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Yield Response of Cassava-Okra Intercrop as Influenced by Population Densities and Time of Introducing Okra in Makurdi, Nigeria

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ABSTRACT

A field experiment was conducted from June to March in years 2013/2014 and 2014/2015 at the Research Farm, University of Agriculture, Makurdi, Nigeria, to evaluate the yield response of cassava-okra intercrop as influenced by population densities and time of introducing okra, as well as assessing the yield advantages of the intercropping system. The experiment was a 3 x 3 factorial combination of treatments, fitted in a randomized complete block design, with four replications. The population densities of okra (33,333, 40,000 and 50,000 plants ha^{-1} equivalent) into cassava constituted the main plots, while the time of introducing okra into cassava (okra sown at the same time with cassava in mid June; okra introduced into cassava in mid July and okra introduced into cassava in mid August) were assigned to the subplots. Results of study showed that sowing okra at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} produced the highest yields of cassava (46.8 t ha^{-1} and 39.2 t ha^{-1} respectively in years 2013 and 2014) and okra (7.7 t ha^{-1} and 7.5 t ha^{-1} respectively in years 2013 and 2014) in a cassava-okra intercrop. This level of interaction also gave the highest total intercrop yields, highest land equivalent coefficient (LEC) values, highest land equivalent ratio (LER) values of 1.86 and 1.84 and highest percentage (%) land saved (46.2 % and 45.7 %) respectively recorded in years 2013 and 2014. The implication of study showed that it is most advantageous having both crops in intercrop when okra was sown at the same time as cassava in mid June, at the population density of 33,000 plants ha^{-1}. This should therefore be recommended for Makurdi location, Nigeria.

***Keywords*:** intercropping, population density, planting dates, cassava, okra, Guinea savannah, Manihot esculenta, Abelmoschus esculentus, Euphorbiaceae, Malvaceae, Makurdi

1. INTRODUCTION

Cassava (*Manihot esculenta* L. Crantz) is a fibrous edible plant of the spurge family Euphorbiaceae which grows in the tropical and sub-tropical areas of the world (FAO, 2001). The crop spread rapidly and arrived on the coast of Africa via the Gulf of Guinea and the river Congo in the 16th century (Echoi, 2012). It may actually have been introduced to Nigeria over 300 years ago, though its systematic cultivation became generally accepted and integrated into the farming systems of southern Nigeria over 150 years ago (FAO, 2001). Nigeria is currently the world leading producer of cassava (Ibeawuchi, 2007). In the country, the crop ranked first with an annual production of 34 million metric tonnes, followed by yam, sorghum, millet and rice (Olasunkanmi *et al*., 2012).

The tubers consist of almost pure starch, the leaves have been found to contain about 17 % protein and therefore a good source of protein in the diet of man and most ruminant animals. The tuber flesh is composed of about 62 % water, 35 % carbohydrate, 1-2 % protein, 0.3 % fat, 1-2 % fibre and 1 % mineral matter (Echoi, 2012).

Okra (*Abelmoschus esculentus* (L) Moench) is an herbaceous, hairy, annual plant of the mallow family Malvaceae and a popular vegetable crop which is grown all the year round for its good nutritional value (Clementine *et al*., 2009). The world's production of okra is 6 million tonnes ha^{-1} (Iyagba *et al*., 2012). It is an important crop grown in Nigeria for its edible tender fresh pods. The crop ranked third following tomato and pepper in terms of consumption and production area (Ibeawuchi *et al*., 2005). The immature pods are very rich in vitamins A, B and C, calcium, potassium and other vital minerals. The pods are consumed as boiled vegetable, while its dried form is used as soup thickener or in stews (Muoneke *et al*., 2007).

Studies have been conducted on sole cassava and sole okra as affected by population density and planting dates aimed at improving the productivity of both crops (Yadev and Dhanker, 2002). Research works have also been carried out as it relates to cassava-okra intercrop as influenced by okra planting density in the humid rain forest agro-ecological zone of Nigeria (Muoneke *et al*., 2007). Though farmers in Makurdi, a location in the southern Guinea savannah of Nigeria intercrop cassava and okra, there is paucity of information on the optimal planting density and appropriate time of introducing okra in a cassava-okra intercrop. The study was therefore designed with the aim of evaluating the yield response of cassava-okra intercrop as influenced by population densities and time of introducing okra, with the objectives of identifying the optimal planting density and appropriate time of introducing okra that will maximize intercrop yields of cassava and okra, as well as assess the yield advantages of the intercropping system.

2. MATERIALS AND METHODS

2. 1. Experimental site, varieties and source of planting materials

The experiments were conducted from June to March in years 2013/2014 and 2014/2015, at the University of Agriculture Teaching and Research Farm, Makurdi, Nigeria, to evaluate the yield response of cassava-okra intercrop as influenced by population densities and time of introducing okra. The okra variety 'NHAe47-4' was obtained from the National Institute of Horticultural Research and Training (NIHORT), Ibadan, Nigeria, while the cassava variety 'TMS 98/0581' was obtained from the National Root Crops Research Institute (NRCRI), Umudike, Nigeria. The varieties of both crops show good adaptation to Makurdi environment.

2. 2. Experimental design, plot size and treatments

The experiment was a 3 x 3 factorial combination of treatments, fitted in a randomized complete block design, replicated four times. The population densities of okra (33,333, 40,000 and 50,000 plants ha^{-1} equivalent) into cassava constituted the main plots, while the time of introducing okra into cassava (okra sown with cassava at the same time in mid June; okra introduced into cassava in mid July; okra introduced into cassava in mid August) were assigned to the subplots. The experimental area cultivated was 665.0 m^2 (0.067 hectares equivalent), and consisted of 44 treatment plots. Each plot had an area of 12.0 m^2.

2. 3. Land preparation and planting

The experimental field was cleared, ploughed, harrowed and ridged. Each plot consisted of 4 ridges. In sole cassava plot, each ridge consisted of 4 cassava stands at an intra-row spacing of 1m. A total of 16 cassava stands were sown in each plot (10,000 cassava plants ha^{-1} equivalent). In the sole okra plot, 10 okra stands were sown on a ridge at an intra-row spacing of 30 cm (Ijoyah *et al*., 2010), giving a total of 40 okra stands per plot (33,333 okra stands ha^{-1} equivalent). In the sole plots, cassava and okra were planted in a single row, on top of the ridge, at the recommended population densities and time of planting, while in the intercrop plots, cassava was sown in a single row on top of the ridge, while okra was sown by the side of the ridge, but at the varied population densities and different time of introduction.

