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Research Article

Influence of intra row spacing on weed suppression in cucumber (*Cucumis sativus*) production in humid rainforest agro-ecological zone of lagos, Nigeria

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Abstract

The use of intra row spacing in crops production has been advocated as a technological alternative to obtain optimum yield increases, due to the better use of resources. The experiment was carried out at the Teaching and Research Farm, Lagos State Polytechnic, Ikorodu in Randomized Complete Block Design with three treatments (1m×0.9m, 1m×0.6m and 1m×0.3m) and replicated three times. Data were collected on weed fresh weight, weed cover score, vine length, and number of leaves at 3, 6 and 9 Weeks After Planting (WAP); number of fruits, fruit length, fruit diameter to evaluate weed suppression, cucumber growth and yield performance. The data were subjected to Analysis of Variance (ANOVA) and significant treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level. Results from the study showed that cucumber planted at 1m x 0.3m spacing had the highest fruit yield (96.33kg/ha) followed by 1m x 0.6m (71.11kg/ha) and 1m×0.9m recorded the least (37.4ikg/ha). While, weed infestation was significantly ($p<0.05$) suppressed at 1m x 0.6m spacing (6.33) followed by 1m x 0.3m (96.67). Based on the results obtained from the study, it is recommended that 1m×0.6m and 1m×0,3m spacing could be adopted by farmers in the study area for cultivation of cucumber as this give the best yield and suppress weed infestation. Further study is also recommended in other agro ecological zones in the rainforest of south western Nigeria in order to explore the possibility of having uniform planting spacing for cucumber.

Introduction

Cucumber (*Cucumis sativus*) is an important plant in the gourd family, Cucurbitaceae. It is one of the most important fruit vegetable crops grown in many parts of the Nigeria all year round. The fruits are eaten as salad and pickle and are often consumed as cooked vegetables in various ways. It contains 0.6g protein, 2.6g carbohydrate, 12cal energy, 18mg Ca, 0.2mg Fe, 0.02mg thiamin, 0.02mg riboflavin, 0.01mg niacin, and 10mg vitamin C/100g of edible portion [1]. Production of cucumber in Nigeria has increased probably due to awareness being created by its market demand and economic returns, short duration in maturity or due to its nutritional and medicinal values.

The crop yield in Nigeria is lower than most cucumber producing nations. Like any other crops, cucumber yield is a multifaceted character that is characterized by many factors including genetic, agronomic and environmental factors [2]. Poor varietal performance and management practices that include inter and intra-row spacing are among the major constraints of cucumber cultivation and productivity in Nigeria. Inter and intra row spacing is important agricultural element and has great effect on fruit yield and yield components of crop plant [3]. Adoption of appropriate inter and intra row spacing, especially in under open field production condition helps in efficient use of available resources such as water, light and soil nutrients [4,5].

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Crops can be favoured in struggle against weeds by use of close spacing and/or higher population densities. Use of close spacing and/or higher population densities accelerates the swiftness of closure of the canopy and enhances canopy radiation interception, thereby increasing crop growth rates and yields [6] and suppressing weed growth and competitiveness [7-9]. Therefore, the use of close spacing and/or higher population densities could be used by smallholder farmers as means of weed control through achieving full ground cover earlier in the season, thereby reducing the impact of weeds on crop growth and yield.

The previous researches showed that proper row spacing affected crop growth and yield [10,11]. In addition, spacing not only affected crop growth and yield but also influenced plant characters, insects, weeds, diseases, soil environment, germination and emergency [12]. In order to obtain better yields in different environments, agronomic practices should be identified for different climate zones. Therefore, the objective of the current effort was to study the effect of intra-row spacing on suppression of weed interference and agronomic performance of cucumber in humid rainforest agro-ecological zone Lagos, Nigeria.

Materials and methods

The experiment was carried out at the Teaching and Research Farm, Lagos State Polytechnic, Ikorodu. The area lies between Latitude 5°10N and Longitude 3°16E of the Greenwich Meridian. It has an altitude of 50m above the sea level with a mean temperature of 25°C and 29°C. The annual rainfall ranges between 1670mm to 2200mm, and relative humidity between 65% and 68%. The experimental site has been under continuous cultivation for over three years with vegetables and arable crops.

The experiment was laid in a Randomized Complete Block Design (RCBD) with three replications on a 182m^2 area of land; ploughed and harrowed to properly tilled the soil for ease seedbed preparation. The experimental plot size was 4 × 3 meters with a distance of 1m between replicates. The treatments consisted of three spacing: 1m×0.9m (T_1); 1m×0.6m (T_2) and 1m×0.3m (T_3).

The cucumber seeds used were obtained at Agro-allied Store, Sabo market Ikorodu, Lagos State and was planted on the well prepared seedbed in accordance with different treatments at three seeds per hole later thinned to one vigorous stands each a week after planting and supplying also done to supply missing stands. All cultural practices such as weeding, pest and disease control were carried out as at when due.

