



## **Response of Cucumber (*Cucumis sativus* L.) and Weeds to Plant Spacing and Weeding Regimes in a Humid Forest Agro-Ecology of Southeastern Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors OS and UEU designed the study. Author OS performed the statistical analysis, wrote the protocol and the first draft of the manuscript with author UEU. Authors JCN and OS managed and supervised the field trial and collected the data. Authors JCN and OS managed the literature searches, and with author UEU prepared the manuscript. All authors read and approved the final manuscript*

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### **ABSTRACT**

The experiment was conducted between April and July 2017 to evaluate the effect of spacing and weeding regimes on cucumber production. The study site was the Teaching and Research Farm of the University of Port Harcourt, Choba, Rivers State, Nigeria, in a humid forest agro-ecology of southeastern Nigeria. The treatment consists of three spacing (75 cm x 25 cm, 75 x 50 cm and 75 cm x 75 cm) and three weeding regimes (no weeding, weeding twice at 3 and 5 weeks after planting (WAP), and weekly weeding). The experiment was a 3 x 3 factorial in a randomized complete block design (RCBD) with three replications. Results showed that plant spaced at 75 x 25 cm produced the highest vine ground coverage, and leaf area index than other spacing regimes. Weed control and cucumber performance were poorer under weedy check than in others weeding regimes. Cucumber spaced at 75 x 25 cm produced the highest fruit yield (2137.70 kg/ha) which was statistically similar to plot with a spacing of 75 x 50 cm (2105 kg/ha). On the average plots that were hoe weeded weekly produced the highest fruit yield (2020.49 kg/ha) while the weedy check had the lowest (975.78 kg/ha). There was an interactive effect between spacing and weeding

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regimes. Plant spaced at 75 cm x 25 cm and weeded weekly had the highest fruit yield of 2571.67 kg/ha but was similar to 75 x 25 cm weeded twice at 3 and 5 WAP (2563.33 kg/ha), and 75 x 50 cm weeded twice at 3 and 5WAP (2533.33 kg/ha). The lowest fruit yield was obtained at a more extensive spacing of 75cm x75 cm with no weeding (382.58 kg/ha). With the present study, it is recommendable to cultivate cucumber at a closer spacing of 75 cm x 25 cm with two weeding for economic reasons. However, further studies are needed to ascertain the cost implications of these treatment combinations within and outside the study area.

**Keywords:** *Cucumber; fruit yield; leaf area index; plant spacing; vine coverage; weeding regimes.*

## 1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) belongs to the family of Cucurbitaceae. It is an important vegetable that is cultivated globally. It has creeping vine that bears large leaves, which form canopy above the cylindrical fruits. It is the eighth most grown vegetable crop around the world; after maize, sugar beet, cassava, tomatoes, watermelons, sweet potatoes, and dry onions [1]. In Asia, it is ranked fourth as a most important vegetable after tomato, cabbage and onion while in Western Europe is next to tomato [2]. In African including Nigeria, it is unranked probably due to inadequate production volume when compared to other European countries [3].

It is cultivated in almost all the agro-ecological zones of Nigeria ranging from coastal to savanna zones. The savanna zone of Nigeria has the greatest potential for its production due to moderate rainfall. However, research has proved that it can grow in some southern parts of Nigeria that had moderate rainfall [4]. The importance of cucumber to mankind can be categorized into three namely: food, medicine and industry. Like food, it is either eaten raw or prepared in various forms especially as components of the vegetable salad. In medicine, it is used to fight against cancers (breast-ovarian, uterine and prostate); treatments for diabetics, skin irritations; rehydrate the body and regain one's self from dryness [5,6]. Its benefits concerning other health and medical conditions are widely documented [7,8,1] noted that it is important in cosmetic industry for the manufacture of soaps, lotions, shampoos and fragrant. Three major cucumber varieties widely grown are slicing, pickling, and burpless [9]. However, there are different cultivars found in the market globally, and they emanate from these three major varieties [9].

