

1 Growth and yield of sesame (*Sesamum indicum* L.) to population density of 2 component cowpea in a sesame/cowpea mixture



4 Abstract

5 **Aim:** To study the effects of population density on the growth and yield of sesame (*Sesamum*
6 *indicum* L.) intercropped with cowpea (*Vigna unguiculata* L.Walp). **Materials and method:** A
7 field trial was carried out at the Teaching and Research Farm of kwara State University, Malete
8 (08⁰ 42" 48.5N and 004⁰ 26 17.9" E) in the southern Guinea savannah agro-ecological zone of
9 Nigeria in 2014 cropping season The treatments consisted of full population of sesame
10 intercropped with 100%, 75%, 50%, and 25 % full population of cowpea. Sole sesame and
11 cowpea were also included as control. Cowpea populations were introduced into sesame at two
12 weeks after planting. The treatments were arranged in a randomized complete block design and
13 replicated three times. Efficiency of intercropping was evaluated using land equivalent ratio
14 (LER) and percentage yield difference indices (PYD).

15 **Results:** Intercropping significantly influenced the growth and yield of cowpea, but the growth
16 and yield of sesame were not affected by intercropping. The highest height of cowpea (22.30cm)
17 was recorded at the full population of both crops. The lowest number of branches (1.03) and
18 pods (1.87) per plants of cowpea were also produced when full populations of both crops were
19 mixed. This population ratio also recorded the highest LER (1.30) and PYD (31%). Sole cowpea
20 significantly out-yielded other treatment combinations in the intercrop. **Conclusion:** The study
21 demonstrated the suitability of intercropping sesame with cowpea in all the component
22 population ratios tested with the best ratios when full populations of both crops were mixed.

Key words: efficiency, competition, intercropping, land equivalent ratio, percentage yield difference.

Introduction

Beniseed (*Sesamum indium* L.) belongs to the double-cotyledon pedaliaceae family. It is an annual plant which grows either bush-like or upright, depending on the variety to a height of 1-2 m. The blossoming of ripening phases takes place over several weeks, starting at bottom of the plant and progresses upward (Ogbonna, and Umar-Shaaba, 2011). Sesame seed is one of the oldest oilseed crops known and has been domesticated for over 5000 years (Albue, *et al.*, 2012). The seed is considered as one of the most important oil crop in the world due to the superior oil and protein, often referred to as the queen of the oil seed crops. It rich in calcium and potassium with high quality and stable oil with high index of sesamin and sesamolin antioxidant as well as monounsaturated and poly unsaturated fatty acid (Rankdah *et al.*, 2010), and is frequently used by many pharmaceutical and cosmetic industries (Suddhiyam *et al.*, 2009).

Cowpea (*Vigna unguiculata* L. Walp), one of the several species in the widely cultivated genus vigna is an important crop in many countries of tropical Africa, Asia and South America. The grains and the leaves are edible products that serves as rich and cheap sources of high-quality protein commonly consumed. According to FAO (2005), careful and positive attention to cowpea production would support 850 million People in the world with high incidence of undernourishment particularly in sub-Saharan Africa.

In most African countries, cowpea is either grown alone or intercropped with other arable crops. This simultaneous growing of two or more crops on the same field is widely practiced among

traditional farmers in the tropics. In addition to increased production per unit area through optimizing the use of natural resources (Calson, 2008, Afe and Olofintoye, 2013), the system also increased income for the growers (Bathi, *et al.*,2013) and can also reduced the quantity of nitrogen required per unit area (Bedousa and Justes, 2011). In the recent time, the cultivation of sesame has increase among the resource poor farmers in the study area majorly as a sole crop in spite of numerous benefits of intercropping.