2. 4. Cultural practices

Weeding was done with the native hoe as the need arose. The recommended rate for mixed fertilizer NPK (15:15:15) for sole okra at the rate of 100 kg ha^{-1} as described by Ekpete (2000); for sole cassava: mixed fertilizer (NPK 20:10:10) was applied at the rate of 100 kg ha^{-1}; and for cassava-okra intercrop: 120 kg N ha^{-1}, 120 kg P ha^{-1} and 120 kg K ha^{-1} were applied (Enwezor *et al*., 1989). The band method of fertilizer application was employed. The fertilizer was applied twice to each plot, at 4 and 8 weeks after planting (WAP).

2. 5. Harvesting

Harvesting of okra was done when the tip of pod was observed to break easily when pressed with the finger tip (Usman, 2001). Cassava was harvested at 36 WAP, when the leaves were observed to dry, turn yellowish and fallen off, which were signs of senescence and tuber maturity (Ijoyah *et al*., 2012).

2. 6. Data collection

Data were collected on the following:

2. 6. 1. Okra

Days to attain 50 % flowering was taken by counting the number of days from when crop was sown to when 50 % plants flowered; plant height (cm) taken at 50 % flowering was measured as the distance from the soil surface to the tip of the topmost leaf. This was obtained from a sample of 4 plants in each plot and averaged. The number of branches and number of leaves per plant were also measured. Leaf area (cm^2) was measured as described by Breda (2003) using the length-width method (L x W), where L is the leaf length and W is the largest width of the leaf. The number of fresh pods per plant at 1st, 2nd and 3rd harvests were obtained from each plot. The pod length and pod diameter were also measured in cm. Fresh okra was harvested and weighed for pod weight (g) and total pods for each net plot area were also harvested and weighed for total yield converted to t ha^{-1}.

2. 6. 2 Cassava

Plant height taken at 8, 12 and 16 WAP, number of branches per plant at 8, 12 and 16 WAP, number of leaves per plant, leaf area (cm^2) at 8, 12 and 16 WAP, number of tubers per plant, tuber length, tuber diameter (cm), tuber weight and tuber yield (t ha^{-1}).

2. 7. Statistical Analysis

Analysis of variance (ANOVA) for factorial experiment was carried out on each observation for each year and the Least significant difference (LSD) was used for means separation ($P \leq 0.05$) following the procedure of Steel and Torrie (1980). Main treatment effect and the interaction were also determined.

2. 8. Evaluation of yield advantages in intercropping

The land equivalent ratio (LER) was determined as described by Willey (1985) using the formula:

$$LER = \frac{Intercrop\ yield\ of\ crop\ A}{Sole\ crop\ yield\ of\ A} + \frac{Intercrop\ yield\ of\ crop\ B}{Sole\ crop\ yield\ of\ B}$$

The competitive ratio (CR) as described by Willey and Rao (1980) was determined using the formula:

$$CR = Lc/Lo,$$

where; Lc: Partial LER for cassava; Lo: Partial LER for okra.

The percentage (%) land saved as described by Willey (1985) using the formula:

$$\%\ \text{land saved} = 100 - 1/LER\ X\ 100$$

Aggressivity (A) gives a simple measure of how much the relative yield increase in component ‘a’ is greater than that for component ‘b’ as described by McGilchrist (1971) using the formula:

$$A = \frac{Mixture\ yield\ of\ 'a'}{Expected\ yield\ of\ 'a'} - \frac{Mixture\ yield\ of\ 'b'}{Expected\ yield\ of\ 'b'}$$

where: A = 0: indicates that both crops are equally competitive; A = - : indicates dominated component A = + : indicates dominant component

The land equivalent coefficient (LEC) as described by Adetiloye *et al*., (1983) was determined using the formula:

$$LEC = La \; x \; Lb;$$

where La: LER of main crop; Lb: LER of intercrop.

These calculations were used to assess the yield advantages of the intercropping system.

3. RESULTS AND DISCUSSION

3. 1. Growth and yield of cassava in a cassava-okra intercrop as influenced by population densities and time of introducing okra

Plant height of cassava recorded at 8, 12 and 16 WAP were not significantly ($P \leq 0.05$) affected by the varied population densities of okra (Table 1). Cassava heights at 8, 12 and 16 WAP significantly ($P \leq 0.05$) increased as time of introducing okra into cassava advanced (Table 1). The highest cassava heights were obtained when okra was introduced into cassava in mid August. The highest cassava heights taken at 16 WAP (178.3 cm and 125.7 cm, respectively in years 2013 and 2014), were obtained when okra was introduced into cassava in mid August, at the population density of 50,000 plants ha^{-1} (Table 2). This result agreed with Uzozie (2001) who reported increase in cassava heights as time of introducing okra into cassava advanced in a rain forest location, Nigeria. Muoneke and Asiegbu (1997) reported increase in cassava height prompted by increase in population density of intercropped maize. They linked this to competition for light which was intensified at higher densities of maize in a cassava-maize intercrop.

Table 1. Main effects of population densities of okra and time of introducing okra on cassava plant height at 8, 12 and 16 WAP and number of branches per cassava plant at 16 WAP in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Plant height (cm) at 8 WAP		Plant height (cm) at 12 WAP		Plant height (cm) at 16 WAP		Number of branches per plant at 16 WAP	
	2013	2014	2013	2014	2013	2014	2013	2014
33,333	44.1	48.3	59.7	70.8	121.7	96.0	1.5	1.7
40,000	41.2	51.9	64.0	70.8	124.6	95.8	1.5	2.1
50,000	39.8	52.8	65.4	84.8	130.8	104.7	1.7	2.3
LSD ($P \leq 0.05$)	4.1	8.1	5.5	9.9	13.8	10.6	0.1	0.5
Time of introducing okra								
Mid June	39.0	44.2	54.5	64.1	95.7	88.4	1.5	1.5
Mid July	42.3	50.5	63.6	76.3	111.1	94.0	1.5	2.0

Mid August	43.8	58.3	71.0	86.1	160.3	114.2	1.7	2.8
LSD (P ≤ 0.05)	2.4	2.0	5.2	3.5	14.3	4.9	0.1	0.2