Despite the importance of this vegetable, plant spacing and weed competition constitute a major constraint to its production. Weed competition in cucumber is a problem due to lack of appropriate weeding regime in this vine vegetable.

Appropriate plant spacing ensures good growth and high crop yield [10]. In the same vein [11] noted that if timely weeding and recommended crop spacing are followed, then the resulting vigorous crop canopy will smother emerging weeds. Plant spacing for cucumber depend on variety, the growth habit and the harvesting method desired. Close spacing increases yields enhances uniform maturity with reduced weed problems [12].

The minimum weed-free period required in cucurbit crops such as cucumber, squash and others have been estimated to be between the first 3 to 4 weeks after planting [13]. Most Nigerian farmers are ignorant of this period of weed competition in crop and as such they weed at their own pace and dictate, which invariably leads to yield reduction. Crops can be favored in competition against weeds by use of narrow rows and higher crop densities [14]. Narrow row planting and high plant densities reduce germination and growth of weeds by decreasing and changing the spectral composition of the incoming radiation incident on the weed seeds and weed seedlings under the crop canopy [15]. Indiscriminate spacing does affect the growth and production of cucumber in Nigeria. Cucumber farmers in Nigeria use wider spacing, which encourages weed growth that compete with cucumber plant and result in low yield. Effect of spacing on cucumber had been widely reported in some literatures [16,17,18] however; reports on effect of weeding regime or combination of spacing and weeding regimes effect are scanty. Hence, the objective of this study was to determine spacing and weeding regimes effect on weed suppression and performance of cucumber.

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site

The field experiment was conducted at the Faculty of Agriculture Teaching and Research farm of the University of Port Harcourt during the

early cropping season between April and July, 2017 in a humid forest agro-ecology with latitude 04° 54' 538"N and longitude 006° 55' 329"E with an elevation of 17metres above sea level. The area has an average temperature of 27°C, relative humidity of 78% and average annual rainfall that ranges from 2500-4000 mm [19]. The area had distinct wet and dry seasons, and the wet season has double rainfall peaks. There are two cropping season early from March to July and late from August to December. The experimental site was left fallow for seven years before the commencement of the study. Weeds such as *Chromolaena odorata*, *Aspilia africana*, *Commelina benghalensis*, *Panicum maximum* and *Cyperus* spp. dominated the vegetation.

## 2.2 Soil Analysis

Prior to the experimentation, representative soil samples were taken randomly from the experimental plot at uniform depth of 0-15 cm with an auger for the determination of physico-chemical properties of the soil. These properties were determined by standard laboratory procedures. Particles size distribution was determined by the hydrometer method [20], pH in 1:2 soil: water ratio [21]), organic matter with wet oxidation method [22] total nitrogen was determined by the [23] method while available phosphorus was determined by rapid perchloric acid digestion method [24] calcium was determined by atomic absorption spectrophotometry while potassium (K) was by flame photometry [25].

## 2.3 Source of Planting Material

Cucumber seeds were bought from the local farmer at Choba village in Port Harcourt in Rivers State.

## 2.4 Treatments, Experimental Design and Cultural Details

The experimental design was a 3 x 3 factorial scheme arranged in a randomized complete block design (RCBD) with 3 replications. Spacing and weeding regimes constituted the factors. The Three spacing were: 75 cm x 25 cm, 75 x 50 cm and 75 cm x 75 cm and the designated equivalent to three population densities: 53,333, 26,667 and 17,778 plants /ha while the three weeding regimes were: no weeding, weeding twice at 3 and 5 weeks after planting (WAP), and weekly weeding. The experimental area was manually cleared using cutlass, and the debris

was packed. The experimental area was pegged into plots of 3 m x 3 m with an alleyway of 1m between plots and 2 m between blocks or replication. Planting was done on the 29<sup>th</sup> of April 2017, the cucumber seeds were planted according to the different spacing treatments of 75 x 25 cm, 75 x 50 cm, and 75 x 75 cm, and the weeding regimes applied as designated Urea was applied at 3 WAP at the rate of 200 kg /ha was carried out at 3WAP. This was done because the soil test result was found to be deficient in nitrogen (0.05%) when compared to that of the critical level of nitrogen 0.15% of southeastern soil established by [26].

