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Effects of Different Row Arrangements And Weeding Regimes on Okra (*Abelmochus Esculentus* (L) Moench)/Cucumber (*Cucumis Spp*) Intercrop in Semi Arid Region of Maiduguri, Borno State

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Abstract: *This study investigates the effects of different row arrangements and weeding regimes on the growth and yield of okra (Abelmoschus esculentus) and cucumber (Cucumis spp) intercrop in the semi-arid region of Maiduguri, Borno State. Okra and cucumber are economically important vegetable crops grown in tropical and sub-tropical regions worldwide. The experiment was conducted during the rainy season of 2023 at the Department of Agricultural Technology Teaching and Research Farm, Ramat Polytechnic Maiduguri. Various growth parameters including plant height, number of leaves per plant, days to flowering, fruit characteristics, and yield were measured for both crops under different treatments. Results indicated that row arrangements significantly influenced the growth and yield of okra and cucumber. In general, 1:2 row arrangements with two hoe weeding sessions favored the growth and yield of both crops. This arrangement allowed for optimal spacing and reduced competition between the two crops. Furthermore, two weeding sessions were found to be beneficial for most growth parameters measured. Overall, the study suggests that 1:2 row arrangements with two hoe weeding sessions can maximize the yield of both okra and cucumber in mixed cropping systems. However, for farmers focusing primarily on okra yield, 2:1 row arrangements with weed-free conditions may be preferred. Further research is recommended to develop more efficient weed management strategies for optimal yield in different row arrangements.*

Keywords: Okra Cucumber Row arrangements Weeding regimes Intercropping.

INTRODUCTION

Okra (*Abelmoschus esculantus)* is one of the most widely known utilized species of the family *Malvacea* and an economically important vegetable crop grown in tropic and sub-tropic parts of the world. Okra plant was previously included in the genus *Hibiscus*. Later, it was designated to *Abelmoschus,* which is distinguished from the genus *Hibiscus*. Okra originated somewhere around Ethiopia and was cultivated by the ancient Egyptian by the 12th Century B.C. Its cultivation spread throughout Middle East and North Africa. The route by which okra has taken from Ethiopia to North Africa, the Eastern Mediterranean, Arabia and India is by no means certain (Franklin, 2012). Okra is known by many local names in different parts of the world. In Northern part of Nigeria it is called “Ngwalto” in Kanuri, “Darraba” in Shuwa, “Azgha” in Gwoza and “Kubewa” in Hausa. It is called “lady’s finger” in England, “Gumbo” in the United States of America while in Ethiopia, it is also called “Kenkase”. The name okra probably drives from one of the Niger-Congo groups of Languages. (The name of okra in the Twi

Language in Nkuruma). The term okra was in the use of English by the late 18th Century. The cucumber most likely originated in India (south foot of the Himalayas), or possibly Burma, where the plant is extremely variable both vegetatively 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.

Okra plants are grown commercially in many countries such as India, Japan, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar, Malaysia, Thailand, Brazil, Ethiopia, Cyprus and in the southern United States. The crop is also grown throughout North Carolina in home garden's and for commercial markets (Sander's 2001). In Nigeria, Okra is grown in about 1 to 2 million hectares (m/ha) of farmland (Adejuonwo, *et. al.,* 1989). The total world annual production of Okra as at 2005 stood about 5 million metric tones (Mmt). India is the highest producers of the Okra (2.55Mmt). Other producing countries are Nigeria (0.74Mmt), Pakistan (0.11Mmt), Ghana (0.1Mmt), Benin (0.035Mmt), Egypt (0.085Mmt), Saudi Arabia (0.046Mmt), Turkey (0.035Mmt) and Burkina Faso (0.026Mmt) among others (FAO, 2005). In Africa, total annual production was put at (1.08Mmt), the leading producers were Nigeria, Ghana, Benin and the highest yield of the Okra was recorded in Egypt (14.17t/ha) while in Kenya (6.26t/ha) and Ghana (5.56t/ha) FAO, (2005). In 2012 the world area under cucumber cultivation was estimated at about 2 million ha, with a total production of 36 million tones. Asia is the world leading producer, with china alone accounting for over 60%. Cucumber is grown in all countries of tropical Africa, but nowhere in a large scale. In 2002 Africa produced 507,000 tons on 25,000 ha, accounting for just less than 1.5% of total world production. Egypt is the largest African producer with 360,000 tons. The world international trade in cucumber as at 2002 amounted to 1.5 million tons, with Mexico, Netherlands and Spain as the main exporters; international trade from African countries is modest and unrecorded.

