# EFFECT OF PLANTING SPACING ON THE GROWTH AND YIELD PERFORMANCE OF CUCUMBER (*Cucumis sativus* L.) IN AWKA SOUTHEASTERN NIGERIA.

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**ABSTRACT**
This experiment was carried out at Nnamdi Azikiwe University, Awka, Anambra State, Southeastern Nigeria to determine the effect of plant spacing on the growth and yield of cucumber (*Cucumis sativus L.*). The cucumber cultivar was evaluated with four plant spacing (50cm x 50cm, 75cm x 50cm, 80cm x 80cm and 100cm x 100cm) in a randomized complete block design (RCBD) with three replications. Data collected from the various observations were subjected to Analysis of Variance (ANOVA) for randomized complete block design (RCBD) using GenStat Release 10.3DE software. The result generated from the experiment was statistically not significant ($P \geq 0.05$) for both growth and yield parameters studied. The closest plant spacing (50cm x 50cm) recorded the highest value in all the parameters assessed in this trial except for vine length, leaf area, number of leaves, number of branches and number of fruits. Hence for maximum production of cucumber, closer plant spacing should be adopted.
**Keywords:** Plant spacing, Cucumber, Growth, Yield, Nnamdi Azikiwe University.

## INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a monoecious annual crop found in the Cucurbitaceae family and has been cultivated by man for over 3,000 years (Adetula and Denton, 2003; Okonmah, 2011). The cucumber is a creeping plant that roots in the ground and grows up on stakes or other supporting frames, wrapping around supports with it's thin, spiraling tendrils (Mariod, *et al.*, 2017). The crop is thought to be one of the oldest vegetables cultivated by man in historical records dating back 5,000 years (Wehner and Guner, 2004). In Asia, cucumber is the fourth most important vegetable after tomato, cabbage and onion (Tatlioglu, 1997) and the second most important vegetable crop after tomato in Western Europe (Phu, 1997). Its place has not been ranked in tropical Africa because of limited uses. Cucumber originated in India (Sebastian, *et al.*, 2010) but a large number of cultivars have been developed and are grown worldwide.

Cucumber grows well on well drained fertile soils with a PH of 6.0 -7.0 and rich in organic matter. The crop is often planted on raised beds and does well in sandy loam soils. The crop requires an ample amount of sunshine, warmth and is mostly grown in green houses (Jeffery, 2001). The plant may also root in a soilless medium and will sprawl along the ground if it does not have supports. The vine has large leaves that form a canopy over the fruits. The fruit of typical cultivars of cucumber is roughly cylindrical, but elongated with tapered ends, and may be as large as 62 centimeters long and 10 centimeters in diameter (Zhang, *et al*., 2019). Cucumbers have health benefits outside the body. Putting them on your skin may help ease sunburn pain, swelling, and damaged skin. That's why people sometimes put a slice or two under their eyes, hoping to shrink bags and ease puffiness (Pathak, 2020). Improper plant spacing is one of the major aspects of crop ecology, production and management that limits crop production (Ibeawuchi *et al*., 2005; Aslam *et al.*, 1993; Conley *et al.*, 2001; Njoku *et al.*, 2008 and Islam *et al.*, 2011). Wide plant spacing is productive since management practices like weeding can be easily carried out (Ibeawuchi *et al.*, 2005). Plant spacing has to be done in the right measurement. When space is too wide, evaporation and weed growth are high (Slamet, *et al.*, 2012). While, not having enough space leads to competition between plants to get sunlight, nutrients and water. Nweke *et al.* (2013), observed that plant spacing of 50cm × 30cm produced the highest numbers of leaves, branches, fruits and showed an increase in leaf area and vine length but decreased as plant spacing increased. Paulo *et al*. (2003), opined that as plant density increased, fruit yield also increased. However, Pangaribuan, *et al.* (2012), experimented that plant spacing at 30cm × 60cm showed a great yield on the number of fruits.

## MATERIALS AND METHODS

The experiment was conducted at the Crop Science and Horticulture Agricultural Farm, Nnamdi Azikiwe University Awka, Anambra State, Nigeria, on a latitude of 6.24, longitude 7.11 and altitude of 30.800 meters above sea level. The experiment took off from September - December 2020. The experimental field had uniform topography, a good vegetative cover around it and a good drainage system. The vegetative cover was made up of weeds such as the spear grass (*Imperata cylindrical*), Elephant grass (*Pennisetum purpureum*) and broad leaf weed like Wild sunflower (*Aspilia africana*) and the Siam weed (*Chromolaena odorata*), water leaf *(Talinum triangule)***,** Bahama grass *(Cynodon dactylon),* witch weed *(Striga genus)* and the land was previously used for cultivating mung bean. The experimental site has an annual rainfall of 1810.3mm per annum, a mean minimum temperature of 27 ºC, a maximum temperature of

27.3 ºC and a relative humidity of 72.3% ( Uko, *et al*., 2018).