## 2.5 Data Collection

### 2.5.1 Weed

Two quadrats of 50 cm x 50 cm thrown at two diagonal transect per plot was used to assessed weed density and weed biomass at 3, 6, 9 and 12 WAP. The above – ground parts within each quadrat were clipped with a secateurs at soil surface. The weeds were counted and expressed in number per square meter (no/m<sup>2</sup>). Thereafter the weeds were sundried to a constant weight, and the dry weight determined with a top – loading mettle balance (Model P1210). The dry weight was expressed in grams per square meter (g/m<sup>2</sup>). Percentage weed ground cover was evaluated at 9 and 12WAP using the beaded string method [27]

### 2.5.2 Cucumber

A sample of three plants was taken at random from the inner rows of each experimental plot to measure the crop parameters.

#### 2.5.2.1 Vine length (cm)

Vine length was measured with a measuring tape from the from soil level to the tip of the plant at 3, 6 9 and 12 WAP.

#### 2.5.2.2 Leaf area index

Leaf area was first determined by using [28] method and thereafter, the leaf area index was calculated by dividing the total leaf area per plot by the land area occupied by the plants at 3, 6 9 and 12WAP.

#### 2.5.2.3 Fruit length (cm)

A meter rule was used in the measurement of the fruit. Measurement was taken from fruit stalk to tip at each interval of pickling. The average of the

three-tagged plants was taken as fruit length per plant for each picking. The fruits were picked thrice at different intervals and their values were pooled for data analysis.

#### 2.5.2.4 Fruit diameter (cm)

A non-elastic thread was placed round the fruit of the tagged plants, thereafter stretched on a meter rule to obtain the diameter fruit at each picking interval. The average value of the tagged plants was taken as fruit diameter per plant. The fruits were picked thrice at different intervals and their values at each picking intervals were pooled for data analysis.

#### 2.5.2.5 Fruit yield (kg/ha)

The fruit yield per hectare was determined from the tagged three plants at weekly intervals for three pickings. The fruit were weighed individually with electronic scale and there averages were taken as fruit weight per plant. The weight per plant per plot was pooled and converted to kilogram per hectare by multiplying by the various plant populations.

#### 2.5.2.6 Cucumber cover assessment (%)

Cucumber ground cover was evaluated at 9 and 12 WAP using the beaded string method [28].

### 2.6 Statistical Analysis

Data generated from the experiment were subjected to analysis of variance (ANOVA). The treatment mean differences were separated

by using least significant difference (LSD) at 5%.

## 3. RESULTS

### 3.1 Soil Physicochemical Properties

The physicochemical properties of the experimental site before planting are presented in Table 1. The soil was sandy, low in nitrogen and high in organic carbon (OC,) Phosphorus (P), Potassium (K), Calcium (Ca) and Magnesium (Mg). The soil was acidic with pH value of 5.40.

### 3.2 Weed Growth Characteristics

#### 3.2.1 Weed density

The effect of spacing and weeding regimes on weed density at 3, 6, 9 and 12 WAP are presented in Table 2. At 3 WAP, there was no significant difference ( $P=0.05$ ) between weeding regime, spacing and their interactions on weed density. At 6, 9 and 12WAP, weeding regime and their interaction were significantly different at ( $P = 0.05$ ) while plant spacing was not significantly different. The highest weed density was obtained at no weeding plots while the lowest was at the weekly weeding plots At 6 WAP, treatment combination of 75 x 75 cm with no weeding produced higher weed density (212.67 no/m<sup>2</sup>) than other treatment combinations. Similar trends were observed at 9 and 12WAP.

