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Evaluation of indigenous cowpea (*Vigna unguiculata* L.) varieties growth and yield response to cucumber (*Cucumis sativus*) intercrop and weed suppression in South-Eastern Nigeria

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Abstract

A field experiment was conducted at Awka, Anambra State, Nigeria to evaluate the growth and yield response of cucumber intercropped with different indigenous cowpea varieties. The experiment was laid out in Randomized Complete Block Design replicated three times. The treatments were three local varieties of cowpea ("Akidi Ana", "Akidi Ocha" and "Akidi Ojii") which were sown sole, intercropped with cucumber include "Akidi Ana" + cucumber, "Akidi Ocha" + cucumber, "Akidi Ojii" + cucumber, and sole cucumber. Results obtained from the study showed that the cowpea varieties intercropped with cucumber exhibited a significantly better growth and yield performance as compared to cowpea varieties sown as sole crop. "Akidi Ana" intercropped with cucumber recorded the highest yield advantage (22.8%) over the control followed by intercropped "Akidi Ojii" (22.4%). The result also showed that the intercropped cucumber had better yield compared with those sown sole. The intercrop between different cowpea varieties and cucumber was able to suppress weed emergence than the cowpea varieties and cucumber sown as sole crop.

Keywords: Cucumber, Cowpea, Intercropping

1. Introduction

The need to provide food in the right quantity, quality and at affordable costs remain a priority in most of the developing world, where bulk of agricultural production is largely in the hands of peasant farmers (Takim and Fadayomi, 2010). Due to limited amount of agricultural lands, these local peasant farmers engage in different intercrop farming systems. Intercropping is a crop management system involving two or more species growing together in a particular portion of land in a production cycle and planted sufficiently close to each other so that intra-specific competition does not occur (Innis, 1997). It is a practice often associated with sustainable agriculture and organic farming. Intercropping is an old and commonly used cropping practice which aims to match efficiently crop demands to the available growth resources and labour (Lithourgids et al., 2011).

Production per unit area must be increased because of remaining fixed or diminishing suitable land for food production (Odedina et al., 2014). More than 70% of food crops consumed in humid tropics, especially in the tropical Africa came from intercropping. According to Susan and Mini (2005), intercropping ensures efficient utilization of light and other resources that reduce soil erosion, suppress weed growth and thereby help to maintain greater stability in crop yield in an intercrop system. It also guarantees greater land occupancy and thereby leads to higher net returns, minimize risk of crop failure, better use of resources by plants of different heights, rooting depths and nutrient requirements, and a more equal distribution of labour through the growing season (Okpara et al., 2004).

Advantages of intercropping with legumes have been demonstrated in numerous studies such as tomato and okra with cowpeas (Olasantan, 1991), amaranth with cowpea and cucumber with cowpea (Susan and Mini, 2005), maize with cowpea (Akanke et al., 2006), cassava with cowpea (Mohammed et al., 2006). These studies have indicated that intercropping was more productive than sole cropping because of the complimentary effect of intercrops. Leguminous plants currently present very good opportunity in sustainable maintenance of soil fertility due to their capability in fixing atmospheric nitrogen and incorporate it to

the soil. Among the various leguminous crops, cowpea appears to be one of the most important crop in playing this role (IITA, 1990).

Cucumber is an important vegetable crop and the most popular member of the *Cucurbitaceae* family (Thoa, 1998). It is Asia's fourth most important vegetable crop after tomato, cabbage and onion (Tatliogtu, 1993), and the second most important crop after tomato in Western Europe (Phu, 1997). In Tropical Africa, its place has not been ranked because of limited use.

Ayoola and Ademiran (2006) reported that fertile soils are commonly used for the cultivation of cucumber; infertile soil results in bitter and misshapen fruits which are often rejected by consumers. Bush fallowing has been an efficient, balanced and sustainable agricultural system for soil productivity and fertility restoration in the tropics. However, the fallow period has been shortened due to increase in human population and as a result the use of external inputs in the form of farmyard organic manures and inorganic fertilizers has become imperative. That is why local cowpea varieties has become potential alternatives and cheap sources of organic manure for the local peasant farmers.