**Experimental Design and Treatment**

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The treatment composed of four planting spacing which are; 50cm x 50cm, 75cm x 50cm, 80cm x 80cm and 100cm x 100cm. The plants were allowed to grow and develop during which measurements were collected on the growth and yield parameters.

**Soil sampling and laboratory analysis**

Soil samples from 0-20cm depth of the experimental site were taken by simple random sampling method in order to analyse the physiochemical properties of the soil at the start of the experiment. Ten sub-samples were randomly taken and mixed thoroughly to get a composite sample. The soil sample was then pre-treated by air drying and passing the soil through a 2mm sieve before analysis. Organic carbon was determined by the wet oxidation procedure (Walkley and Black, 1934) and total Nitrogen by micro-Kjeldahl's digestion method. Magnesium was extracted using the Mehlich's method and determined by the auto analyser. The total and available soil phosphorus (P) was determined by the method of (Okalebo *et al*., 1993). Soil pH was measured potentiometrically in 1:2:5. i.e. soil: water: mixture. Calcium (Ca), potassium (K) and sodium (Na) were determined by a flame photometer (JENWAY) as described by (Taffouo *et al*., 2008).

**Planting and Management Practices**

The cucumber was planted with four different plant spacing. Three seeds were sown per hole. A total of twenty-four seeds were sown in each plot which was later thinned to one plant at two weeks after planting. The experimental field size measuring 19mx12m ($228m^2$) was marked out using measuring tape, rope and pegs. Land clearing was fine manually using machete and the debris packed using rake. The field was demarcated into 3 blocks, each block contained four plots making it a total of twelve plots. Each plot was measured at 3.5m by 1.5m ($5.25m^2$) and was prepared using a hoe, and a furrow spacing of 1.5m along each plot and a 3m pathway across each plot. Poultry droppings were worked into the beds one week before planting. Insect pests were controlled using Knockoff (*Lamdacy halothrin*) insecticide. Watering was done daily and weeding was done two weekly interval using a hoe.

**Data Collection and Analysis**

Data were collected on the growth and yield of the plant at 3, 6 and 9 weeks after planting (WAP). The measurement taken were: Vine length, leaf area, number of leaves, number of branches, number of fruits, fruit length, fruit girth, fruit weight per plant and fruit yield per hectare. Data collected from the various observations were subjected to Analysis of Variance (ANOVA) for randomized complete block design (RCBD) using GenStat Release 10.3DE software (2011).

**RESULTS**

**Physiochemical properties of soil taken from 0-20cm depth of the experimental site in Nnamdi Azikiwe University, Awka.**

The physiochemical analysis of the soil used in this experiment revealed that the soils were slightly acidic, had a texture of sandy loam, low in essential plant nutrients such as; nitrogen, phosphorus, potassium, low in organic carbon and moderate in organic matter which indicates its low fertility status (Table 1).

**Table 1. Physiochemical properties of soil taken from 0-20cm depth of the experimental site in Nnamdi Azikiwe University, Awka.**

| Physiochemical Properties | Value |
|---|---|
| **Physical Properties** | |
| Sand (%) | 78.80 |
| Silt (%) | 8.80 |
| Clay (%) | 12.40 |
| Textural Class | Sandy Loam |
| **Chemical Properties** | |
| Organic Carbon (%) | 0.78 |
| Organic Matter Content (%) | 1.34 |
| Total Nitrogen (%) | 0.067 |
| Total Exchangeable Acidity (Cmol/kg) | 1.20 |

| | |
|---|---|
| Aluminum (Cmol/kg) | 0.70 |
| Hydrogen (Cmol/kg) | 0.50 |
| Available Phosphorus (mg/kg) | 3.63 |
| Potassium (Cmol/kg) | 0.18 |
| Sodium (Cmol/kg) | 0.14 |
| Calcium (Cmol/kg) | 2.40 |
| Magnesium (Cmol/kg) | 1.60 |
| Soil PH (H20) | 6.56 |
| Carbon Exchange Capacity (Cmol/kg) | 5.52 |
| Base Saturation (%) | 78.2 |

**Effect of Planting Spacing on the Vine Length of Cucumber at 3, 6 and 9 Weeks After Planting**

The effect of planting spacing on the vine length of cucumber, showed that plant spacing at 80cm x 80cm had the highest growth rate at 3 WAP, 6 WAP and 9 WAP respectively while plant spacing at 50cm x 50cm had the least growth rate at 3 WAP and 100cm x 100cm recorded the least at 6WAP and 9WAP. There was no significant difference at ($P \geq 0.05$) at 3 WAP, 6 WAP and 9 WAP respectively (Table 2).