In crop mixture, population density is an important agronomic consideration for optimum yield. According to Vanasten, *et al.*, (2011) the benefits of the system may increase through the correct use and management of the soil, plant density and planting configuration. The significant role of cowpea as a component crop in crop mixture is well known. It is tolerant to shade and also enriches the soil through nitrogen fixation. However, information's on sesame intercropping with cowpea particularly at different component population is inconsistent. In a study involving sesame and maize system Mkamilo (2004), observed that interplant competition from sesame significantly reduced the yield of maize and suggested that sesame should be planted two weeks after maize. Similarly, Guedes *et al.*, (2010), observed a reduction of 22.64% of cowpea bean in cowpea/sesame mixture when the two crops were sown at the same time. Meanwhile, Bathi, *et al.*, (2013), reported a more aggressive competitive behavior characteristic of cowpea which led to 26.0% yield reduction of sesame in a cowpea/sesame intercropping.

While considerable information's are available in cowpea intercropping with other crops, information's on sesame-cowpea mixture is scanty and inconsistent particularly with component population ratio. However, with the current growing interest of farmers in the study area suggest the need to provide information that is research base for guidance. This research was therefore

initiated to study the effects of population density on the growth and yield of sesame in sesame/cowpea mixture with a view of determining the suitability of intercropping sesame with cowpea and the population density of cowpea for optimum yield.

Materials and method

The experiment was carried out at the Teaching and Research Farm of Kwara State University, Malete, in the southern guinea savannah ecological zone of Nigeria in 2014 cropping season. The mean annual rainfall of the study area during the trial was 1,076mm in 55 rainy days. The maximum temperature was 37.7°C while minimum was 21.4°C with relative humidity of 92.6% (PME, 2014). The land was ploughed and doubled harrowed for good seed germination. Four to five seeds of sesame were planted per stand at a spacing of 60cm x 10cm and were thinned to two plants per stand at two weeks after planting (WAP). The treatments consisted of full population of sesame intercropped with full, 75%, 50%, and 25% full population of cowpea in a randomized complete block design in three replicates. Cowpea populations were introduced into sesame after two weeks of planting. Sole crop of sesame and cowpea were also included in the treatment as a check.

Pendimethalin ([N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitrobenzenamine] was applied as a pre-emergence herbicide immediately after planting of sesame at the rate of three litres per hectare using knapsack sprayer. This was followed by hand weeding at 6WAP. The two crops were protected from insect by spraying with cyalothrin at the rate of 1.5kg active ingredients/hectare. Inorganic N.P.K (15:15:15) fertilizer was applied to sesame at the rate of 150 kg/hectare at 4 WAP using the side placement method.

Data collection

Growth parameters: Plant heights, stem girth, number of branches and pods per plant were taken from five tagged plants at the two inner rows for the two crops. The numbers of days at which 50% population of both crops flowered and pod were also recorded. The dry matter was determined by the difference in the initial and final weight from randomly selected five plants that were oven dried to a constant weight. The yield obtained from the nested plot (4.66m²) from each plot was converted to kilograms per hectare and 1000 seeds from harvested plots were weighed on a sensitive balance in the laboratory. The efficiency of intercropping was determined using land equivalent ratio (Mead, and Willey, 1980) and percentage yield difference (Afe and Atanda, 2015) indices. LER is defined as the total land area required under sole cropping giving the yield obtained in the intercrops. PYD is defined the yield differences between the sole crop at full population (100%) and the intercrop when expressed in percentage. It gives the numerical value of intercropping advantage when the percentage intercrop is deducted from the sole crop.

$$LER = Y_{ij}/Y_{ii} + Y_{ji}/Y_{jj}$$

Where: Y = yield per unit area
 Y_{ii} and Y_{jj} = sole crop yield of component crop i and j
 Y_{ij} and Y_{ji} = intercrop yield

$$PYD = 100 - \{ Y_{sa} - Y_{ja} / Y_{sa} + Y_{sb} - Y_{jb} / Y_{sb} \} \times 100 / 1$$

Where: Y_{sa} = sole crop yield of crop A
 Y_{sb} = sole crop yield of crop B
 Y_{ja} = intercrop yield of crop A
 Y_{jb} = intercrop yield of crop B