#### 3.2.2 Weed dry weight

The effect of spacing and weeding regimes on weed dry weight at 3, 6, 9 and 12 WAP are

**Table 1. Physicochemical properties of the experimental site before planting**

Soil properties	Value	Critical level*
<b>Physical properties</b>		
Sand (%)	94.50	–
Silt (%)	1.87	–
Clay (%)	3.63	–
Textural class	Sand	-
<b>Chemical properties</b>		
pH (H <sub>2</sub> O)	5.40	–
Total organic carbon (%)	1.87	1.16
Total nitrogen (%)	0.05	0.15
Available P (mg/kg)	18.67	8.50
Cation exchange capacity (cmol/kg)		
Ca	3.89	1.50
Mg	2.41	0.28
Na	0.22	–
K	1.10	0.16

\*[26]

**Table 2. Effect of spacing and weeding regimes on weed density (no. /m<sup>2</sup>)**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>3WAP</b>				
75 x 25	270.67	193.33	232.67	232.22
75 x 50	233.33	180.00	276.00	229.78
75 x75	224.67	206.00	204.67	211.78
Weeding regime mean	242.89	193.11	237.78	
LSD (P=0.05)				
Spacing		90.859NS		
Weeding regime (S X WR)		90.859NS		
		157.373NS		
<b>6WAP</b>				
75 x 25	177.33	78.67	77.33	111.11
75 x 50	181.33	80.00	72.00	111.11
75 x75	212.67	78.67	69.33	120.22
Weeding regime mean	190.44	79.11	72.89	
LSD (P=0.05)				
Spacing		63.375NS		
Weeding regime (S X WR)		63.375NS		
		109.769		
<b>9WAP</b>				
75 x 25	102.67	67.33	51.33	73.78
75 x 50	121.33	36.67	30.67	62.89
75 x75	171.33	41.33	47.33	86.66
Weeding regime mean	131.78	48.44	43.11	
LSD (P=0.05)				
Spacing		36.465NS		
Weeding regime (S X WR)		36.465NS		
		63.158		
<b>12WAP</b>				
75 x 25	69.33	69.33	25.33	54.66
75 x 50	80.67	71.33	26.67	59.56
75 x75	112.00	52.00	23.33	62.44
Weeding regime mean	87.33	64.22	25.11	
LSD (P=0.05)				
Spacing		31.763NS		
Weeding regime (S X WR)		31.763NS		
		55.01		

NS = not significant at 5% level of probability

presented in Table 3. Plant spacing, weeding regime and their interaction did not differ significantly on their effect on weed dry weight at 3 WAP; at 6, 9 and 12 WAP, plant spacing had no significant effect on weed dry weight but weeding regime and the interaction had significant effect on weed dry weight. The no weeding plots gave the highest

weed dry weight while the weekly weeding plots had the lowest weed dry weight. At 6WAP, treatment combination of 75 x 75 cm with no weeding produced higher weed dry weight (103.53 g/m<sup>2</sup>) than other treatment combination. Similar trends were noticed on weed dry weight at 9 and 12 WAP.

**Table 3. Effect of spacing and weeding regimes on weed dry weight (g/m<sup>2</sup>)**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>3WAP</b>				
75 x 25	109.70	87.82	55.27	84.26
75 x 50	80.48	115.35	58.83	84.89
75 x75	91.59	102.97	89.68	94.75
Weeding regime mean	93.92	102.05	67.93	
LSD (P=0.05)				
Spacing		49.969NS		
Weeding regime (S X WR)		49.969NS		
		86.548NS		
<b>6WAP</b>				
75 x 25	82.60	8.80	2.80	31.40
75 x 50	97.60	16.60	5.13	39.78
75 x75	103.53	14.33	3.73	40.53
Weeding regime mean	94.58	13.24	3.89	
LSD (P=0.05)				
Spacing		19.259NS		
Weeding regime (S X WR)		19.259NS		
		33.359		
<b>9WAP</b>				
75 x 25	33.67	4.00	2.93	13.53
75 x 50	54.67	3.07	1.33	19.69
75 x75	62.53	3.73	2.60	22.95
Weeding regime mean	50.29	3.60	2.29	
LSD (P=0.05)				
Spacing		21.529NS		
Weeding regime (S X WR)		21.529NS		
		37.286		
<b>12WAP</b>				
75 x 25	28.73	10.60	3.20	14.18
75 x 50	35.73	7.60	2.93	15.35
75 x75	53.40	5.27	4.40	21.02
Weeding regime mean	39.22	7.82	3.51	
LSD (P=0.05)				
Spacing		19.303NS		
Weeding regime (S X WR)		19.303NS		
		33.45		