**Table 2. Effect of planting spacing on the vine length of cucumber 3, 6 and 9 WAP**

| Plant spacing | 3 WAP | 6 WAP | 9 WAP |
|---|---|---|---|
| 50x50cm | 71.5 | 215.7 | 244.8 |
| 75x50cm | 71.6 | 208.2 | 231.9 |
| 80x80cm | 75.2 | 223.3 | 250.8 |
| 100x100cm | 73.6 | 187.8 | 230.5 |
| $LSD_{0.05}$ | NS | NS | NS |

**Effect of plant spacing on the leaf area of cucumber at 3, 6 and 9 WAP**

The effect of plant spacing on the leaf area as shown in Table 3, recorded the highest effect at 80cm x 80cm at 3 WAP while 75cm x 50cm had the least effect at 3 WAP but had the highest effect at 6 and 9 WAP respectively. 50cm x 50cm and 100cm x 100cm recorded the least effect at 6 and 9 WAP respectively. There was no significant difference at ($P \geq 0.05$) at 3 WAP, 6 WAP and 9 WAP respectively.

**Table 3. Effect of plant spacing on the leaf area of cucumber at 3, 6 and 9 WAP**

| Plant Spacing | 3 WAP | 6 WAP | 9 WAP |
|---|---|---|---|
| 50x50cm | 229.5 | 298.4 | 323.1 |
| 75x50cm | 223.0 | 339.6 | 355.9 |
| 80x80cm | 234.6 | 336.4 | 332.9 |
| 100x100cm | 226.3 | 314.2 | 318.1 |
| $LSD_{0.05}$ | NS | NS | NS |

**Effect of plant spacing on number of leaves and branches plant$^{-1}$ of cucumber at 8 WAP**

Table 4, showed that number of leaves plant$^{-1}$ had the highest number of leaves at 100cm x 100cm plant spacing for 8 WAP and recorded the least number at 50cm x 50cm. There was no significant difference at ($p>0.05$) at 8 WAP while the effect of plant spacing on number of branches plant$^{-1}$ recorded the highest number at 75cm x 50cm and 100cm x 100cm respectively and recorded the least number at 80cm x 80cm. There was no significant difference at ($P \geq 0.05$) at 8 WAP.

**Table 4. Effect of plant spacing on number of leaves and branches plant$^{-1}$ of cucumber at 8 WAP**

| Plant Spacing | Number of leaves plant$^{-1}$ 8 WAP | Number of branches plant$^{-1}$ 8 WAP |
|---|---|---|
| 50x50cm | 52.6 | 4.27 |
| 75x50cm | 53.1 | 4.53 |
| 80x80cm | 59.7 | 4.13 |
| 100x100cm | 60.4 | 4.53 |
| $LSD_{0.05}$ | NS | NS |

**Effect of plant spacing on the number of fruits plant$^{-1}$, fruit length and fruit girth of cucumber**

Table 5, showed that number of fruits plant$^{-1}$ recorded the highest number at 100cm x 100cm and the least number at 75cm x 50cm. There was no significant difference at (*P≥0.05*). The effect of plant spacing on the fruit length recorded the maximum length at 50cm x 50cm and the minimum length at 75cm x 50cm. There was no significant difference at (*P≥0.05*). While the effect of plant spacing on the fruit diameter recorded maximum diameter at 50cm x 50cm and the minimum diameter at 75cm x 50cm. There was no significant difference at (*P≥0.05*).

**Table 5. Effect of plant spacing on the number of fruits plant$^{-1}$, fruit length and fruit girth of cucumber**

| Plant Spacing | Number of fruits plant$^{-1}$ | Fruit Length | Fruit Diameter |
|---|---|---|---|
| 50x50cm | 2.6 | 26.89 | 5.54 |
| 75x50cm | 2.43 | 24.47 | 5.22 |
| 80x80cm | 2.6 | 26.43 | 5.27 |
| 100x100cm | 3.37 | 25.26 | 5.27 |
| $LSD_{0.05}$ | NS | NS | NS |

**Effect of plant spacing on the fruit weight plant$^{-1}$ and fruit yield of cucumber hectare$^{-1}$**

Effect of plant spacing on the fruit weight plant$^{-1}$, showed that fruit weight plant$^{-1}$ recorded the highest weight plant$^{-1}$ at 50cm x 50cm and the lowest weight at 75cm x 80cm and 100cm x 100cm respectively. There was no significant difference at (*P≥0.05*). The effect of plant spacing on the fruit yield hectare$^{-1}$ recorded the highest yield at 50cm x 50cm and the lowest yield at 75cm x 50cm and 100cm x 100cm respectively. There was no significant difference at (*P≥0.05*).

