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Evaluation Of Maize (*Zea Mays* L.) And Okra (A*belmoschus Esculentus* (L.) Moench) Intercropping System At Samaru, Zaria

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Abstract
Field experiments were conducted during the 2013 and 2014 cropping seasons at the Teaching and Research Farm of Samaru College of Agriculture, Ahmadu Bello University Zaria, to evaluate the performance of maize-okra intercropping system as affected by varying planting ratio. The experiment consisted of seven planting ratio which include; sole maize, sole okra, 1:1, 1:2, 1:3, 2:1 and 3:1. The seven treatments were replicated three times in a randomized complete block design (RCBD). Results obtained showed that sole maize or okra significantly produced lower yields compared to intercrops. The highest intercrop growth and yield of maize/okra for the two cropping seasons was obtained from 3:1 ratio, but were not significantly different from the rest of the intercrops.

Keyword: Intercropping, efficient utilization of light and other resources, reduce soil erosion, suppress weed growth.

1. INTRODUCTION

Intercropping is a type of mixed cropping system and is defined as the agricultural practice of cultivating two or more crops in the same space at the same time (Ijoyah, 2012). The important reason for growing two or more crops together is to increase productivity per unit area of land in (Ijoyah, 2012). Intercropping with cereal crop such as maize in tropical region is a way of growing a staple crop while obtaining several benefits from the additional crop. It is the most appropriate cropping system for the maintenance of soil productivity within the tropics and ensures good soil cover throughout the year (Ijoyah and Dzer, 2012). These practices have been so interwoven in the socio-economic lives of peasant farmers (Ijoyah, 2012). The reason for the persistence of this practice is that gross returns per unit area of land are usually higher under intercropping than in sole cropping (Brintha and Seran, 2009). The system also offers the farmers insurance against crop failure helps to control erosion, weeds, insect infestation and brings about a more distribution of farm labour than sole cropping (Ali *et al.*, 2000). There are also some socio-economic, biological and ecological advantages in intercropping over mono cropping (Ijoyah, 2012). Several scientists have worked on cereal based intercropping, such as maize-bean, maize-potato, maize-cassava, maize-yam, maize-soybean and maize-groundnut, amongst many others (Ijoyah and Fanen, 2012). Studies on intercropping have recently focused on cereal-vegetable mixture (Hugar and Palled, 2008; Ijoyah and Jimba, 2012; Ijoyah *et al*., 2012).

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Intercropping with maize is a way of growing a staple crop while obtaining several benefits from the additional crop. Ijoyah (2012) evaluated the yield of maize in a maize-okra mixture as affected by time of planting reported that the greatest intercropped yield of maize was obtained when maize was planted at the same time as okra. This result agreed with Ijoyah and Dzer (2012) who reported that best intercropped maize yield was obtained when planting was done at the same time as okra in a maize-okra mixture. Ijoyah and Dzer (2012) also reported that intercropping maize and okra at same time produced the best okra yield compared to that obtained from mono cropped okra. Intercropping ensures efficient utilization of light and other resources, reduce soil erosion, suppress weed growth and thereby help to maintain greater stability in crop yield under okra/cowpea intercropping system (Susan and Mini, 2005). It also guarantees greater land occupancy and thereby higher net returns. Other advantages ascribed to intercropping include insurance against crop failure thereby minimizing risk, better use of resources by plants of different heights, rooting depths and nutrient requirements and a more equal distribution of labor through the growing season (Okpara *et al.*, 2004). Maximization of yields in crop mixtures will always be on the basis of high species compatibility (Odedina *et al.,* 2014). Similarly, the advantages of intercropping with legumes have been demonstrated in numerous studies; tomato or okra with cowpea (Odedina *et al.*, 2014), amaranth with cowpea (Susan and Mini, 2005), cucumber with cowpea (Susan and Mini, 2005), maize with cowpea (Akande *et al.*, 2006), cassava with cowpea (Mohammed *et al.,* 2006). The objective of this study is to evaluate the effect of maize-okra intercropping system at Samaru, Zaria.

2. MATERIALS AND METHODS

Field experiment were conducted during the 2013 and 2014 cropping seasons at the Teaching and Research Farm of Samaru College of Agriculture Ahmadu Bello University Zaria, Nigeria (Latitude 11^0 11`N and Longitude $07^0$38`E). The treatments include; sole maize, sole okra, 1:1, 1:2, 1:3, 2:1 and 3:1 ratio, replicated three times in a randomized complete block design (RCBD). The experimental field was ploughed and harrowed with each plot measuring 4m x 2.5m. Maize variety TZESR-W and okra variety NHAE-47-4 were used for the intercropping system. Sowing was done at a spacing of 50 cm x 50 cm for both maize and okra with 2 and 3 seeds hole^{-1} respectively in a 4m x 2.5m plot size. Okra was thinned to two seedlings hole^{-1} giving a population density of 83,333 plants ha^{-1} for both crops. NPK 15:15:15 at 150 kg ha^{-1} was applied to all plots two weeks after sowing (2WAS). Hand hoe weeding was done at 2 and 4WAS, thereafter both crops formed sufficient ground cover to control weeds effectively.