NS = not significant at 5% level of probability

### 3.3 Cucumber Performance

#### 3.3.1 Vine length

The effect of spacing and weeding regimes on vine length at 3, 6, 9 and 12 WAP are presented in Table 4. At 3 WAP, spacing and weeding regime had no significant effect on vine length of cucumber but their interaction had effect (P =

0.05). The longest vine was recorded at a plant spacing of 75 x 50 cm with weeding twice at 3 and 5 WAP while the shortest vine was recorded at 75 x 25 cm at the same weeding regime. At 6 and 9 WAP, plant spacing, weeding regime and interaction had no significant effect on vine length. At 12 WAP, spacing, weeding regime, and their interaction had significant effect on vine length .The longest vine was obtained at

**Table 4. Effect of spacing and weeding regimes on vine length (cm)**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>3WAP</b>				
75 x 25	13.34	9.33	14.63	12.43
75 x 50	9.51	17.09	11.86	12.82
75 x75	12.30	10.98	10.07	11.12
Weeding regime mean	11.72	12.47	12.19	
LSD (P=0.05)				
Spacing		3.697NS		
Weeding regime (S X WR)		3.679NS		
		6.403		
<b>6WAP</b>				
75 x 25	18.68	21.69	38.76	26.38
75 x 50	34.03	44.72	30.20	36.32
75 x75	21.57	19.35	31.65	24.19
Weeding regime mean	24.76	28.59	33.54	
LSD (P=0.05)				
Spacing		17.073NS		
Weeding regime (S X WR)		17.073NS		
		29.572NS		
<b>9WAP</b>				
75 x 25	51.22	43.77	72.38	55.79
75 x 50	59.00	47.00	83.49	63.16
75 x75	36.00	58.66	62.27	52.31
Weeding regime mean	48.74	49.81	72.72	
LSD (P=0.05)				
Spacing means		30.493NS		
Weeding regime (S X WR)		30.493NS		
		52.824NS		
<b>12WAP</b>				
75 x 25	122.67	133.00	141.67	132.44
75 x 50	115.00	123.00	138.00	125.33
75 x75	97.00	107.67	120.33	108.33
Weeding regime mean	111.56	121.22	133.33	
LSD (P=0.05)				
Spacing		0.985		
Weeding regime (S X WR)		0.985		
		1.707		

NS = not significant at 5% level of probability

plant spacing of 75 x 25 cm while the shortest vine was at plant spaced at 75 x75 cm. Plots that were weekly weeded had the longest vine while the shortest vine was in plots that were weedy. The treatment combination of 75 x 25 cm with weekly weeding produced the longest vine (141.67 cm) while 75 x 75 cm with no weeding had the shortest vine (97.00 cm)

### **3.3.2 Leaf area index**

The effect of spacing and weeding regimes on leaf area index at 3, 6 and 12 WAP are presented in Table 5. At 3 WAP, there were no significant treatment effects of spacing, weeding regime and interaction on leaf area index.