WAP: weeks after planting; C: cassava; O: okra

Table 2. Interaction of population densities of okra x time of introducing okra on cassava plant height at 8,12 and 16 WAP and number of branches per cassava plant at 16 WAP in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Plant height (cm) at 8 WAP		Plant height (cm) at 12 WAP		Plant height (cm) at 16 WAP		Number of branches per plant at 16 WAP	
		2013	2014	2013	2014	2013	2014	2013	2014
33,333	Mid June	40.9	43.9	48.4	57.7	95.6	86.1	1.4	1.3
	Mid July	45.9	46.8	61.8	73.3	110.0	92.6	1.5	1.6
	Mid August	45.3	54.3	68.9	81.4	159.3	109.4	1.7	2.3
40,000	Mid June	38.1	42..7	50.7	65.1	92.1	88.3	1.6	1.4
	Mid July	42.6	51.2	66.8	70.4	108.2	91.7	1.5	2.1
	Mid August	42.9	61.8	74.7	76.9	143.3	107.4	1.6	2.9
50,000	Mid June	38.1	46.1	62.4	69.4	99.2	90.9	1.6	1.8
	Mid July	38.3	53.4	64.5	85.2	114.9	97.6	1.6	2.2
	Mid August	43.1	58.7	69.4	99.9	178.3	125.7	1.9	3.1
LSD (P ≤ 0.05)		14.9	18.2	5.6	10.3	9.3	5.3	0.2	0.6

WAP: weeks after planting

The highest number of branches per plant at 16 WAP (1.9 and 3.1, respectively in years 2013 and 2014), were also obtained when okra was introduced into cassava in mid August, at the population density of 50,000 plants ha^{-1} (Table 2).

Although, in both years, number of cassava leaves per plant at 16 WAP increased as population densities of okra increased and as time of introducing okra into cassava advanced (Table 3), however, number of cassava leaves per plant was not significantly ($P \leq 0.05$) affected by the main effects of the two factors studied (Table 3). Similarly, the interaction of population densities of okra x time of introducing okra did not significantly ($P \leq 0.05$) affect number of leaves per cassava plant at 16 WAP (Table 4).

Increasing the population density of okra from 33,333 plants ha^{-1} to 50,000 plants ha^{-1} significantly ($P \leq 0.05$) increased the leaf area of cassava at 16 WAP (Table 3). The largest leaf area of cassava at 16 WAP, was obtained when okra was sown into cassava at the population density of 33,333 plants ha^{-1} (Table 3). The lowest competition for growth resources which might have occurred at the lower intercropped okra density of 33,333 plants ha^{-1} could be attributed to the largest leaf area of cassava obtained. Muoneke *et al*., (2007) also reported that increasing the population density of okra in a cassava-okra intercrop, reduced the leaf area of cassava. Planting okra at the same time as cassava in mid June gave the largest leaf area of cassava (227.2 cm^2 and 222.9 cm^2) respectively in years 2013 and 2014, significantly ($P \leq 0.05$) larger than when okra was introduced into cassava in mid July and mid August (Table 3). Ijoyah and Jimba (2011) reported that okra sown at the same time as sweet potato produced larger leaf area of sweet potato as compared to that obtained from sweet potato with okra introduced at later dates. Planting okra at the same time as cassava in mid June, at the okra population density of 33,333 plants ha^{-1}, produced the largest leaf area of cassava (230.7 cm^2 and 230.0 cm^2) respectively, in years 2013 and 2014 (Table 4).

Number of tubers significantly ($P \leq 0.05$) decreased with increase in population density of okra from 33,333 plants ha^{-1} to 50,000 plants ha^{-1} (Table 3). The highest number of tubers was produced when okra was sown in the intercrop at the population density of 33,333 plants ha^{-1}. Mbah (2007) reported improved performance of main crops with low plant densities of component crops. Ezumah and Namky (1984) also reported a reduction in number of tubers as okra density increased from 14,000 to 56,000 plants ha^{-1}.

They attributed this to greater competition for growth resources at higher plant densities. Number of tubers per plant significantly ($P \leq 0.05$) decreased as time of introducing okra in the intercrop advanced (Table 4). Planting okra at the same time as cassava in mid June produced the highest number of tubers in both years (Table 4).

Table 3. Main effects of population densities of okra and time of introducing okra on number of cassava leaves per plant at 16 WAP, leaf area of cassava at 16 WAP and number of tubers per plant at harvest in years 2013 and 2014 at Makurdi, Nigeria.

Population of densities of okra	Number of cassava leaves per plant at 16 WAP		Leaf area (cm^2) of cassava at 16 WAP		Number of tubers per plant at harvest	
	2013	2014	2013	2014	2013	2014
33,333	59.0	60.5	220.8	211.0	7.8	7.7
40,000	63.7	65.8	216.2	204.1	7.3	6.7
50,000	59.1	70..4	212.8	175.0	6.5	5.9
LSD ($P \leq 0.05$)	15.2	14.8	2.3	5.6	0.4	0.7
Time of introducing okra						
Mid June	56.0	63.7	227.2	222.9	8.0	7.9
Mid July	60.7	74.4	221.1	206.8	7.2	6.9
Mid August	65.0	79.7	204.4	170.4	6.5	5.8
LSD ($P \leq 0.05$)	12.7	12.5	4.9	6.8	0.3	0.4

WAP: weeks after planting

Table 4. Interaction of population densities of okra x time of introducing okra on number of cassava leaves per plant at 16 WAP, leaf area of cassava at 16 WAP and number of tubers per plant at harvest in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Time of introducing okra	Number of cassava leaves per plant at 16 WAP		Leaf area (cm^2) cassava at 16 WAP		Number of tubers per plant at harvest	
		2013	2014	2013	2014	2013	2014
33,333	Mid June	54.2	56.3	230.7	230.0	8.3	8.3
	Mid July	62.3	60.9	220.8	211.6	7.3	7.6
	Mid August	60.4	64.1	208.5	191.5	6.6	7.3
40,000	Mid June	58.9	56.9	226.3	227.3	8.1	7.9
	Mid July	63.9	64.4	218.7	216.3	7.2	6.9
	Mid August	68.4	68.3	199.6	198.7	6.6	5.3
50,000	Mid June	55.0	77.2	225.3	211.5	7.5	7.7
	Mid July	56.0	79.2	216.9	192.5	7.1	6.2
	Mid August	66.3	80.4	205.3	121.0	6.2	4.9
LSD ($P \leq 0.05$)		16.0	15.5	3.8	6.2	0.2	0.4

WAP: weeks after plantings

The greater shading effect of okra when introduced at later dates into cassava, might have limited the phothosynthetic efficiency of the intercropped cassava, thus reducing tuber number. Number of tubers produced when okra was planted at the same time as cassava in mid June significantly ($P \leq 0.05$) increased by 10.0 % and 12.7 % respectively, in years 2013 and 2014, as compared to when okra was introduced into cassava in mid July, and by 18.8 % and 26.6 % respectively, in years 2013 and 2014, as compared to when okra was introduced into cassava in mid August. Planting okra at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} produced the highest number of tubers per plant at harvest in both years (Table 4).