All the data were subjected to statistical analysis with Assistat Statistical package (2009) version and treatment means compared at 5% level of probability using Duncans Multiple Range Test

Results

Plant heights, stem girth, days to 50% flowering and podding of sesame were not influenced by intercropping, but these parameters in cowpea were affected (Table 1). The highest height of cowpea (22.33cm) was significantly taller than all other population ratios including the sole stand. Notwithstanding, superior thicker plant of cowpea were observed at the sole stand compared to other treatments. Intercropping cowpea at full population with full population of sesame takes longer days to flower and pod.

The effect of intercropping on number of branches and pods per plant and dry matter weight in sesame/cowpea mixture is presented in table 2. The number of branches and pods per plant and the dry matter weight of cowpea increased as the population pressure decreased. Compared to other population ratios, more number of branches and pods of cowpea were recorded at the sole stand. Although more branches of sesame were observed at the sole stand, it was not statistically different from the intercrop populations.

The significant effect of intercropping on the weight of 1000 grains, grain yield of cowpea and sesame, land equivalent ratios and percentage yield difference is presented in table 3. Irrespective of the population ratios at the intercrop, the sole stand of cowpea significantly had more seed weight and grain yield. The highest gain yield of cowpea (1,739.04 kg/ha) at the

intercrop was recorded when full population of both crops were mixed. Based on LER and PYD indices, all the population ratios tested demonstrated intercropping advantages over their respective sole crops stand. The highest LER (1.30) and PYD (31%) were recorded when full populations of both crops were intercropped.



Table 1. Effects of intercropping on plant height stem girth days to 50% flowering and podding in a sesame/cowpea mixture in 2014

Component population ratios		Plant height (cm)		Stem girth (cm)		Days to 50% flowering		Days to 50% podding	
S	C	S	C	S	C	S	C	S	C
100	100	101.89a	22.33a	1.10a	0.76b	63.67a	31.03a	74.67a	59.00a
100	75	101.10a	19.97b	1.18a	0.77b	60.99b	30.67a	77.00a	57.33b
100	50	98.20a	19.30b	1.26a	0.78b	61.33b	30.09b	73.33a	55.67d
100	25	96.40a	19.67b	1.15a	0.81b	61.97b	29.00c	77.67a	56.67c
Sole		99.42a	19.50b	1.22a	0.89a	60.33b	28.80c	76.00a	46.67c

Values with the same letter(s) in the same column are not significantly different at 5% level of probability by Duncan's Multiple Range Test. s = sesame, c = cowpea

Table 2: Effects of intercropping on number of branches and pods/plant and dry matter weight in a sesame/cowpea intercropping in 2014

Component population ratios		Number of branches/plant		Number of pods /plant		Dry matter weight (g)	
S	C	S	C	S	C	S	C
100	100	10.00a	1.03c	43.50a	15.87c	58.89b	38.37c
100	75	10.03a	1.05c	43.92a	16.13c	58.97b	41.33d
100	50	10.00a	2.04b	43.75a	16.53b	59.98b	43.02c
100	25	10.03a	2.06b	43.50a	16.60b	60.00b	56.97b
Sole		10.04a	7.53a	43.98a	19.13a	62.09a	114.07a

Values with the same letter(s) in the same column are not significantly different at 5% level of probability by Duncan's Multiple Range Test. s = Sesame, c = cowpea

171 Table 3: Effects of intercropping on the weight of 100grains, yield LER and PYD in a sesame/cowpea intercropping
172 in 2014

173

Component population ratios		Weight of 100 grains (gm)		Yield (kg/ha)		LER	PYD(%)
S	C	S	C	S	C		
100	: 100	3.05a	117.67b	888.37a	1,739.04b	1.30a	31%
100	: 75	3.01a	128.67b	887.53a	1,661.28b	1.28	29%
100	: 50	3.03a	128.70b	888.36a	1,481.76c	1.25	25%
100	: 25	3.00a	127.67b	890.37a	1,426.28bc	1.23c	23%
Sole		3.08a	129.33a	990.39a	4,278.24a	1.00d	100%