Okra is eaten and can add nutritional benefits to our diet, if used properly. Almost all tribes in Nigeria make use of okra to prepare traditional meals, delicious soups and sauces. Okra leafs are traditionally used to feed young farm animals and sometimes used as vegetables in similar manner to salad leaf. For long term uses, okra is grinded to powder and eaten from time to time. While it might not be as nutrient dense as vegetables such as spinach, it is packed with some valuable nutrients. It is a high fiber food, for starters: Nearly half of its nutrition is a soluble fiber in the form of gums and pectins. Nearly 10 percent of the recommended levels of vitamin B6 and folic acid are also present in a half cup of cooked okra. Okra is known as a high antioxidant, it can fight free radical. Supports and improves cardiovascular and coronary heart diseases, type 2 diabetes, digestive diseases, and even some cancers. Additionally, it is abundant in several other vitamins and minerals, including thiamine, riboflavin/vitamin B2 and zinc. (Hamma et. al, 2012). Raw non peeled cucumber contains Potassium, Vitamin K, Vitamin C and it is a good source of Phosphorus and Manganese, Magnesium, Pantothenic Acid and Vitamin A. It is also very low on Sodium, Cholesterol and Saturated Fat. Cucumber is a very edible fruit; it is being used for different purpose as it can be eaten raw or cooked. Cucumber is consumed in fresh form particularly by diabetic patients and its consumption is on the increase, therefore, the need to step up its production cannot be an overstatement. In Northern Nigeria, farmers grow cucumber mostly in a mixed cropping pattern with okra. However, there is no well defined row arrangement for cucumber and other crops grown in mixture.

Arrangement of crops in mixture in the traditional farming systems of the local farmers is not specified which might have consequences on the crops grown in terms of uptake of nutrition by competing crops, this might lead to poor crop yield. Similarly, there is no established suitable manual weeding regime for cucumber grown in mixture with other crops. Manual (hoe weeding, hand pulling and slashing) weeding regime in crops like cucumbers whose produce are directly born (produced) on the soil surface and consumed when it is still raw is important, as use of herbicide to control weed in such crop is not advisable because of health hazard. The development of appropriate row arrangement and

suitable manual weeding regime for cucumber in mixture with any crop such as okra is therefore paramount. Therefore, the objectives of the study are to: determine the effects of different row arrangements on the growth and yield of okra-cucumber mixed crop and to determine the effects of weeding regimes on the growth and yield of okra-cucumber mixed.

MATERIALS AND METHODS

Experimental Site

The experiment will be conducted in Borno State during the rainy season of 2023. The experiment will be conducted at the Department of Agricultural Technology Teaching and Research Farm Ramat Polytechnic Maiduguri (Latitude 12°N and Longitude 13°130 E altitudes of 354 m above sea level). The experimental Site is situated in the Sudan Savannah Region of Nigeria.

Data Collected on Okra

Establishment count

This was done at two weeks after sowing(2 WAS) by counting fully established seedling stands from gross plot and average stands counts for each treatment was computed.

Plant height (cm)

Plant height was measured from 4 – 8 weeks after sowing (WAS). Three plants were randomly selected and tagged from each net plot area and their height measured from ground level to the apex of the plant with a graduated meter rule, and average computed.

Number of leaves/plant

Average number of fully expanded leaves per plant was determine from 4 - 8WAS. This was done by selecting 3 plants at random from each plant and counting the fully expanded leaves and average was recorded per plant.

Days to 50% flowering

This was determining by visual observation and noting when 50% of the plants population per plot flowers.

Leaf area

This was calculated using method described by Asif (1977) as below:

$\delta = 115x - 1050$

Where δ = leaf area

X = length of the leaf mid-rid.