**Table 6. Effect of plant spacing on the fruit weight plant$^{-1}$ and fruit yield of cucumber hectare$^{-1}$**

| Plant Spacing | Fruit weight plant$^{-1}$ | Friut yield hectare$^{-1}$ |
|---|---|---|
| 50x50cm | 0.35 | 2.21 |
| 75x50cm | 0.31 | 1.96 |
| 80x80cm | 0.32 | 2.02 |
| 100x100cm | 0.31 | 1.96 |
| **$LSD_{0.05}$** | NS | NS |

**DISCUSSION**

The plant spacing at 80cm × 80cm recorded the highest effect on the vine length and this is because of the plants ability to easily spread out to access more growth resources such as sun light, nutrients and available water. The result was similar to the findings of Ijaz *et al.* (2007), who observed that cucumber spaced at 80cm x 40cm recorded the highest growth rate while (Ansa and Garjila, 2019) opined that 100cm × 50cm recorded the highest growth rate. This shows that wider plant spacing has a better chance of achieving high growth rate than closer plant spacing.

The results of the leaf area showed that 75cm x 50cm had a high effect on the leaf area, followed by 80cm x 80cm while 100cm x 100cm recorded the least. The result contradicts the findings of Nweke *et al.* (2013), who recorded closest plant spacing of cucumber at 50cm x 30cm, produced the highest leaf area but the leaf area decreased as the plant spacing increased to 50cm x 50cm. This indicates that wider inter spacing and closer intra spacing produce the highest leaf area (Ansa and Garjila, 2019). Streck *et al.* (2014) also reported that leaf area of cassava increases as wider plant spacing decreases.

The effect of plant spacing on the number of leaves showed that 100cm x 100cm recorded the highest number of leaves while 50cm x 50cm recorded the least number of leaves. This aligned with the findings of Ansa and Garjila, (2019) who observed highest number of leaves at 100cm x 100cm in cucumber but contrast with the findings of Nweke *et al.* (2013) who observed that closer plant spacing had a great effect on the number of leaves for cucumber. However, a study by Oga and Umekwe (2013) on the effect of plant spacing on the number of leaves of watermelon revealed that plant spacing of 50cm x 50cm had the least number of leaves.

The plant spacing at 75cm x 50cm and 100cm x 100cm recorded the same highest number of

branches respectively. This was in accordance with the findings of Baloch *et al.* (2013), who recorded highest number of branches of Indian squash at 120cm x 100cm, indicating that increased plant spacing gives a higher number of branches.

The yield attributes of cucumber showed that 100cm x 100cm which was the widest plant spacing recorded the highest number of fruits. The result was in consonance with the findings of (Vikram *et al*., 2017; Oga and Umekwe, 2013) who recorded highest number of fruits at a wider plant spacing, while 50cm x 50cm which was the closest plant spacing recorded the highest in fruit length, fruit diameter, fruit weight plant$^{-1}$, and fruit yield per hectare respectively. Ansa and Garjila, (2019) was in conformity with 50cm x 50cm recording the highest fruit length and fruit diameter but recorded the highest fruit weight with a wider spacing which is contrary to the observations made in this trial. Ijaz *et al.* (2007), observed that cucumber grown at wider inter row spacing produced bigger and weightier fruits. However, (Gebologu and Saglam, 1999) recorded highest fruit yield with the closest plant spacing and the finding aligned with the observations made in this trial.

## CONCLUSION

The result showed that there was no significant difference in both vegetative growth and yield parameters. For the vegetative growth parameters, plant spacing at 80cm x 80cm recorded the highest in vine length, 75cm x 50cm recorded the highest in leaf area, 100cm x 100cm recorded the highest number of leaves both 75cm x 50cm and 100cm x 100 cm had the highest number of branches. For the yield parameters, 100cm x 100cm recorded the highest number of fruits while 50cm x 50cm had the highest fruit length, diameter, weight plant$^{-1}$ and yield hectare$^{-1}$

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