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175 Values with the same letter(s) in the same column are not significantly different at 5% level of
176 probability by Duncan's Multiple Range Test. s = Sesame, c =cowpea, LER= Land equivalent
177 ratio, PYD = Percentage yield difference

178
179 **Discussion**

180 The overall result of the study indicated that sesame could be intercropped with cowpea in all the
181 population ratios considered. This implies that planting sesame and cowpea in the mixture is
182 better than planting any of the crops as a sole. The intercropping advantage as observed in this
183 study is consistent with the works of earlier researchers on intercropping involving cowpea and
184 sesame such as: cowpea/ maize (Afe, and Olofintoye, 2013), cowpea/sesame (Bathi et al.,2013,
185 Udom *et al.*,2000, Araujo, *et al.*, 2013) and maize/sesame (Mkamilo, 2004).

186
187 Although, the height and other parameters of sesame were not statistically affected by
188 intercropping in all the observed population ratios tested, the growth and yield of cowpea in the
189 mixture were influenced. Cowpea height decreased as the population of components crops
190 decreased. The observed tall plants of cowpea at high population ratio particularly at full
191 population of both crops could be due to competition for natural resources especially light
192 between the two component crops. Cowpea being an under storey crops had to compete for light
193 at the initial growth stages. As expected, when plant competes for light they tend to grow taller

by producing more nodes/stem so as to capture more light, hence the recorded tall cowpea at high population pressure.

Another reason for the non significant effect of intercropping on the growth and yield of sesame could be due to early planting of sesame before cowpea. Although cowpea flowered before the components sesame did, the time of podding coincided with the period of flowering in sesame. Sesame, been naturally taller than cowpea in addition with the vigorous growth habit and early establishment was able to utilize the natural resources better than cowpea at this critical growth stage of cowpea. Earlier(Mkamilo, 2004) reported a decreased of 19-55% in maize yield due to inter-plant competition from the associated sesame

The yield parameters of sesame viz; number of branches and pods per plant were not statistically affected by intercropping, these traits of cowpea were influenced. Poor number of branches and pods per plant of cowpea at high population pressure of component crops had been reported (Afe, and Olofintoye, 2013). Fewer number of pod/plant of cowpea at the intercrop as observed in this study, was a reflection of poor number of branches/plant. Although, at reduced population of cowpea in the intercrop, the production of branches and consequently the pods per plant were appeared to be favored probably due to wider spacing of cowpea that encouraged more branching as a result of reduction in competition. However, despite this, the fewer number of plants could not compensate for the yield. The observed non significant effects of intercropping on the growth and yield of sesame did not conform to the findings of Bathi *et al.*, (2013) who recorded 26% reduction in the yield of sesame due competition from associated cowpea. The contrast could be ascribed to time of introduction of cowpea in the mixture. In the earlier

216 experiment, the two crops were planted at the same time whereas in the foregoing, cowpea was
217 introduced to sesame at two weeks after planting.

218 Based on LER and PYD indices, all the component ratios tested demonstrated the suitability of
219 intercropping cowpea with sesame. That is mixing the two crops is more preferred than planting
220 either of the crops alone. In an earlier study, on sesame/cowpea mixture (Osman, *et al.*, 2006)
221 the same intercropping advantages were recorded especially in a 2:2 and 2:1 spatial row
222 arrangements. This improved biological intercropping advantage was due better utilization of
223 natural resources by the two crops.

224

225 **Conclusion**



226 The growth and yield of sesame were not affected by intercropping in a sesame/ cowpea mixture
227 especially when sesame is planted two weeks before cowpea. However, intercropping
228 significantly reduced the yield of cowpea. All the population ratios tested demonstrated the
229 suitability of intercropping cowpea with sesame with the best population ratio of 100S:100C

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231 **References**

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