Weeds density was made by placing the quadrate (0.5m×0.5m) at random locations in plots repeated three times in order to obtain a reasonably good estimate of weeds. Weed cover score was obtained by visual observation of prevalence of weeds on the plots and score ranging from 0 to 9 were assigned. While weed fresh weight was obtained after weighing weeds removed from each plot at 3, 6 and 9 weeks after planting (WAP).

A sample of four plants was taken randomly tagged from the inner rows of each experimental plot to measure the following growth and yield attributes at 3, 6, and 9 weeks after planting (WAP):

- **Vine length (cm):** measured using a meter rule from the base of the plant to the terminal growing part.
- Number of leaves per plant were taken by counting the leaves on each tagged plants.
- Leaf area was determined by measuring the length and width of the largest leaf on the tagged plants and multiplied by 0.73 [13].
- **Days to 50% flowering:** The number of days from sowing to the time when 50 percent of the plants within the plot bear at least one flower each.
- Crop vigour score was measured using a 1-4 rating (score): 1= Low, 2= Moderate, 3= Vigorous, 4 = Highly Vigorous following procedure adopted by [14].
- **Number of fruits per plant:** Fruits were harvested at 8 WAP after the fruit reached to edible maturity and number of fruits harvested per plant/plot was recorded.
- **Fruit yield (Kg ha^{-1}):** Harvested fruits were weighed with a weighing scale and results extrapolated to hectare basis (Kg ha^{-1}) to determined yield per plot.
- **Fruit length (cm):** The length of the fruit from ground stalk point to the tip of the fruit.
- **Fruit diameter (cm):** Diameters were measured with the help of vernier caliper.

Data collected were subjected to analysis of variance (ANOVA) procedure for a randomize complete block design [15] and where treatment means were significant, they were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability using ASSISTAT 7.1 statistical software.

Results and Discussion

Effect of intra row spacing on vine length of cucumber

Result presented in Table 1 shows that vine length was not significantly ($p \geq 0.05$) affected by different intra row spacing at 3, 6 and 9 WAP. At 9 WAP, cucumber planted at 1m x 0.6m spacing had the longest vine (165.92cm) followed by 1m x 0.9m (145.17cm) and 1m x 0.3m having the shortest vine (125.67cm). The results is in contrast with the findings of Efediyi, et al. [16], who reported that the spacing has positive effect on plant height. The result obtained may also be due to the optimum plant density of 1m x 0.6m which is in agreement with the finding of Ramos, et al. and Campagnol, et al. [17,18] that optimum plant densities have a positive effect on the growth of mini watermelons. These results however were in disagreement to Cohen, et al. [19] and Baloch [20], who reported that in wider row spacing vine length was increased.

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Effect of intra row spacing on leaf area of cucumber

Result in Table 2 shows that cucumber leaves area was not significantly (p≥0.05) affected at 3, 6 and 9 WAP by different spacing. However, at 9 WAP cucumber spaced at 1m×0.6m has the highest leaves area (258.71cm) followed by 1m×0.3m (233.42cm) and 1m×0.9m (224.87cm). It was hypothesized that lower planting density provides more space to the plants to expand their leaves and reduces shading from surrounding plants. Thus, there is increased light interception per plant and, consequently, suppressing weed competition and greater individual growth [21-23].

Effect of intra row spacing on number of leaves of cucumber

Table 3, shows that number of leaves produced by cucumber was significantly (p≤0.05) at 3 WAP. However, there was no significant (p≥0.05) difference was observed in the number of leaves produced at 6, and 9 WAP. From the result cucumber planted at 1m x 0.9m produced the highest number of leaves (11.0) at 3 WAP followed by 1m×0.6m (10.42) and 1m×0.3m produced the least number of leaves (7.42). The result shows that number of leaves reduces as spacing reduces. This might be due to low competition with water, nutrient and light between crops promoting better growth of cucumber. This result is in contrast with the work done by Sabo, et al. [24], who reported that, there was no significant difference in all the level of spacing (1m×1m, 1m×1.5m and 1m×2 m) used in promoting number of leaves of watermelon.

Effect of intra row spacing on crop vigour score of cucumber

Table 4 shows that intra row spacing did not significantly (p≥0.05) affected cucumber vigour at 3, 6 and 9 WAP. Cucumber spaced at 1m x 0.9m has the highest crop vigour score (3.75) at 9 WAP, followed by 1m×0.6m (3.67) then 1m×0.3m having the least vigour (3.58). The result shows that cucumber vigour score increases as intra row spacing increases. This is in agreement with Mangala and Mausia and Dean, et al. [25,26], who reported that plant growth parameters linearly increased with increase in spacing.