Tuber length significantly ($P \leq 0.05$) reduced as okra population density in the intercrop increased from 33,333 plants ha^{-1} to 50,000 plants ha^{-1} (Table 5). Tuber length significantly ($P \leq 0.05$) decreased as time of introducing okra in the intercrop progressed (Table 5). Highest tuber length was produced from cassava sown at the same time as okra in mid June. The low light intensity on cassava due to the greater shading effect of okra at later introduction dates could be responsible for the decrease in tuber length. Sowing okra at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} produced the highest tuber length of 43.8 cm and 55.8 cm respectively, in years 2013 and 2014 (Table 6). Tuber diameter was neither affected by the varied population densities of intercropped okra nor by the varied time of introducing okra into cassava. (Table 5). The interaction of population density of okra x time of introducing okra into cassava did not significantly ($P \leq 0.05$) affect tuber diameter (Table 6).

Table 5. Main effects of population densities of okra and time of introducing okra on tuber length at harvest, tuber diameter at harvest and tuber weight at harvest in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Tuber length (cm) at harvest		Tuber diameter (cm) at harvest		Tuber weight (kg) at harvest	
	2013	2014	2013	2014	2013	2014
33,333	40.8	44.7	17.8	18.0	0.25	0.27
40.000	36.0	42.1	17.8	18.0	0.17	0.20
50.000	30.6	35..7	18.0	16.8	0.14	0.15
LSD ($P \leq 005$)	3.0	2.5	4.9	6.7	0.02	0.05
Time of introducing okra						
Mid June	38.2	52.9	18.1	17.5	0.26	0.24
Mid July	35.5	43.5	17.9	16.9	0.18	0.17
Mid August	31.6	36.1	17.6	16.2	0.13	0.10
LSD ($P \leq 0.05$)	1.6	2.6	8.7	10.6	0.04	0.02

Table 6. Interaction of population densities of okra x time of introducing okra on tuber length at harvest, tuber diameter at harvest and tuber weight at harvest in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Time of introducing okra	Tuber length (cm) at harvest		Tuber diameter (cm) at harvest		Tuber weight (kg) at harvest	
		2013	2014	2013	2014	2013	2014
33.333	Mid June	43..8	55.8	18.2	18.4	0.26	0.27
	Mid July	37.0	41.9	18.2	18.3	0.14	0.15
	Mid August	33.9	36.4	17.1	17.3	0.13	0.13
40.000	Mid June	38.7	47.8	18.3	18.4	0.18	0.19
	Mid July	38.2	43.4	17.6	17.5	0.16	0.15
	Mid August	34.3	34.9	17.6	16.8	0.14	0.13
50,000	Mid June	33.8	55.1	17.7	17.1	0.16	0.18
	Mid Juiy	31.3	45.1	17.8	16.9	0.13	0.16
	Mid August	26.6	36.9	18.4	16.3	0.12	0.11
LSD ($P \leq 0.05$)		3.5	4.2	5.3	4.1	0.01	0.02

Increasing the population density of okra up to 50,000 plants ha^{-1} in the cassava-okra intercrop significantly ($P \leq 0.05$) reduced tuber weight (Table 5). The highest tuber weight was obtained with the planting of okra at the density of 33,333 plants ha^{-1}. Sowing okra at the same time as cassava in mid June produced the highest tuber weight of 0.26 kg and 0.24 kg respectively, in years 2013 and 2014 (Table 5). The highest tuber weights obtained when okra was sown in the intercrop at the density of 33,333 plants ha^{-1} and at when okra was sown at the same time with cassava in mid June could have been influenced by the number of tubers per plant produced at those treatment levels. Planting okra at the same time as cassava in mid June and at the population density of 33,333 plants ha^{-1} produced the highest tuber weights in both years (Table 6).

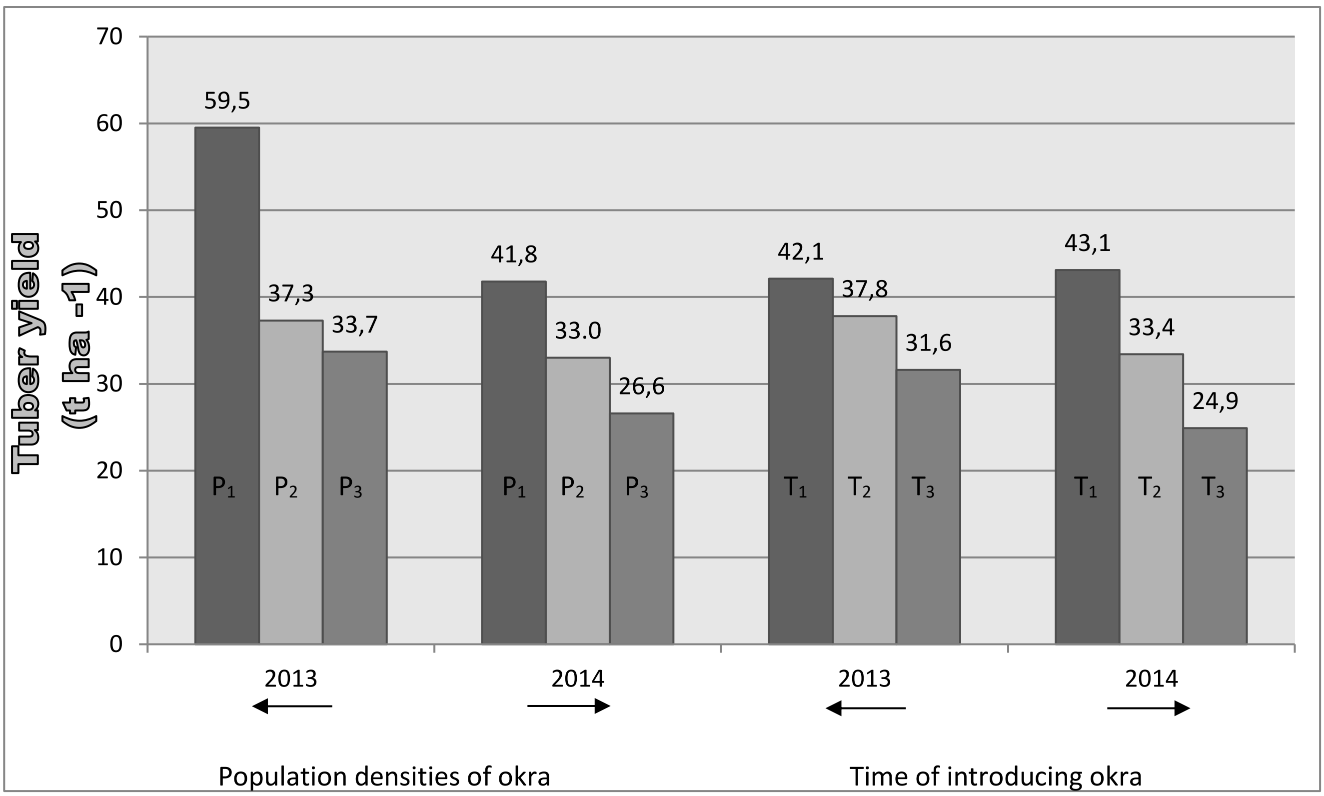

Fig 1. Main effects of population densities of okra and time of introducing okra on tuber yield (t ha^{-1}) in a cassava-okra intercrop in years 2013 and 2014 at Makurdi, Nigeria.