**Table 5. Effect of spacing and weeding regimes on leaf area index**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>3WAP</b>				
75 x 25	0.09	0.11	0.23	0.14
75 x 50	0.10	0.16	0.08	0.11
75 x75	0.32	0.12	0.05	0.16
Weeding regime mean	0.17	0.13	0.12	
LSD (P=0.05)				
Spacing		0.205NS		
Weeding regime (S X WR)		0.205NS		
<b>6WAP</b>				
75 x 25	0.26	0.28	0.78	0.44
75 x 50	0.21	0.31	0.46	0.33
75 x75	0.07	0.13	0.17	0.12
Weeding regime mean	0.18	0.24	0.47	
LSD (P=0.05)				
Spacing		0.229		
Weeding regime (S X WR)		0.229		
<b>9WAP</b>				
75 x 25	0.21	0.31	0.92	0.48
75 x 50	0.17	0.23	0.36	0.25
75 x75	0.06	0.09	0.25	0.13
Weeding regime mean	0.15	0.21	0.51	
LSD (P=0.05)				
Spacing		0.310		
Weeding regime (S X WR)		0.310		
<b>12WAP</b>				
75 x 25	0.03	0.10	1.16	0.43
75 x 50	0.30	0.30	0.48	0.36
75 x75	0.04	0.10	0.22	0.12
Weeding regime mean	0.12	0.17	0.62	
LSD (P=0.05)				
Spacing		0.186		
Weeding regime (S X WR)		0.186		

NS = not significant at 5% level of probability

At 6WAP, the spacing, weeding regime and interaction had significant effect on number of leaf area index. The highest leaf area index was obtained at plant spacing of 75 x 25 cm while the lowest was at plant spaced at 75 x75cm. Plots that were weekly weeded had the highest leaf area index while the weedy plots had lowest. The treatment combination of 75 x 25 cm with weekly weeding produced the highest leaf area index (0.78) while 75 cm x75 cm with no weeding had

the (0.07). 9 WAP and 12 WAP followed similar trend of 6WAP.

### **3.3.3 Cucumber cover and weed cover**

The effect of spacing and weeding regimes on percentage cucumber cover and weed cover at 9 and 12 WAP are presented in Table 6. At 9 WAP, spacing, weeding regime and interaction effects did not differ significantly in terms of

cucumber percentage ground cover. Also, there were no significant difference on spacing and weeding regimes on weed ground cover. However there interaction differed significantly on weed ground coverage. The highest percentage weed cover (90%) occurred at all the three spacing treatment combination with no weeding while the least weed cover (80.67%) occurred at a spacing of 75 x 25 cm combined with weekly weeding.

**Table 6. Effect of spacing and weeding regimes on cucumber and weed ground cover (%) at 9 and 12 WAP**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>Cucumber cover at 9WAP</b>				
75 x 25	14.67	27.00	29.33	23.67
75 x 50	24.67	22.67	20.33	22.56
75 x75	17.67	12.67	27.67	19.34
Weeding regime mean	19.00	20.78	25.78	
LSD (P=0.05)				
Spacing		13.301NS		
Weeding regime (S X WR)		13.301NS		
		23.038NS		
<b>Weed ground cover at 9WAP</b>				
75 x 25	90.00	88.67	80.67	86.22
75 x 50	90.00	98.67	98.67	93.11
75 x75	90.00	93.33	93.33	91.33
Weeding regime mean	90.00	93.56	93.56	
LSD (P=0.05)				
Spacing		9.287NS		
Weeding regime (S X WR)		9.287NS		
		16.086		
<b>Cucumber cover at 12 WAP</b>				
75 x 25	28.00	45.00	42.67	38.56
75 x 50	9.00	27.00	37.00	24.33
75 x75	7.00	17.33	42.00	22.11
Weeding regime mean	14.67	29.78	40.56	
LSD (P=0.05)				
Spacing		11.166		
Weeding regime (S X WR)		11.166		
		19.339		
<b>Weed ground cover at 12WAP</b>				
75 x 25	100	78.67	51.67	76.78
75 x 50	100	86.33	65.67	84.00
75 x75	100	82.00	56.33	79.44
Weeding regime mean	100	82.33	57.89	
LSD (P=0.05)				
Spacing		14.755NS		
Weeding regime (S X WR)		14.755NS		
		25.556		