Table 1: Effect of intra row spacing on vine length (cm) of cucumber.

Vine length			
Treatments	**3WAP**	**6WAP**	**9WAP**
1m ×0.9m	19.03	82.58	145.17
1m×0.6m	20.19	84.17	165.92
1m×0.3m	19.22	62.75	125.67
LSD	10.01	35.26	111.45
Level of Significance	ns	ns	ns

WAP: Weeks After Planting; NS: Non Significant

Table 2: Effect of intra row spacing on leaf area of cucumber.

Leaf Area (cm^2)			
Treatments	**3WAP**	**6WAP**	**9WAP**
1m×0.9m	181.17	152.4	224.87
1m×0.6m	165.93	156.44	258.71
1m×0.3m	100.66	128.17	233.42
LSD	96.48	69.3	178.32
Level of significance	ns	ns	ns

WAP: Weeks After Planting; NS: Non Significant

Table 3: Effect of intra row spacing on number of leaves of cucumber.

Number of leaves			
Treatments	**3WAP**	**6WAP**	**9WAP**
1m x 0.9m	11.00a	59.17	94.58
1mx0.6m	10.42ab	43.92	71.92
1mx0.3m	7.42ab	38.17	72.5
LSD	3.37	0.5	72.47
Level of Significance	*	ns	ns

WAP: Weeks After Planting; * Significant at 5 and 1% probability; means followed by the same letters are not significantly different at 5% probability using Duncan's multiple range test NS: Non Significant

Table 4: Effect of intra row spacing on vigor score of cucumber 2019.

Crop vigour score (CVS)			
Treatments	**3WAP**	**6WAP**	**9WAP**
1m x 0.9m	3.08	3.67	3.75
1m x 0.6m	2.75	3.67	3.67
1m x 0.3m	2.08	3.5	3.58
LSD	1.4	1.51	1.25
Level of significance	ns	ns	ns

WAP – Weeks after planting, NS – Non significant

Effect of intra row spacing on weed cover score in cucumber

Result in Table 5 shows that intra row spacing significantly (p≤0.05) influenced weed cover at 3 WAP. While at 6 and 9 WAP intra row spacing exhibited non-significant (p≥0.05) weed cover score (WCS). The result shows that the plots with the highest plant density and closest spacing (1m×0.3m) recorded the highest weed cover score and this is in agreement with Ismaila, et al. [27], who reported that narrow spacing leads to reduction in weed infestation of rice. Also Njoku, et al. [28], reported that the competitive effect of weeds was reduced when the seeding rate increased from low density (wider spacing) to a higher density (closer spacing) in orange fleshed sweet potato.

Effect of intra row spacing on weed fresh weight (g) in cucumber

Table 6 shows that fresh weight of weed in cucumber plots under different spacing was not significantly (P≥0.05) different at 3, 6 and 9 WAP. At 9 WAP, intra row spacing of 1m×0.6m has the highest weed fresh weight (29.67g) followed by 1m×0.9m (24.67g) and 1m×0.3m having the least (9.33g) weeds fresh weight. This result could be explained in terms of the ability of cucumber to form cover as growth progresses and with close

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spacing which implies that lower growth of weeds was found on the plot. The result obtained in this study aligned with that of Hamide, et al. [29].

Effect of intra row spacing on weed density in cucumber

Table 7 shows that weed density in cucumber planted at different intra row spacing was significantly (P≤0.05) affected at 6 WAP. At 6 WAP cucumber planted at 1m×0.9m spacing recorded the highest weed density (17.67), followed by 1m×0.3m (9.67) then 1m×0.6m having the least (6.33) weed density. The result indicates that optimum spacing has positive effect on plant growth and development thereby suppressing weeds and reducing the weed density which is in agreement with the finding of Ramos, et al. and Campagnol, et al. [17,18] that optimum plant densities have a positive effect on the growth and development of watermelons.

Effect of intra row spacing on weed dry weight in plots planted with cucumber

Table 8 shows that the different spacing adopted in this study did not significantly (P≥0.05) affected dry weight of weeds in cucumber plots at 3, 6 and 9 WAP. Though at 9 WAP, 1m×0.6m spacing had the highest weed dry weight (10.33g) followed by 1m x 0.9m (7.33g) and 1m×0.3m having the least (3.33g) dry weight of weeds. This result shows that the optimum spacing had the highest weed dry weight which is in contrast with Njoku, et al. [28], that the competitive effect of weeds was reduced when the seeding rate increased from low density (wider spacing) to a higher density (closer spacing) in orange fleshed sweet potato.