P_1: Okra at density of 33,333 plants ha^{-}1
P_2: Okra at density of 40,000 plants ha^{-}1
P_3: Okra at density of 50,000 plants ha^{-}1

T_1: Okra introduced into cassava in mid June
T_2: Okra introduced into cassava in mid July
T_3: Okra introduced into cassava in mid August

In both years, tuber yield decreased as population density of okra increased from 33,333 plants ha^{-1} to 50,000 plants ha^{-1} (Fig. 1). This result agreed with Muoneke and Asiegbu (1997) who reported that cassava root yield declined as maize population density increased in a cassava-maize intercrop. They attributed this to the depression of the early cassava growth by the vigorous maize component, thereby reducing the amount of assimilate allocated to cassava roots.

The highest tuber yields of 39.5 t ha^{-1} and 41.8 t ha^{-1} respectively, in years 2013 and 2014 were produced from cassava with okra sown at the population density of 33,333 plants ha^{-1}. Sowing okra at same time with cassava in mid June increased tuber yield by 10.2 % and 22.5 % respectively in years 2013 and 2014, as compared to when okra was introduced in the intercrop in mid July, and by 24.9 % and 42.2 %, as compared to when okra was introduced in the intercrop in mid August (Fig. 1). The largest leaf area for cassava recorded at 16 WAP and highest number of tubers produced from cassava with okra sown at the population density of 33,333 plants ha^{-1}, and at the period of planting okra same time with cassava in mid June, could be linked to the highest tuber yields obtained at those treatment levels.

3. 2. Growth and yield of okra in a cassava-okra intercrop as influenced by population densities and time of introducing okra

Although, days to attain 50 % flowering for okra was not significantly ($P \leq 0.05$) affected by the varied population densities of okra in the cassava-okra intercrop, however, okra height and number of branches per okra plant significantly ($P \leq 0.05$) reduced as population density of okra increased from 33,333 plants ha^{-1} to 50,000 plants ha^{-1} (Table 7). Majnoun *et al*., (2001) reported that plant height and number of branches of soybean decreased with increase in plant population density up to 1,034,000 plants ha^{-1}. Okra height, number of branches per okra plant and number of okra leaves per plant at 50 % flowering significantly ($P \leq 0.05$) decreased in both years as time of introducing okra into cassava advanced (Table 7).

Table 7. Main effects of population densities of okra and time of introducing okra on days to attain 50 % flowering for okra, plant height of okra at 50 % flowering, number of branches per plant at 50 % flowering and number of okra leaves per plant at 50 % flowering in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Days to attain 50 % flowering for okra		Plant height of okra at 50 % flowering		Number of branches per plant at 50 % flowering		Number of okra leaves per plant at 50 % flowering	
	2013	2014	2013	2014	2013	2014	2013	2014
33,333	67.3	67.2	86.4	91.6	7.6	7.9	22.6	25.6
40,000	66.7	66.4	84.2	86.0	6.2	6.8	18.5	20.4
50,000	66.2	66.0	74.0	74.2	5.0	5.2	17.2	17.0
LSD ($P \leq 0.05$)	4.5	5.6	1.5	4.6	0.5	0.7	10.4	15.2
Time of introducing okra								
Mid June	68.4	68.0	92.6	98.2	7.2	7.6	24.8	25.8
Mid July	67.2	67.1	85.1	86.0	4.2	4.3	18.2	18.4
Mid August	66.0	66.8	65.2	71.4	3.0	3.1	15.3	16.2
LSD ($P \leq 0.05$)	6.2	8.2	2.5	4.3	1.1	0.8	2.3	2.1

Tsefu and Yamoah (2010) reported that number of branches per carrot plant decreased as sowing dates progressed. The highest number of okra leaves produced when okra was sown at the same time as cassava in mid June could be linked to the highest number of branches produced at same period. Ozer (2003) reported that increase in branching could be a major cause in the increase in number of leaves. The tallest okra height, highest number of branches per plant and highest number of okra leaves per plant were obtained from okra sown with cassava at the same time in mid June, at the population density of 33,333 plants ha^{-1} (Table 8).

Table 8. Interaction effects of population densities of okra x time of introducing, okra on days to attain 50 % flowering for okra, plant height of okra at 50 % flowering, number of branches per plant at 50 % flowering and number of leaves per plant at 50 % flowering in years 2013 and 2014, at Makurdi Nigeria.

Population density of okra	Time of introducing okra	Days to attain 50 % flowering for okra		Plant height (cm) of okra at 50 % flowering		Number of branches per plant at 50 % flowering		Number of leaves per plant at 50% flowering	
		2013	2014	2013	2014	2013	2014	2014	2015
33,333	Mid June	68.5	68.2	94.7	99.6	7.9	7.7	33.8	34.6
	Mid July	68.2	68.0	90.2	94.2	6.5	6.2	24.2	25.2
	Mid August	67.4	67.8	68.0	70.1	5.0	5.1	22.1	21.1
40,000	Mid June	66.5	67.5	92.7	98.4	6.5	5.4	21.8	22.8
	Mid July	67.3	67.2	87.1	80.1	5.2	5.0	18.7	18.7
	Mid August	66.4	67.0	81.0	72.4	3.0	3.1	17.2	17.1
50,000	Mid June	67.1	67.5	71.2	82.6	5.2	5.0	18.8	19.8
	Mid July	65.4	66.1	65.7	66.7	4.2	4.0	16.2	16.4
	Mid August	66.2	66.0	60.1	60.4	2.8	3.0	15.0	15.1
LSD ($P \leq 0.05$)		7.2	9.4	2.4	3.2	0.5	0.2	2.6	3.2

Leaf area of okra and number of pods per plant at 1st, 2nd and 3rd harvests reduced as population density of okra in the intercrop increased up to 50,000 plants ha^{-1} in both years (Table 9). The lowest competition for growth resources which might have occurred at the reduced okra density of 33,333 plants ha^{-1} could have promoted the largest leaf area and highest number of pods at 1st, 2nd and 3rd harvests. This view agreed with Muoneke and Mbah (2007) who reported that in the rain forest zone, leaf area of okra and number of pods in the cassava-okra intercrop decreased as okra density increased. The largest leaf area of okra (378.4 cm^2 and 395.9 cm^2 respectively, in years 2013 and 2014) and highest number of pods at 1st, 2nd and 3rd harvest were produced from okra sown into cassava at the density of 33,333 plants ha^{-1} (Table 9). Sowing okra at the same time as cassava in mid June produced the largest leaf area and highest number of pods per plant (Table 9). Turk *et al.*, (2003) reported that late planting reduced the number of lentil pods per plant. Okra sown at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} gave the largest leaf area and highest number of pods per plant at 1st, 2nd and 3rd harvests (Table 10).