There is lack of information regarding the yield and growth response of cucumber when intercropped with cowpea in South-Eastern Nigeria. This study is aimed to evaluate the (i) effect of intercropping different indigenous cowpea varieties with cucumber (ii) the yield and growth performances of the cowpea varieties in the crop mixtures.

2. Materials and Method

2.1 Site description

The study area is Awka, Anambra State, located in the South-Eastern part of Nigeria. It lies between latitude 7°04'N and 6° 13'E, 145.246m above sea level. The climate of South-Eastern Nigeria is essentially humid tropical rainforest with an average annual precipitation of 2163mm. The area is characterized by bimodal rainfall with a total annual mean of 1830mm in the northern part to 3188 mm in the Delta region (Odurukwe *et al.*, 1995). The vegetation is essentially secondary forest tending towards derived savanna because of population pressure and repeated annual bush burning (Okorie and Okpala, 2000).

2.2 Experimental layout

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The treatments were: sole cucumber, sole "Akidi Ana", sole "Akidi Ocha", sole "Akidi Ojii", "Akidi Ana" + cucumber, "Akidi Ocha" + cucumber, and "Akidi Ojii" + cucumber. Planting was carried out in the last week of September in

2014. The cucumber variety "Ashley" was used for intercropping, it was planted at a spacing of 75 by 75 cm as per the national recommendation (Eifediyi and Remison, 2010). The cowpea was planted in between cucumber stands (spacing...?). One hoe weeding was done at 5 (WAP?), after which the cowpea formed sufficient ground cover to control weeds effectively.

Organic fertilizer (six (6) kg of manure equivalent to 30 kg N ha⁻¹) was applied for each plot two weeks before planting

2.3 Data collection

Data was collected on the following parameters on both the cowpea and cucumber: shoot emergence pattern, leaf area, number of branches, number of leaves, number of fruits, flowering pattern, total number of leaves, fruit yield and total number of cowpea seeds per plant.

2.4 Data Analysis

All the data collected were subjected to Analysis of variance using the Genstat Discovery Edition 4, and where F-ratios were significant ($P < 0.05$); means were separated using least significant difference (LSD) test.

3. Results and Discussion

Shoot emergence pattern – The shoot emergence pattern of cowpea and cucumber are shown in Table 1. The result showed that the highest and fastest emergence was recorded by the intercropped cucumber and 'Akidi Ocha' (1.03), followed by intercropped cucumber with 'Akidi Ana'. The slowest emergence was recorded in the intercropped cucumber and 'Akidi Ojii' (0.27). The range of shoot emergence was 0.27.

Leaf area: Intercropped cowpea and cucumber significantly performed better than the sole cropping (Table 1). The sole cucumber and cowpea varieties recorded relatively lower leaf area when compared with the intercrops. This is an indirect indication that the intercrop between cucumber and cowpea varieties enhances the yield of both crops. Intercropped 'Akidi Ana' (10.75 m²) gave the highest leaf area for cowpea while the highest leaf area for cucumber was in cucumber and 'Akidi Ojii' (17.99).

Number of branches: The number of branches of both cucumber and cowpea varieties were not significantly different (Table 1). Although the number of branches of cucumber and cowpea was not significantly different from each other, numerically intercropped species had higher number of branches than sole crops in both cucumber and cowpea.

Table 1: Effect of intercrop on the shoot emergence pattern, number of branches, leaf area and total number of leaves on both cucumber and cowpea varieties.