Five plants of each crop were randomly selected for determining traits such as plant height, number of leaves plant^{-1}, number of cobs plot^{-1}, cob yield hectare^{-1} in maize and plant height (cm), number of leaves plant^{-1}, number of fruits plot^{-1} and fruit yield hectare^{-1} in okra. Data from the two seasons were subjected to Analysis of Variance (ANOVA). Least significant difference (LSD) at 5% probability was used for mean separation.

3. RESULTS

Table 1 shows the results of soil analysis during the 2013 and 2014 cropping seasons at Samaru, Zaria. It was observed that the soil contains a higher proportion of sand in the two seasons (86.27 and 87.88%), low silt (7.22 and 7.32%), low clay (11.14 and 11.23%), low organic carbon (5.14 and 5.42%) and PH in water (6.42 and 6.52), respectively. The chemical analysis revealed that the soil contains low amount of total nitrogen, phosphorus, potassium, calcium sodium magnesium and cation exchange capacity (CEC).

Evaluation of maize-okra intercropping system on growth and yield traits of maize

Plant height (cm)

Table 2 shows a significant difference (P<0.05) on plant height of maize due to maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting maize in sole cropping significantly produced lower means (53.34 and 52.65cm) on plant height than the other intercrops. However, planting one maize row to two rows of okra significantly gave higher means (59.48 and 58.27cm) on plant height, followed by planting three rows of maize to one row of okra (57.32 and 56.82cm), one row of maize to one row of

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okra (55.86 and 54.46cm), two rows of maize to one row of okra (54.67 and 54.49cm) and one row of maize to three rows of okra (52.35 and 53.34cm).

Number of leaves plant^{-1}

Table 2 shows a significant difference (P<0.05) on number of leaves plant^{-1} of maize as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole maize significantly produced lower means (14.58 and 14.29) of number of leaves plant^{-1}. However, planting three rows of maize to one row of okra significantly produced higher means (17.48 and 17.43) of number of leaves plant^{-1} in the two cropping seasons, followed by planting two rows of maize to one row of okra (17.36 and 17.39), one row of maize to three rows of okra (17.24 and 17.31), one row of maize to two rows of okra (17.01 and 17.28) and one row of maize to one row of okra (16.89 and 16.68).

Number of cobs plot^{-1}

Table 2 shows a no significant difference (P>0.05) on number of cobs plant^{-1} of maize as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole maize did significantly differ with intercropping maize-okra in both 2013 and 2014 cropping seasons on number of cobs plot^{-1}.

Cob yield hectare^{-1}

Table 2 shows a no significant difference (P>0.05) on number of cobs hectare^{-1} of maize as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole maize did not significantly differ with intercropping maize-okra in both 2013 and 2014 cropping seasons on number of cobs hectare^{-1}.

Evaluation of maize-okra intercropping system on growth and yield traits of okra

Plant height (cm)

Table 3 shows a significant difference (P<0.05) on plant height of okra due to maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting okra in sole cropping significantly produced lower means (52.56cm and 51.64cm) on plant height than the intercrops. However, planting three rows of maize to one row of okra significantly gave higher means (57.89cm and 57.91cm) on plant height, followed by planting two rows of maize to one row of okra (56.78 and 56.98cm), two rows of maize to one row of okra (55.76cm and 54.76cm), one row of maize to one row of okra (54.57cm and 53.68cm) and one row of maize to three rows of okra (52.35 and 53.34cm).

Number of leaves plant^{-1}

Table 3 shows a significant difference (P<0.05) on number of leaves plant^{-1} of okra as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole okra significantly produced lower means (18.47 and 18.65) of number of leaves plant^{-1}. However, planting three rows of maize to one row of okra significantly produced higher means (25.67 and 25.68) of number of leaves plant^{-1} in the two cropping seasons on okra, followed by planting two rows of maize to one row of okra (24.56 and 24.48), one row of maize to three rows of okra (22.36 and 22.35), one row of maize to two rows of okra (21.45 and 21.65) and one row of maize to one row of okra (20.00 and 20.22).

Number of pods plot^{-1}

Table 3 shows a significant difference (P<0.05) on number of pods plot^{-1} of okra as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole okra did significantly differed with intercropping maize-okra in both 2013 and 2014 cropping seasons. Sowing okra sole significantly gave the lowest means (31.42 and 30.48). However, planting three rows of maize to one row of okra significantly produced higher means (37.68 and 37.78), followed by planting two rows of maize

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to one row of okra (36.46 and 36.66), followed by planting one row of maize to three rows of okra (36.37 and 36.47), followed by planting one row of maize to two rows of okra35.46 and 35.86) and planting one row of maize to one row of okra (35.56 and 34.26).

Pod yield hectare^{-1}

Table 3 shows a no significant difference (P>0.05) on pod hectare^{-1} of okra as affected by maize-okra intercropping system in 2013 and 2014 cropping seasons. Planting sole okra did significantly differ with intercropping maize-okra in both 2013 and 2014 cropping seasons on means on pod yield hectare^{-1}.