Pod length at 1st, 2nd and 3rd harvests reduced as population densities of intercropped okra increased up to 50,000 plants ha^{-1} (Table 11). Similarly, pod length at 1st, 2nd and 3rd harvests significantly ($P \leq 0.05$) reduced as time of introducing okra into cassava advanced (Table 11). Planting okra at the same time as cassava in mid June, at the density of 33,000 plants ha^{-1} gave the highest pod length for each harvest (Table 12).

Table 9. Main effects of population densities of okra x time of introducing okra on leaf area of okra at 50 % flowering and number of pods per plant at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Leaf area ofokra (cm^2) at 50 % flowering		Number of pods per plant at 1st harvest		Number of pods per plant at 2nd harvest		Number of pods per plant at 3rd harvest	
	2013	2014	2013	2014	2013	2014	2013	2014
33,333	378.4	395.9	27.8	26.3	25.7	25.6	20.8	19.2
40,000	363.2	365.2	24.0	22.1	22,.4	21.5	15.4	13.0
50,000	305.1	296.1	20.0	19.3	18.0	18.1	10.2	9.1
LSD ($P \leq 0.05$)	7.5	9.2	2.2	1.1	2.0	1.5	3.6	2.7
Time of introducing okra								
Mid June	389.7	477.6	26.6	27.5	24.7	24.9	18.7	17.5
Mid July	282.3	368.1	22.7	23.0	20.5	20.0	10.5	9.2
Mid August	278.1	365.0	19.2	19.0	17.0	16.2	6.3	4.0
LSD ($P \leq 0.05$)	8.2	10.1	2.0	2.5	2.3	3.0	3.2	4.1

Table 10. Interaction effects of population densities of okra x time of introducing okra on leaf area of okra at 50 % flowering and number of pods per plant at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Time of introducing okra	Leaf area of okra (cm^2) at 50 % flowering		Number of pods per plant at 1st harvest		Number of pods per plant at 2nd harvest		Number of pods per plant at 3rd harvest	
		2013	2014	2013	2014	2013	2014	2014	2013
33,333	Mid June	478.3	498.2	27.3	28.4	26.2	26.7	17.7	15.8
	Mid July	408.2	418.5	25.0	25.2	23.1	23.0	10.2	10.0
	Mid August	370.1	380.4	22.0	22.1	20.0	19.0	6.2	6.3

40,000	Mid June	318.4	327.4	24.4	24.2	22.7	22.9	13.6	13.4
	Mid July	302.2	294.1	21.0	21.0	18.4	17.2	8.4	7.0
	Mid August	273.0	253.6	18.0	18.1	15.0	13.1	5.2	5.0
50,000	Mid June	310.2	325.5	23.7	23.9	20.9	20.7	9.6	8.5
	Mid July	274.0	262.3	18.0	19.2	15.4	16.2	5.3	5.0
	Mid August	240.1	226.8	17.2	17.0	12.0	12.1	3.0	2.5
LSD ($P \leq 0.05$)		8.3	10.4	1.8	1.4	2.2	2.0	2.4	2.1

Table 11. Main effects of population densities of okra and time of introducing okra on pod length at 1st, 2nd and 3rd harvests in years 2013 and 2104 at Makurdi, Nigeria.

Population density of okra	Pod length(cm) at 1st harvest		Pod length (cm) at 2nd harvest		Pod length (cm) at 3rd harvest	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**
33,333	12.8	12.7	9.8	10.7	7.8	7.8
40,000	12.1	12.0	9.1	9.0	7.0	7.0
50,000	11.3	11.6	8.3	8.6	5.2	5.4
LSD ($P \leq 0.05$)	0.4	0.2	0.5	0.7	0.5	0.3
Time of introducing okra						
Mid June	12.6	12.8	9.6	9.8	7.5	7.6
Mid July	11.3	11.7	8.3	7.7	6.2	5.6
Mid August	10.1	10.3	7.1	6.3	5.0	4.5
LSD ($P \leq 0.05$)	0.3	0.5	0.2	0.4	0.8	0.6

The longer vegetative period derived from early introduction of okra (mid June) into cassava and the decrease in the competition for nutrients and water, resulting from lower okra density (33,333 plants ha^{-1}) could have promoted the highest pod length produced from the interaction of population density of okra x time of introducing okra in the intercrop.

Although, pod diameter at 1st, 2nd and 3rd harvests were not significantly ($P \leq 0.05$) affected by the varied population densities of okra, however, okra sown at the same time as cassava in mid June significantly ($P \leq 0.05$) produced the highest pod diameter at 1st, 2nd and 3rd harvests, as compared to the rest introduction dates of okra into cassava (Table 13). This result agreed with Shad *et al*., (2010) who reported that the delay in time of sowing faba bean promoted the reduction in the size of the pods. The highest pod diameter at 1st, 2nd and 3rd harvests was obtained from okra sown at the same time as cassava in mid June, at the population density of 33,000 plants ha^{-1} (Table 14).

Table 12. Interaction effects of population densities of okra x time of introducing okra on pod length at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population densities of okra	Time of introducing okra	Pod length (cm) at 1st harvest		Pod length (cm) at 2nd harvest		Pod length (cm) at 3rd harvest	
		2014	2013	2014	2013	2014	2013
33,333	Mid June	12.1	12.7	9.8	9.7	7.6	7.5
	Mid July	11.0	11.1	8.0	8.0	7.0	6.8
	Mid August	10.5	10.2	7.5	7.2	6.2	6.0
40,000	Mid June	10.7	10.5	7.7	7.5	6.4	6.0
	Mid July	8.0	9.8	6.0	7.8	5.0	5.2
	Mid August	7.0	8.6	5.0	6.6	4.1	4.0
50, 000	Mid June	8.0	8.1	6.0	6.1	5.2	5.0
	Mid July	7.3	7.2	5.3	5.2	4.1	4.0
	Mid August	7.1	6.0	5.1	4.0	4.0	3.6
LSD ($P \leq 0.05$)		0.2	0.4	0.3	0.5	0.4	0.2

Table 13. Main effects of population densities of okra and time of introducing okra on pod diameter at 1st, 2nd and 3rd harvests in years 2013 2014 at Makurdi, Nigeria.