Effect of intra row spacing on yield attributes of cucumber

Table 9 shows that cucumber fruits diameter and fruit length was not significantly (p≥0.05) affected by different spacing; 1m x 0.9m has the highest fruit diameter (27.54cm), followed by 1m×0.3m (26.6cm) and 1m×0.6m having the least fruit diameter (25.75cm). While, cucumber spaced at 1m×0.6m has the highest fruit length (16.58cm) closely followed by 1m×0.3m (15.32cm) then 1m×0.9m having the least (14.9cm) fruit length. Similar result was reported by Baloch [20] who opined that in wider inter and intra row spacing, thicker and longer fruits were obtained.

Number of fruit harvested was not significantly (P≥0.05) affected by different spacing (Table 9). But cucumber spaced at 1m×0.6m has the highest number of fruits (20.67), followed by 1m×0.9m (15) and 1m×0.3m having the least number of fruits (15). The greater number of fruits produced under wider plant spacing was probably due to more space available for vines in a row and the individual vines shared relatively greater amounts of light, moisture and nutrients, while in narrow plant spacing, the plants become more competitive for light, moisture and nutrients and thus, performance of the crop relatively suppressed. Similar results have also been reported by Baloch [20], Bradley, et al. [30] and Pant [31], whose consolidated findings suggested that under wider spacing fruits per vine were increased.

Fruit weight per hectare recorded in the experiment was significantly (P≤0.05) affected by different spacing (Table 9).

Table 5: Effect of different spacing on weed cover score in cucumber.

Treatments	3WAP	6WAP	9WAP
1m x 0.9m	3.67b	4	4.67
1mx0.6m	2.67b	4	4
1mx0,3m	6.33	3.33	4.67
LSD	2.56	2.72	3.54
Level of Significance	*	ns	ns

WAP: Weeks After Planting; * Significant at 5 and 1% probability; means followed by the same letters are not significantly different at 5% probability using Duncan's multiple range test

Table 6: Effect of different spacing on weed fresh weight (g) in cucumber.

Treatments	3WAP	6WAP	9WAP
1m × 0.9m	25.67	32	24.67
1m×0.6m	10	32	29.67
1m×0.3m	23.33	20.33	9.33
LSD	23.14	36.81	28.77
Level of significance	ns	ns	ns

WAP: Weeks After Planting; NS: Non Significant

Table 7: Effect of different spacing on weed density in cucumber.

Treatments	3WAP	6WAP	9WAP
1m x 0.9m	15.33	17.67a	7
1mx0.6m	7	6.33b	9
1mx0. 3m	12.67	9.67ab	4.67
LSD	11.26	11.05	6.19
Level of significance	ns	*	ns

WAP: Weeks after planting. * Significant at 5 and 1% probability; means followed by the same letters are not significantly different at 5% probability using Duncan's multiple range test NS: Non Significant

Table 8: Effect of different spacing on weed dry weight in cucumber.

Treatments	WAP	6WAP	9WAP
1m x 0.9m	16.33	20	7.33
1mx0.6m	5.33	17.67	10.33
1mx0. 3m	8.67	10	3.33
LSD	30.24	33.72	15.35
Level of significance	ns	ns	ns

WAP: Weeks After Planting; NS: Non Significant

Table 9: Effect of different spacing on yield attributes of cucumber.

Treatment	Fruit diameter (mm)	Fruit length (cm)	No. of fruit	fruit yield (kg/ha)
1m x 0.9m	27.54	14.99	15.00	37.41
1mx0.6m	25.75	16.58	20.67	71.11
1mx0.3m	26.60	15.32	13.00	96.33
LSD	39.21	3.85	19.03	93.68
Level of Sig	ns	ns	ns	ns

WAP: Weeks After Planting, NS: Non Significant

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Cucumber planted at 1m×0.3m has the highest fruit weight per hectare (96333kg/ha) followed by 1m×0.6m (71111kg/ha) and 1m×0.9m having the least (37407kg/ha) of fruit weight per hectare. This decrease in fruit yield under wider plant spacing and narrower row spacing might be the result of decrease in the plant population. Similar results have also been reported by Baloch [20], who opined that cucumber fruit yields were significantly higher under high density plantation irrespective of superiority of low density plantation for other growth and yield contributing characters, probably due to less plant population under low density plantation.

Conclusion and Recommendation

The results from this study clearly indicated that cucumber planted at 1m×0.3m spacing had the highest fruit yield (96.33kg/ha) and provided the best weed suppression attributes (weed density 4.67 at 9 WAP). While those planted at 1m x 0.6m spacing showed superior growth attributes at 9 WAP (Vine length 165.92, leaf area 258.71) respectively. From the result of this study, the relationship between the growths attributes and yield attributes of cucumber under the different spacing under review were inversely proportional to each other, thus, it is recommended that 1m x 0.6m and 1m x 0,3m spacing could be adopted by farmers in the study area for cultivation of cucumber as this give the best yield and suppress weed infestation. . Further study is also recommended in other agro ecological zones in the rainforest of south western Nigeria in order to explore the possibility of having uniform planting spacing for cucumber.

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