NS = not significant at 5% level of probability

At 12 WAP, plant spacing, weeding regime and interaction differed significantly on percent cucumber cover (Table 6). The highest percentage cucumber coverage was obtained from plant spaced at 75 x 25 cm while the lowest was at plant spaced at 75 x75 cm. Plots that were weekly weeded had the highest percent cucumber cover while the lowest was in plots that were left weedy. The highest cucumber cover (45%) was obtained from a plant spacing of 75 x 25 cm combined with weeding twice while the least cover (7%) occurred at a spacing of 75 x 75 cm with no weeding.

Similarly, at 12 WAP, there were no significant difference on plant spacing and, weeding regimes on percentage weed ground cover but their interaction differed significantly on percentage weed ground cover. All the three plant spacing treatment combination with no weeding had the highest weed ground cover (100%) while the least weed ground cover (51.67%) was obtained from a spacing of 75 x 25 cm combined with weekly weeding.

### 3.3.4 Fruit length and diameter

The effect of spacing and weeding regimes on fruit length and diameter are presented in Table 7. The spacing, weeding regime and their interaction had significant effect on fruit length.

The longest fruit was obtained from plant spaced at 75 x 75 cm while the shortest was from 75 x 25 cm. Plots that were weekly weeded produced the longest fruit while the weedy plots had the shortest. The highest value (23.05 cm) of interaction on fruit length was obtained from spacing of 75 x75 cm combined with weeding weekly while the least value (3.45 cm) was obtained from a spacing of 75 x 25 cm combined with no weeding.

The spacing and weeding regime, and their interaction had significant effect on fruit diameter. The highest fruit diameter was obtained from plant spaced at 75 x75 cm while the lowest was from 75 x 25 cm. Plots that were hoe weeded twice at 3 and 5 WAP had the highest diameter but statistically at *par* with weekly weeding while the weedy plots had the lowest. The highest diameter value (28.50 cm) ) on interaction was obtained from spacing of 75 x75 cm combined with weeding twice at 3 and 5 WAP while the least value (4.08 cm) was obtained from a spacing of 75 x 50 cm combined with weeding twice at 3 and 5 WAP.

### 3.3.5 Fruit yield

The spacing, weeding regime their and interaction had significant effect on fruit yield (Table 8). Plant spaced at a closer spacing of

**Table 7. Effect of spacing and weeding regimes on fruit length and diameter (cm)**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
<b>Fruit length</b>				
75 x 25	3.50	14.13	4.70	7.44
75 x 50	13.75	8.87	8.45	10.36
75 x75	3.45	8.85	23.05	11.78
Weeding regime means	6.90	10.62	12.07	
LSD (P=0.05)				
Spacing		2.812		
Weeding regime (S X WR)		.812		
		4.871		
<b>Fruit diameter</b>				
75 x 25	5.95	5.17	17.61	9.58
75 x 50	9.35	4.08	8.67	7.37
75 x75	11.70	28.50	11.07	17.09
Weeding regime means	9.00	12.58	12.45	
LSD (P=0.05)				
Spacing		3.559		
Weeding regime (S X WR)		3.559		
		2.908		

**Table 8. Effect of spacing and weeding regimes on fruit yield (Kg/ha)**

Spacing (S) (cm)	Weeding regime (WR)			Spacing mean
	No Weeding	Weeding twice at 3 and 5WAP	Weekly weeding	
75 x 25	1278.00	2563.33	2571.67	2137.70
75 x 50	1266.67	2515.00	2533.33	2105.00
75 x75	382.58	776.89	956.47	705.31
Weeding regime mean	975.78	1951.74	2020.49	
<i>LSD (P=0.05)</i>				
	<i>Spacing</i>		25.869	
	<i>Weeding regime</i>		25.869	
	<i>Interaction (S X WR)</i>		44.807	