Treatments	Shoot emergence pattern	Number of branches	Leaf area (/m ²)	Total number of leaves
Sole Akidi Ocha	0.83	12.33	7.01	37.00
Sole Akidi Ana	0.87	13.00	9.61	39.00
Sole Akidi Ojii	0.87	17.20	9.57	51.60
Sole Cucumber	0.80	15.93	15.90	15.80
Intercropped Akidi Ocha	1.03	17.67	10.11	54.20
Intercropped Akidi Ana	0.37	16.40	10.75	49.20
Intercropped Akidi Ojii	0.37	21.07	9.84	63.20
Cucumber + Akidi Ocha	0.90	17.60	15.51	17.60

Cucumber + Akidi Ana	0.93	15.93	15.89	15.90
Cucumber + Akidi Ojii	0.27	20.27	17.99	20.30
LSD _(0.05)	0.39	NS	3.61	17.08

Total number of leaves: The total number of leaves were significantly different in the intercrop between cucumber and cowpea varieties (Table 1). Intercropped 'Akidi Ocha' recorded the highest number of leaves while the sole cowpea (Akidi Ocha) had the lowest number of leaves. The result clearly showed that intercropped plants performed better than sole crops.

Flower emergence pattern: The intercrop between cucumber and cowpea varieties enhanced flower emergence in both cucumber and cowpea varieties (Table 2). Majority of the intercropped plants had better flower emergence compared to the sole plants. Intercropped cucumber and 'Akidi Ana' recorded the highest while sole cowpea (Akidi Ocha) had the lowest.

Total number of pods /and fruits: The result of the intercrop between cowpea and cucumber showed a

significant increase in the total number of pods and fruits for the different cowpea varieties and cucumber respectively (Table 2). Intercropped 'Akidi Ana' had the highest number of pods compared to the sole cowpea varieties. Total number of fruits in intercropped cucumber followed the same trend the cowpea number of pods. The intercropped cucumber had higher number of fruits compared to the sole cucumber as well.

Total number of cowpea seeds/plant or pod: Number of cowpea seeds increased significantly in an intercrop with cucumber compared to the sole crops (Table 3). Intercropped 'Akidi Ocha' had the highest total number of seeds while sole 'Akidi Ocha' recorded the lowest number of seeds. The intercrops performed better than the sole crops. This may be an indication that there is a synergistic effect between cucumber and cowpea varieties.

Table 2: Effect of intercrop on flower emergence pattern, total number of fruits /and pods on both cucumber and cowpea varieties.

Treatments	Flower emergence pattern	Total number of fruits per plant	Total number of pods per plant
Sole Akidi Ocha	0.83	-	12.33
Sole Akidi Ana	0.87	-	13.00
Sole Akidi Ojii	0.87	-	17.20
Sole Cucumber	0.80	15.93	-
Intercropped Akidi Ocha	1.03	-	17.67
Intercropped Akidi Ana	0.37	-	16.40
Intercropped Akidi Ojii	0.37	-	21.07
Cucumber + Akidi Ocha	0.90	17.60	-
Cucumber + Akidi Ana	0.93	15.93	-
Cucumber + Akidi Ojii	0.27	20.27	-
LSD _(0.05)	0.39	NS	NS

Average cowpea pod weight: The average cowpea pod weight was significantly affected by the intercropping (Table 3). The highest pod weight (0.797g) was intercropped 'Akidi Ojii' while intercropped 'Akidi Ana' had the lowest (0.497g). Compared to sole crop, majority of the intercropped species significantly ($P < 0.05$) performed better.

Cowpea pod length: Cowpea pod length followed the same trend as average cowpea pod weight (Table 3). Intercropped 'Akidi Ocha' recorded the highest pod length (15.30 cm) and the lowest was sole 'Akidi Ana' (5.28 cm).

The intercrops relatively produced longer pod compared to sole cowpea.

Total cowpea pod weight per plant: Total cowpea pod weight per plant was also significantly affected by the intercropping (Table 3). The result showed that intercropped 'Akidi Ocha' had the highest pod weight (21.53 g) followed by the intercropped 'Akidi Ojii' (20.93 g) while sole 'Akidi Ana' had the lowest pod weight (14.20 g). Intercropped plants produced better pod weight than sole plants.

Table 3: Effect of intercrop on total number of cowpea seeds, average pod weight, pod length and total pod weight on the different cowpea varieties.