Thus, mean length of the leaf mid-rid obtained from the average length of the 3 sampled plants was used to compute the single leaf area and then multiplied by the total number of the leaf number of the plant to get the total leaf area of a particular plant.

Leaf area index

This was computed as the ratio of leaf area of the stand to ground area covered by its canopy.

Number of fruits harvested/plant

This was done by taking the average of the total number of fruits harvested from each sampled plant at each harvested.

Fruits weight/plant (g)

Fruit weight of fresh fruit recorded using weighing balance. This was done by dividing the total weight of the fruits by their number.

Fruit length (cm)

Mean fruit length was recorded using a measuring tape. This was done by measuring the full length of the fruits from the sample plants and averaged.

Fruit diameter

Mean fruit diameter was recorded using a Vanier calliper at the middle point of the fruits.

Total fruit yield/ha

This was obtained by weighing all the fruits yield harvested from each net plot in kg and extrapolated to yield per hectare using the formula:

$$\text{Fruit yield kg ha}^{-1} = \text{fruit yield/net plot Hectare} \times \frac{10{,}000\text{m}^2}{\text{Net plot area (m}^2\text{)}}$$

Data Collected on Cucumber

Number of leaves/plant

This was obtained by counting the number of cucumber leaves from three (3) randomly selected and tagged plants from the net plot and average was computed. This was done at 3, 6 and 9 WAS.

Length of primary vine (cm)

This was determined by measuring the length of primary branches from three (3) selected and tagged plant from net plot at 3, 6 and 9 WAS.

Number of secondary vines/plant

This was determined by counting the number of secondary vine from three (3) selected and tagged plants from net plot at 3, 6 and 9 WAS.

Days to first flowering

This was obtained by carefully nothing the date (i.e. the number of days from planting) when first flowering begins in each plot.

Days to 50% flowering

This was obtained by carefully nothing the number of days from planting till when 50% of the plants in each plot have flowered. This was achieved by regular field observation.

Number of fruits/plant

This was obtained by counting the number of fruits at each harvest from the tagged plants for each treatment plot and the average later determined and recorded.

Fruits diameter (cm)

This was determined by measuring the diameter of the fruits from the three (3) tagged plants in the net plot using a Vanier calliper at harvest. The average was then computed and recorded.

Fruits length (cm)

This was determined by measuring the length of the fruits from the three (3) tagged plants in the net plot using meter ruler at harvest. The average was then computed and recorded.

Fruits weight/plant

This was determined by measuring the weight of the fruit from the three (3) tagged plants in the net plot using weighing machine at harvest. The average was then computed.

Total fruit yield/ha

This was obtained by weighing all the fruits yield harvested from each net plot in kg and extrapolated to yield per hectare using the formula:

$$\text{Fruit yield kg ha}^{-1} = \frac{\text{fruit yield/net plot Hectare} \times 10{,}000\text{m}^2}{\text{Net plot area (m}^2\text{)}}$$

RESULTS AND DISCUSSION

Plant Height (cm)

The effects of row arrangements and weeding regimes on plant height of okra is presented in Table 1. In both the years and combined mean, there was no significant effect of row arrangements on plant height of okra. However, there was significant effect of weeding regimes on plant height of okra at 4, 6 and 8 weeks after sowing (WAS) in both years and combined mean.Weed free treatment produced significantly higher okra plant height and the least was observed in weedy check in both years and combined mean. There was no significant interaction between row arrangements and weeding regimes on plant height of okra in both years and combined mean.

Growth parameters such as number of leaves/plant was found to be significantly higher for okra plants grown using 1:2 row arrangements than for the other row arrangements used. This could he attributed to the fewer okra plant population in this planting pattern of okra/cucumber mixture which enhanced more leaf formation and expansion. The presence of the cucumber in the mixture simply served as mulch being a low growing crop (trailing plant) and could not pose competition for the okra at least to the above ground resources such as light and carbon dioxide. This statement is supported by the work of Hamma *et al*(2012) who grew intercropped okra with watermelon to serve as live mulch in Samaru Zaria and found that the okra produced higher number of leaves and controlled weeds significantly compared

to when okra was grown as a sole crop (i.e without presence of watermelon), Okra a tall growing crop while watermelon is a trailing crop serving as mulch for the okra.