Population densities of okra	Pod diameter (cm) at 1st harvest		Pod diameter (cm) at 2nd harvest		Pod diameter at 3rd harvest	
	2014	2013	2014	2013	2013	2014
33,333	7.1	6.2	6.4	6.2	5.4	5.0
40,000	7.0	6.7	6.0	5.5	4.2	4.0
50.000	7.0	6.4	6.0	5.0	4.0	4.0
LSD ($P \leq 0.005$)	5.8	4.2	4.8	3.7	8.3	10.2
Time of introducing okra						
Mid June	8.4	8.6	7.2	7.0	5.2	5.1
Mid June	6.9	6.5	5.2	5.0	3.2	3.1
Mid August	5.8	5.2	4.0	4.1	2.6	2.4
LSD ($P \leq 0.005$)	0.3	0.5	0.2	0.4	0.5	0.3

Table 14. Interaction effects of population densities of okra x time of introducing okra on pod diameter at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Pod diameter (cm) at 1st harvest		Pod diameter (cm) at 2nd harvest		Pod diameter (cm) at 3rd harvest	
		2013	2014	2013	2014	2013	2014
33,333	Mid June	8.6	9.4	7.4	7.2	5.3	5.1
	Mid July	8.5	8.2	6.2	6.0	4.3	4.2
	Mid August	8.2	7.8	6.0	5.7	3.8	3.4
40,000	Mid June	6.9	7.0	5.2	5.0	4.2	4.0
	Mid July	6.0	6.2	4.5	4.3	3.7	3.4
	Mid August	5.2	6.0	4.0	3.8	3.1	3.0
50,000	Mid June	6.0	6.2	4.6	4.4	3.5	3.4
	Mid July	5.7	5.0	3.5	3.2	2.6	2.5
	Mid August	5.0	5.0	3.2	3.0	2.1	2.0
LSD ($P \leq 0.05$)		0.2	0.3	0.5	0.2	0.3	0.4

Table 15. Main effects of population densities of okra and time of introducing okra on pod weight at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Pod weight (g) at 1st harvest		Pod weight (g) at 2nd harvest		Pod weight (g) at 3rd harvest	
	2013	2014	2013	2014	2013	2014
33,333	17.6	19.2	15.4	15.2	12.5	12.7
40,000	14.3	16.0	12.1	12.0	9.4	9.2
50,000	12.0	13.0	10.1	9.7	6.4	6.0
LSD ($P \leq 0.05$)	1.3	2.2	1.6	2.5	1.4	1.3
Time of introducing okra						
Mid June	18.0	19.0	16.4	16.8	13.5	13.2
Mid July	15.3	14.2	13.2	13.0	10.2	10.0
Mid August	10.0	12.1	9.5	9.4	7.0	6.8
LSD ($P \leq 0.05$)	2.5	1.6	2.2	1.8	2.4	1.6

Table 16. Interaction effects of population densities of okra x time of introducing okra on pod weight at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Pod weight (g) at 1st harvest		Pod weight (g) at 2nd harvest		Pod weight (g) at 3rd harvest	
		2013	2014	2013	2014	2013	2014
33,333	Mid June	16.3	16.2	13.2	13.0	10.5	10.7
	Mid July	13.7	13.0	9.7	9.0	7.4	7.1
	Mid August	13.0	12.2	8.4	8.2	6.0	6.0
40,000	Mid June	14.7	14.1	11.5	11.7	7.4	7.2
	Mid July	11.3	11.0	8.4	8.0	5.4	5.2
	Mid August	9.2	9.0	6.3	6.0	3.4	3.3
50,000	Mid June	13.6	13.4	9.4	9.5	5.2	5.2
	Mid July	10.2	10.0	6.2	6.1	3.1	3.2
	Mid August	8.1	8.0	5.1	5.0	2.6	2.8
LSD ($P \leq 0.05$)		1.4	1.8	1.3	1.1	1.5	0.6

Table 17. Main effects of population densities of okra and time of introducing okra on pod yield at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Pod yield (t ha^{-1}) at 1st harvest		Pod yield (t ha^{-1}) at 2nd harvest		Pod yield (t ha^{-1}) at 3rd harvest	
	2013	2014	2013	2014	2013	2014
33,333	7.5	7.6	6.4	6.4	5.5	5.6
40,000	6.5	6.3	5.2	5.0	4.3	4.2
50,000	6.0	6.0	4.7	4.5	3.1	3.0
LSD ($P \leq 0.05$)	0.3	0.2	0.2	0.4	0.8	0.6
Time of Introducing okra						
Mid June	6.3	6.5	5.2	5.0	4.8	4.6
Mid July	5.4	5.7	4.1	4.0	3.4	3.0
Mid August	4.6	4.2	3.1	3.0	2.0	2.0
LSD ($P \leq 0.05$)	0.3	0.7	0.5	0.3	0.5	0.8

Table 18. Interaction effects of population densities of okra x time of introducing okra on pod yield at 1st, 2nd and 3rd harvests in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Pod yield (t ha^{-1}) at 1st harvest		Pod yield (t ha^{-1}) at 2nd harvest		Pod yield (t ha^{-1}) at 3rd harvest	
		2013	2014	2013	2014	2013	2014
33,333	Mid June	7.7	7.5	6.5	6.4	5.4	5.5
	Mid July	5.4	5.1	5.2	5.1	4.2	4.3
	Mid August	4.6	4.0	4.2	4.0	3.0	3.1
40,000	Mid June	6.0	5.3	5.4	5.4	4.5	4.3
	Mid July	5.0	4.6	4.0	4.2	3.2	3.0
	Mid August	4.2	4.0	3.0	3.0	2.5	2.3
50,000	Mid June	5.4	5.2	4.6	4.5	3.5	3.4
	Mid July	4.2	4.0	3.2	3.3	2.5	2.4
	Mid August	4.0	3.6	2.8	2.3	1.4	1.2
LSD ($P \leq 0.05$)		0.3	0.2	0.2	0.5	0.7	0.4

Increasing population density of okra up to 50,000 plants ha^{-1} significantly ($P \leq 0.05$) reduced pod weight at 1st, 2nd and 3rd harvests (Table 15). Okra sown at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} gave the highest pod weights at 1st, 2nd and 3rd harvests (Table 16). The reduced inter-specific competition for growth resources at the period of planting okra at the same time as cassava, and at the population density of 33,333 plants ha^{-1} could be linked to the highest pod weights obtained at 1st, 2nd and 3rd harvests.