4. DISCUSSION

The study showed that intercropping maize with okra significantly gave higher yield than sole maize or okra. The gross returns per unit area of land increased under intercropping than in sole cropping (Brintha and Seran, 2009). There were also some socio-economic, biological and ecological advantages in intercropping over sole cropping as reported by (Ijoyah, 2012). Similarly, several scientists have worked on cereal based intercropping, such as maize-bean, maize-potato, maize-cassava, maize-yam, maize-soybean and maize-groundnut, amongst many others (Ijoyah and Fanen, 2012). Ijoyah (2012) in an experiment to evaluate the yield of maize in a maize-okra mixture as affected by time of planting reported that the greatest intercropped yield of maize was obtained when maize was planted at the same time as okra. Ijoyah and Dzer (2012) also reported that intercropping maize and okra at same time produced the best okra yield compared to that obtained from mono cropped okra. The intercrops irrespective of their ratio significantly gave higher yield than the sole crops.

Ijoyah and Dzer (2012) similarly reported that intercropping ensures efficient utilization of light and other resources, reduce soil erosion, suppress weed growth, and thereby help to maintain greater stability in crop yield in okra/cowpea intercropping system. It also guarantees greater land occupancy and thereby higher net returns (Susan and Mini, 2005). Similar reports on the advantages ascribed to intercropping include insurance against crop failure thereby minimizing risk, better use of resources by plants of different heights, rooting depths and nutrient requirements and a more equal distribution of labor through the growing season (Okpara *et al.*, 2004). Maximization of yields in crop mixtures will always be on the basis of high species compatibility (Odedina *et al.*, 2014). Advantages of intercropping with legumes have been demonstrated in numerous studies; tomato or okra with cowpea (Odedina *et al.*, 2014), amaranth with cowpea (Susan and Mini, 2005), cucumber with cowpea (Susan and Mini, 2005), maize with cowpea (Akande *et al.*, 2006), cassava with cowpea (Mohammed *et al.,* 2006).

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Table 1: Physical and Chemical Properties of the Soil used for the Experiment during the 2013 and 2014 Cropping Seasons.

Mechanical composition	2013 Soil depth 0-15cm	2014 Soil depth 0-15cm
Sand %	86.27	87.88
Silt%	7.22	7.32
Clay%	11.14	11.23
Organic carbon%	5.14	5.42
$_{P}$H in H_20	6.42	6.52
Total nitrogen %	3.52	3.54
Available phosphorus mg kg^{-1}	2.21	2.22
Available potassium mg kg^{-1}	1.54	1.54
Available calcium mg kg^{-1}	0.53	0.54
Available sodium mg kg^{-1}	0.50	0.51
Available magnesium mg kg^{-1}	1.32	1.32
Cation exchange capacity (CEC) mg kg^{-1}	5.21	5.22

Table 2: Evaluation of Maize-okra intercropping system in 2013 and 2014 cropping seasons at Samaru, Zaria

Treatments	Plant height (cm)	Plant height (cm)	Number of leaves plant^{-1}	Number of leaves plant^{-1}	Number of cobs plot^{-1}	Number of cobs plot^{-1}	Cob yield hectare^{-1} (kg)	Cob yield hectare^{-1} (kg)
Maize : okra	2013	2014	2013	2014	2013	2014	2013	2014
Sole maize	53.34	52.65	14.58	14.29	29.36	29.36	2,632	2,742
1:1	55.86	54.46	16.89	16.68	31.24	31.24	2,779	2,874
1:2	59.48	58.27	17.01	17.28	32.16	32.16	2,874	2,976
1:3	52.35	53.34	17.24	17.31	32.28	32.28	2,893	3,063
2:1	54.67	54.49	17.36	17.39	33.19	33.19	2,912	3,132
3:1	57.32	56.82	17.48	17.43	33.24	33.24	3,014	3,226
LSD	3.24	3.24	1.26	1.26	NS	NS	NS	NS

Table 3: Evaluation of maize-okra intercropping system in 2013 and 2014 cropping seasons at Samaru, Zaria

Treatments	Plant height (cm)	Plant height (cm)	Number of leaves plant^{-1}	Number of leaves plant^{-1}	Number of pods plot^{-1}	Number of pods plot^{-1}	Pod yield hectare^{-1} (kg)	Pod yield hectare^{-1} (kg)
Maize : okra	2013	2014	2013	2014	2013	2014	2013	2014
Sole okra	52.56	51.64	18.47	18.65	31.42	30.48	2,468	2,532
1:1	54.57	53.68	20.00	20.22	34.56	34.26	2,635	2,648
1:2	55.76	54.76	21.45	21.65	35.46	35.86	2,754	2,756
1:3	55.80	55.84	22.36	22.35	36.37	36.47	2,893	2,991
2:1	56.78	56.98	24.56	24.48	36.46	36.66	2,935	3,211

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3:1	57.89	57.91	25.67	25.68	37.68	37.78	3,124	3,342
LSD	3.21	3.22	1.67	1.67	1.46	1.46	NS	NS