Table 1: Effect of row arrangements and weeding regimes on plant height of okra in Maiduguri

	Plant height (cm)		
Treatment	**4WAS**	**6WAS**	**8WAS**
Row arrangements (A)			
1:1	10.56[a]	25.28[a]	39.79[a]
1:2	10.51[a]	25.47[a]	39.24[a]
2:1	10.58[a]	25.68[a]	40.59[a]
SE ±	0.16	0.33	0.65
Weeding regimes (B)			
Weedy Check	9.05[c]	18.82[d]	30.84[c]
1W	10.32[a]	23.89[c]	38.89[b]
2W	11.18[a]	26.33[b]	44.44[a]
WF	11.64[a]	27.53[a]	45.32[a]
SE ±	0.18	0.38	0.53
Interaction			
A x B	NS	NS	NS

Means followed by the same letter (s) in a column are not significantly different at P=0.05 level of probability using DMRT.

NS = Not significantly different at P =0.05
1W = Hoe weeding once at 3 weeks after sowing (WAS)
2W = Hoe weeding twice at 3 and 6 (WAS)
WF = Weed free
1:1 = One okrarow /one cucumber row
1:2 = One okra row /two cucumber row
2:1 = Two okra row /one cucumber row

Number of Fruits/Plant

The treatments (except row arrangements) significantly influence number of fruits/plant of okra. Two weedings was optimum for number of fruits/plant of okra in both years and combined mean. Weedy check in both years and combined mean, produced the least number of fruits/plant. The interaction between row arrangements and weeding regimes on numbers of fruits/plant mean was not significant (Table 2).

The okra yield/ha from the present study was significantly favoured by 2:1 row arrangements compared with the other row arrangements. This is expected as the 2:1 row arrangements had higher population of okra in the okra/cucumber mixture. It could also be due to the tall height of plant under 2:1 row arrangements in the present study. Though, they are not statistically different in height due to the different row arrangements but value was higher for 2:1 row arrangements. Although the fruit sizes were smaller for plants grown using 2:1 row

arrangements, the higher number of plants/plot from this treatment resulted to higher yield/ha. This finding is in agreement with Dantata*et al*. (2020) who reported higher maize yield/ha in 2:1 row arrangements of maize/watermelon mixture compared with 1:1 or 1:2 row arrangements.

Table 2: Effect of row arrangements and weeding regimes on number of fruits/plant of okra in Maiduguri

	Number of fruits/plant
Treatment	
Row arrangements (A)	
1:1	12.47[a]
1:2	12.97[a]
2:1	12.36[a]
SE ±	0.22
Weeding regimes (B)	
Weedy Check	5.39[d]
1W	12.48[c]
2W	15.09[ab]
WF	15.43[a]
SE ±	0.25
Interaction	
AXB	NS

Means followed by the same letter (s) in a column are not significantly different at P=0.05 level of probability using DMRT.
NS = Not significantly different at P =0.05
1W = Hoe weeding once at 3 weeks after sowing (WAS)
2W = Hoe weeding twice at 3 and 6 (WAS)
WF = Weed free
1:1 = One okra row /one cucumber row
1:2 = One okra row /two cucumber row
2:1 = Two okra row /one cucumber row

Length of Main Vine (cm)

The effects of row arrangements and weeding regimes on length of main vine is presented in (Table 3). There was no significant effect of row arrangements on length of main vine of cucumber in both years and combined mean. There was significant effect of weeding regimes on length of main vine of cucumber. Two weeding was optimum for length of main vine mean and weedy check produced the least length of main vine. There was no significant interaction between row arrangements and weeding regimes on length of main vine of cucumber.

The result of the study showed that 1:2 row arrangements gave outstanding number of secondary vines/plant with 2:1 giving the least. Similarly, number of fruits/plant, fruits length, fruits weight/plant and fruit yield/ha were also higher in 1:2 row arrangements and least in 2:1 row arrangements. It should be noted that the 2:1 row arrangements had the highest population of okra and 1:2 had the least population of okra and vice versa for cucumber. Thus, the result appeared to show that cucumber responded negatively to okra population in the mixture. The okra been an erect plant could be posing shading effect on cucumber been a low

growing trailing plant. The cucumber did not have competition within itself and hence the good growth and yield at 1:2 row arrangements where there was low population of okra in the mixture. This finding corroborates with the report of Silwama *et al.*(2007) who grew beans as a trailing plant with maize and erect plant and found out that beans performed well where there is low population of maize (low shading effect from maize).