75 x 25 cm produced the highest fruit yield while plant spaced at a wider spacing of 75 x 75 cm had the lowest yield. Plots that were weekly weeded had the highest fruit yield which was statistically identical to that of plots that were weeded twice at 3 and 5WAP. The weedy plots had the lowest yield. Plant spaced at 75 cm x 25 cm combined with weekly weeding had the highest value of interaction of fruit yield of 2571.67 kg/ha, which was statistically similar to that of 75 x 25 cm combined with weeding twice at 3 and 5WAP (2563.33 kg/ha) and 75 x 50 cm combined with weeding twice at 3 and 5WAP (2533.33 kg/ha). The lowest fruit yield was obtained at a wider spacing of 75 cm x75 cm with no weeding (382.58 kg/ha)

#### 4. DISCUSSION

Our result showed that interaction of spacing and weeding regimes on weed density and dry weighty at 3 WAP did not differ significantly. The non-significant differences observed on weed density and biomass could be attributed to lack of treatment effect. Researchers [29,30] had reported similar observation in some arable crops. The researchers attributed their findings to poor weed germination and improper canopy formation from crop plants during the early growth periods of crops. The variation in weed density and weed dry weight of in other sampling intervals could be attributed to treatments effect of the spacing and weeding regime applied. Cucumber performed poorly in no weeding plot in terms of vine length, vine cover, length of, length and diameter of fruit, and fruit yield. This could be due to severe weed competition with cucumber for available growth resources such as water, light, nutrients and space. Some workers [31,32] had reported similar findings on the effect of weed competition with arable crops. The workers noted that weeds caused reduction in

growth and yield of crops plants by competing with crop plants for available growth resources.

On the other hand, cucumber fruit yield was reduced by treatment combination of plant spaced at wider spacing of 75 x 75 cm with weedy plot (no weeding plot) by 85.12% when compared with closer spacing of 75 cm x 25 cm with weekly weeding plots, 85.07% when compared to plots that were spaced closer at 75 x 25 cm with twice weeding at 3 and 5WAP and 84.90% when compared with intermediary plant spaced at 75 x 50 cm with weekly weeding. [33] noted that weeds remove plant nutrient more efficiently than crops and if left undisturbed, weeds can grow faster and taller than crops suppressing them. Spacing did not have any significant effect on weed density and weed dry weight, weed cover and cucumber cover, the probable reasons for this is that the plants spaced at the various spacing had little or no competition with weeds for available growth resources. Generally, plant spaced at a closer spacing of 75 cm x 25 cm did better than others in majority of the plant growth parameters that were assessed. The remarkable yield obtained at a close spacing of 75 x 25 cm might be attributed to its high population density which led to better weed suppression through canopy shading, better water utilization as a result of less evaporation and better radiant energy utilization. [34] attributed an increase in okra growth to reduced weed competition, increase in oxygen and also water movement in the soil. The poor yield obtained at a wider spacing of 75 cm x 75 cm might be attributed to the inability of the cucumbers vines to smother weeds because of scanty plants and available space for weeds to thrive. This wide space gave opportunity for the crop and weeds to compete for nutrients, light, water, carbon dioxide and space, which gave the weeds the greater advantage over the crop in terms of resource utilization.

There is always a period in the life cycle of crops when the presence of weeds is most critical and as such weeds must be removed. The significant interaction of spacing and weeding regime on the performance of cucumber confirms the ability of these two factors to minimize weed competition and increase crop yield.

## 5. CONCLUSION

Plant spaced at 75 cm x 25 cm with weekly weeding, 75 cm x 25 cm with twice weeding at 3 and 5 WAP and 75 cm x 50 cm with weekly weeding had highest cucumber fruit yield while the lowest of that was from 75 cm x 75 cm with a weedy check. Although the yields obtained from these combinations were statistically the same, it is recommendable to cultivate cucumber at a closer spacing of 75 cm x 25 cm when combined with weeding twice for economic reasons. However, further studies are needed to ascertain the cost implications of these treatment combinations.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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