumber.

Hamayoum *et al.* (2018) reported that staked cucumber produced fruits that double the quantity of the ones on the ground. Jaffe (2021) reported that staking brings about an increase in color quality, fruit length.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The result showed that staking treatment had an effect on the vegetative growth and yield of cucumber. The non-staked treatment consistently gave the least values in all the vegetative and yield parameters measured except in the fruit weight per plot. The findings also indicate that, although staked cucumber performed better than the non-staked cucumber, however, among the three staking methods (Anchor, Spring, and Single staking), Spring staking performed best on both vegetative and yield and yield component of cucumber followed by Single staking and Anchor staking recording low on both vegetative and yield performance of cucumber. The result, therefore, suggests that the vegetable farmers who have the intention of producing high-quality cucumber fruit with higher yield may go in for String staking.

6.2 Recommendation

Base on the results the two recommendation are made:

- That cucumber farmers should practice staking (String,Anchor,and single) staking since it produced the highest results(both vegetative and yield).
- It also recommended that similar study should be conducted under different environment to confirm this finding.

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