Table 3: Effect of row arrangements and weeding regimes on Length of Main Vine (cm) of cucumber in Maiduguri

	Length of main vine (cm)		
Treatment	**3WAS**	**6WAS**	**9WAS**
Row arrangements (A)			
1.1	8.48[a]	67.12[a]	150.41[a]
1.2	8.50[a]	67.20[a]	163.07[a]
2.1	8.30[a]	67.07[a]	156.92[a]
SE ±	0.21	0.28	4.34
Weeding regimes (B)			
Weedy Check	7.90[b]	49.32[c]	92.24[d]
1W	8.38[ab]	59.34[b]	117.18[b]
2W	8.65[a]	69.50[ab]	168.03[a]
WF	8.77[a]	70.38[a]	173.07[a]
SE ±	0.24	0.33	5.01
Interaction			
AXB	NS	NS	NS

Means followed by the same letter (s) in a column are not significantly different at P=0.05 level of probability using DMRT.
NS = Not significantly different at P =0.05
1W = Hoe weeding once at 3 weeks after sowing (WAS)
2W = Hoe weeding twice at 3 and 6 WAS
WF = Weed free
1:1 = One okra row /one cucumber row
1:2 = One okra row /two cucumber row
2:1 = Two okra row /one cucumber row

Fruits Weight/Plants (kg)

The effects of row arrangements and weeding regimes on fruits weight/plant of cucumber mean is presented in (Table 3). There was significant effect of row arrangements on fruits weight/plant of cucumber. The 1:2 row arrangements produced the best fruits weight/plant of cucumber and the least fruits weight/plant was observed in 2:1 row. There was significant effect of weeding regimes on fruits weight/plant of cucumber. Two weeding and Weed free produced the best fruits weight/plant. However, two weeding was optimum for fruits weight/plant of cucumber and the least was observed in weedy check. The interaction between row arrangements and weeding regimes on fruits weight/plant of cucumber.

A general trend of increase in all the growth parameters measured with successive increase in weeding was observed during this study. However, the two weeding was found to be optimum for number of leaves/plant, length of main vine/plant, number of secondary vines/plant, number of fruits/plant, fruits diameter, fruits length, fruits weight/plant and fruit yield/ha.

Table 3: Effect of row arrangements and weeding regimes on fruits weight/plants of cucumber in Maiduguri

Treatment	Fruits weight/plants (kg)
Row arrangements (A)	
1:1	2.93[b]
1:2	3.83[a]
2:1	2.23[c]
SE ±	0.49
Weeding regimes (B)	
Weedy Check	1.86[d]
1W	2.66[c]
2W	4.89[a]
WF	4.95[a]
SE ±	0.11
Interaction	
A X B	*

Means followed by the same letter (s) in a column are not significantly different at P=0.05 level of probability using DMRT.
* Significant
1W = Hoe weeding once at 3 weeks after sowing (WAS)
2W = Hoe weeding twice at 3 and 6 WAS
WF = Weed free
1:1 = One okra row /one cucumber row
1:2 = One okra row /two cucumber row
2:1 = Two okra row /one cucumber row

CONCLUSION

Generally, from the result of the present study, the growing of okra and cucumber in mixture at the planting pattern of 1:2 row arrangements with two weeding appeared more advantageous. However, if a farmer is more interested in okra yield, he should go for 2:1 row arrangements with weed free. If he is more interested in cucumber yield for maximum profit, he can maintain 1:2 row arrangements with two weeding.

RECOMMENDATIONS

1. For maximum return from okra/cucumber mixture, farmers are encouraged to use 1:2 row arrangements in combination with two hoe weeding.
2. From the results of the present study, maximum yield of okra was obtained at 2:1 row arrangements with weed free, but maintaining weed free in crop production is very expensive. Therefore, more efficient weed management to be combined with the 2:1 row arrangements need to be determined.

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