In both years, increasing population densities of okra up to 50,000 plants ha^{-1} significantly ($P \leq 0.05$) reduced pod yields at 1st, 2nd and 3rd harvests (Table 17). Planting okra at the same time as cassava in mid June reduced pod yields at 1st, 2nd and 3rd harvests (Table 17). In year 2013, sowing okra at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} gave the highest pod yields of 7.7 t ha^{-1} and 6.5 t ha^{-1} and 5.4 t ha^{-1} respectively, for 1st, 2nd and 3rd harvests, while in year 2014, by 7.5 t ha^{-1}, 6.4 t ha^{-1} and 5.5 t ha^{-1} respectively, for 1st, 2nd and 3rd harvests (Table 18). The largest leaf area and highest number of pods produced from okra sown at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1} could be attributed to the highest pod yields obtained at the same interaction level.

3. 3. Yield advantages of intercropping cassava and okra

The intercrop yields were lower than the sole crop yields (Table 19). The reduction in the intercrop yields of component crops compared to sole crop yields could be linked to the inter-specific competition and greater demands for growth resources occurring under intercropping compared to sole cropping. This view agreed with that of Olufajo (1992) who reported higher yields in sole cropping over intercropping. Irrespective of the population densities of okra and time of introducing okra into cassava, total intercrop yields were greater than the sole and intercrop yields of the component crops (Table 19).

The highest land equivalent ratio (LER) values of 1.86 and 1.84 respectively recorded in years 2013 and 2014 were obtained when okra was planted at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1}, thereby saving 46.2 % and 45.7 % of land in years 2013 and 2014, which could be used for other agricultural purposes (Table 20). It is most advantageous to have both crops in intercrop at this level of interaction. This could be due to greater efficiency of resource utilization at this treatment level. This view agreed with Hiebsch and McCollum (1987) who reported that LER greater than 1.00, could be due to greater efficiency of resource utilization in intercropping.

The highest land equivalent coefficient (LEC) values recorded at this level of treatment agreed with the result of Adetiloye *et al*., (1983) who reported that for a two crop mixture, the minimum expected productivity coefficient is 0.25 (Table 20). While the lowest competitive ratio (CR) was recorded when okra was introduced into cassava in mid August, at the population density of 50,000 plants ha^{-1}, the highest positive aggresivity was recorded when okra was introduced into cassava in mid July, at the population density of 33,000 plants ha^{-1} (Table 20). At this level of interaction, both crops can be termed as dominant crops.

Table 19. Sole crop yields, intercrop yields and total intercrop yields as affected by the interaction of population densities of okra x time of introducing okra in a cassava-okra intercrop in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Sole crop yields (t ha^{-1})				Intercrop yields (t ha^{-1})				Total intercrop yields (t ha^{-1})	
		Cassava		Okra at 1st harvest		Cassava		Okra at 1st harvest			
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
33,333	Mid June	-	-	-	-	46.8	51.3	7.7	7.5	54.5	58.8
	Mid July					39.2	42.4	5.4	5.1	44.6	47.5
	Mid August	-	-	-	-	32.6	31.7	4.6	4.0	37.2	35.7
40.000	Mid June	-	-	-	-	42.3	43.0	6.0	5.3	48.3	48.3
	Mid July	-	-	-	-	39.2	32.1	5.0	4.6	44.2	36.7
	Mid August	-	-	-	-	33.5	24.0	4.2	4.0	37.7	28.0
50,000	Mid June	-	-	-	-	37.4	35.1	5.4	5.2	42.8	40.3
	Mid July	-	-	-	-	35.1	25.7	4.2	4.0	39.3	29.7
	Mid August	-	-	-	-	28.8	19.1	4.0	3.6	32.8	22.7
Soles		52.6	58.4	7.9	7.8	-	-	-	-	-	-

Table 20. Evaluation of yield advantages of cassava-okra intercrop as influenced by the interaction of population densities of okra x time of introducing okra in years 2013 and 2014 at Makurdi, Nigeria.

Population density of okra	Time of introducing okra	Lc		Lo		LER		CR		% Land saved		Aggressivity		LEC	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
33,333	Mid June	0.89	0.88	0.97	0.96	1.86	1.84	0.92	0.92	46.2	45.7	-0.08	-0.08	0.86	0.84
	Mid July	0.75	0.73	0.68	0.65	1.43	1.38	1.10	1.12	30.0	27.5	+0.07	+0.08	0.51	0.47
	Mid August	0.62	0.54	0.58	0.51	1.20	1.05	1.07	1.06	16.7	4.80	+0.04	+0.03	0.36	0.28
40,000	Mid June	0.80	0.74	0.76	0.68	1.56	1.42	1.05	1.09	35.9	29.6	+0.04	+0.06	0.61	0.50
	Mid July	0.75	0.55	0.63	0.59	1.38	1.14	1.19	0.93	27.5	12.3	+0.12	-0.04	0.47	0.32
	Mid August	0.64	0.41	0.53	0.51	1.17	0.92	1.21	0.80	14.5	-8.70	+0.11	-0.10	0.34	0.21
50,000	Mid June	0.71	0.60	0.68	0.67	1.39	1.27	1.04	0.86	28.1	21.3	+0.03	-0.07	0.48	0.40
	Mid July	0.67	0.44	0.53	0.51	1.20	0.95	1.26	0.86	16.7	-5.30	+0.14	-0.07	0.36	0.22
	Mid August	0.55	0.33	0.51	0.46	1.06	0.79	1.08	0.72	5.70	-26.6	+0.04	-0.13	0.28	0.15

LER: Land equivalent ratio
Aggressivity (A) where:
A = 0 (component crops are equally competitive)
A = - value (Dominated crop)
A = + value (Dominant crop)
Lc: Partial LER for cassava
Lo: Partial LER for okra
CR: Competitive ratio; LEC: Land equivalent coefficient

4. CONCLUSION

From the results obtained, it can be concluded that the highest tuber yield, highest pod yield, highest land equivalent ratio (LER) values and highest land equivalent coefficient (LEC) values were obtained sowing okra at the same time as cassava in mid June, at the population density of 33,333 plants ha^{-1}. Though, the lowest competitive ratio (CR) was obtained introducing okra into cassava in mid August, at the population density of 50,000 plants ha^{-1}, however, the highest positive aggresivity was recorded introducing okra in mid July, at the population density of 33,333 plants ha^{-1}. It is however recommended that further study be evaluated across wider varieties of cassava and okra, and across different locations within the Guinea savannah agro-ecological zone of Nigeria.

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