Treatments	Total number of cowpea seeds per plant	Average pod weight (g)	Pod length (cm)	Total pod weight per plant (g)
Sole Akidi Ocha	127	0.650	5.58	19.60
Sole Akidi Ana	113	0.643	5.28	14.20
Sole Akidi Ojii	141	0.643	6.45	20.43
Intercropped Akidi Ocha	311	0.767	15.30	21.53
Intercropped Akidi Ana	155	0.497	9.55	20.07
Intercropped Akidi Ojii	202	0.797	14.50	20.93
LSD _(0.05)	142.8	0.26	5.35	6.76

Cucumber fruit length: The intercropping significantly increased cucumber fruit length (Table 4). The result of the effect of the intercrop showed that cucumber intercropped with 'Akidi Ana' had the highest fruit length (21.33 cm).

The intercropped plant had significantly longer fruit compared to the sole cucumber. This may be as a result of the nitrates fixed by the companion crop.

Cucumber fruit girth: For cucumber fruit girth, cucumber intercropped with 'Akidi Ocha' recorded the highest fruit girth while the sole cucumber had the lowest fruit girth (Table 4). All the cucumber intercropped with cowpea irrespective of the variety, produced significantly better fruit girth than the sole cucumber.

Average cucumber fruit weight: Cucumber fruit weight was significantly enhanced by the intercrop compared to sole cucumber (Table 4). The result showed that cucumber intercropped with 'Akidi Ana' had significantly the highest

average fruit weight (281.6 g) while sole cucumber had the lowest fruit weight (117.9 g). The cucumber intercropped with the different cowpea varieties produced heavier fruits than the sole crops.

Total fruit weight per plant: Total cucumber fruit weight followed the same trend in average cucumber fruit weight and fruit girth (Table 4). The result showed that cucumber intercropped with cowpea benefited from the companion crop which resulted to the overall fruit weight.

Table 4: Effect of intercrop on cucumber fruit length, fruit girth, average fruit weight and total fruit weight.

Treatments	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Total fruit weight per plant (g)
Sole Cucumber	11.73	9.47	117.9	664
Cucumber + Akidi Ocha	20.47	16.43	261.2	1404
Cucumber + Akidi Ana	21.33	16.17	281.6	1694
Cucumber + Akidi Ojii	20.87	16.23	278.9	1579
LSD _(0.05)	5.69	4.664	64.57	390.40

Weed density and dry matter: The intercrop between cucumber and all the three local varieties of cowpea suppressed both weed density and weed dry matter (Table 5). Cucumber and 'Akidi Ana' intercrop significantly suppressed weed density followed by the intercrop between

cucumber and 'Akidi Ojii' which had better ground cover resulting to significant weed suppression. Baumann *et al.* (2001) reported that canopy suppressive ability is of critical importance in the design of effective weed management strategies.

Table 5: Effect of intercrop on weed density and weed dry matter.

Treatments	Broadleaf (/m ²)	Grass (/m ²)	Sedge (/m ²)	Total weed density (/m ²)	Total weed dry matter (/g)	
					4 WAP	12 WAP
Sole Akidi Ocha	13.50	8.00	5.00	26.50	13.70	18.17
Sole Akidi Ana	6.50	6.00	3.00	15.50	10.80	12.30
Sole Akidi Ojii	7.70	8.50	4.80	21.00	11.40	14.90
Sole Cucumber	6.50	8.00	5.00	19.50	12.40	14.63
Cucumber + Akidi Ocha	6.50	7.00	4.30	18.00	10.30	11.70
Cucumber + Akidi Ana	3.00	4.50	3.00	10.50	7.10	8.57
Cucumber + Akidi Ojii	4.00	5.50	4.50	14.00	9.80	10.50
LSD _(0.05)	0.26	2.20	0.25	1.57	ns	0.56

4. Conclusion

The result obtained from the study indicated that the three varieties of cowpea when intercropped with cucumber performed much better than the sole crops. The yield response of cucumber followed the same trend as that of the cowpea varieties intercropped with cucumber. The intercrop yield of both cowpea varieties and cucumber were higher when compared with the sole cropping and also was able to suppress weed emergence than the sole crops. This is an indication that there is a synergy between cowpea and cucumber intercropping. This study also revealed that the cowpea varieties intercropped with cucumber exhibited a significantly better growth and yield compared to cowpea varieties sown as sole crop.

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