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Research Article

Growth, Yield and Competitive Indices of Cowpea and Sorghum in Sole and Intercropped System

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Abstract
The need to increase cowpea production to solve the menace of malnutrition is a global challenge and land limitations have also made intercropping indispensable. Field trials were carried out at the Teaching and Research Farm, Kwara State University, Malete, and National Centre for Agricultural Mechanization (NCAM) Idofian to evaluate the growth and yield of cowpea cultivars and sorghum with their competitive behavior in cowpea-sorghum intercropping. Five cultivars of cowpea (IITA-256, IITA-277, VITAL-5, IT98K-491-4, and IITA-288) were intercropped with sorghum (SAMSORG47-SKV8). Sole crops were included in the treatments as a check. The treatments were arranged in a Randomized Complete Block Design and replicated three times. Among the sole, vital-5 cultivar had the highest number of branches and pods per plant with the highest grain yield of 591.30 kg/ha and 530.00 kg/ha respectively, in Malete and NCAM. At the intercrop, IITA-288 significantly had the least number of branches per plant and took longer days to attain flowering compared to other cultivars. Regardless of location, the lowest grain yield at the intercrop was also obtained with this cultivar. Sorghum intercropped with cowpea cultivar IITA-288 was at par with the sole sorghum in all the parameters. The least grain yield of sorghum at the intercrop was obtained in sorghum intercropping with IITA-256 cowpea cultivar. The maximum Land Equivalent Ratio (LER), and Land Equivalent Coefficient (LEC), was obtained with the Vital-5 cultivar. Regardless of location, the competitive ratio (CR) values for IITA-256, IITA-277, and Vital-5 cowpea cultivars were higher than sorghum. The aggressivisity, (A) for these cultivars were also positive for cowpea and negative for sorghum. Although, all the cowpea cultivars demonstrated intercropping advantages in efficient utilization of natural resources intercropping sorghum with the Vital-5 cowpea cultivar was superior and could be adopted by the farmer.

Keywords: Cowpea, Cultivars, Grain yield, Intercropping, Sorghum

Introduction

Simultaneous growing of two or more crops is a worldwide farming system by smallholders in many tropical and sub-tropical regions (Brooker *et al*., 2015) with a view of mitigating the risks that are associated with sole cropping (Kermah *et al*., 2017) as well as meeting the nutritional needs, balance the environmental and socio-economic objectives of farming (Musumba *et al*. 2017). Cowpea is naturally tolerant to drought and has been reported to perform better than other legumes in areas with unstable rainfall (Timko and Sigh, 2008). It is frequently intercropped with drought-tolerant crops such as sorghum and pearl millet (Ewansiha *et al*., 2005). According to Ojiem *et al.* (2014), intercropping cowpea with staple cereal is a key technology in the choice towards sustainable intensification of agriculture.

In crop mixture, identifying a variety that is suitable for intercropping is an important factor

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for consideration to achieve optimum productivity this is because a cultivar that performs well at the monoculture may not do well at the intercrop. Peoples *et al*. (2009) and Kermal *et al*. (2001) had earlier noted that land and labor productivity in a crop mixture was enhanced when companion crops were compatible due to interspecific facilitation and niche complementarity. Because of the morphological differences and maturity dates that exist among cowpea cultivars that may affect their performance at the intercrop, the selection of a variety that is adaptable to intercropping is important for optimum productivity in the cowpea system.

In a recent study, Talent *et al.* (2020) noted that variety selection is an important factor for consideration in improving productivity in the cereal-legume mixture. Similarly, Yildirim and Guyenc (2005) also pointed out that compatible companion crops in intercrops under limited external inputs could provide potential productivity and profitability to a poor resource farmer. In an experiment carried out by Ajeigbe *et al*. (2005) and Oseni (2010) both reported that row arrangement and crop varieties were major determinants responsible for the yield of sorghum and cowpea. In the studies, it was observed that increasing cowpea rows with sorghum rows at the intercrop was found to increase the yield of cowpea with a reduction in the yield of sorghum. In a similar study, Mohammed *et al*. (2008) evaluating cowpea genotypes under intercropping with sorghum reported that the yield and yield components of sorghum were not affected by cowpea genotypes. In another study, Mohammed *et al*. (2008) noted a significant yield reduction in sorghum yield when it was intercropped with late-maturing cowpea. This yield reduction according to Ajeigbe *et al*. (2006) and Mohammed *et al*. (2008) was attributed to the absence of below-ground niche differentiation in the root distribution and shading effects from the cereals.
Evaluating intercropping efficiency in sorghum-cereal intercrop, Jeranyama *et al*. (2000) and Masvaya *et al.* (2017) reported that the low population density of cowpea resulted in lower partial land equivalent ratio values compared to the cereals. Aggressivity, an index for evaluating how much a relative yield increase of a dominant species is greater than the recessive was found to be positive for sorghum and negative for cowpea, an indication that sorghum was dominant while cowpea was recessive (Afe, 2020). In another study, the competitive ratio was reported to be higher in sorghum than in cowpea (Oseni, 2010). Presently, several cowpea cultivars are intercropped with sorghum among the poor resource farmer in the southern guinea savannah agro ecology to mitigate crop failure and to balance the nutritional needs. Information on the productivity of these cultivars is scanty. The present study was designed to evaluate the growth and yield responses, as well as competitive behavior of cowpea cultivars intercropping with sorghum, with a view to selecting the appropriate cultivar for intercropping with sorghum.

Materials and Methods

The experiment was conducted during the 2019 cropping season, at the Teaching and Research Farm of the Faculty of Agriculture, Kwara State University, Malete, and the National Center for Agricultural Mechanization (NCAM) Farm, Idofian, Nigeria. Five cultivars of cowpea (IITA 256, IITA- 277, VITAL- 5, IT98K-491-4, and IITA- 288) were intercropped with Sorghum cultivar (SAMSORG47-SKV8). The sole stand of both sorghum and cowpea was also included in the treatment as a check. The treatments were arranged in a Randomized Complete Block Design (RCBD) and replicated three times.
The land was plowed and harrowed twice. The field was then marked out into blocks with 1.0 m between blocks and 0.5 m between plots with each plot measured 3.0 m x 3.0 m. Four seeds of cowpea and sorghum were simultaneously planted in an alternate ratio 1:1 single row arrangement at spacing of 60.0 cm x 60.0 cm giving five rows each of both crops and plant population of 555,555 plants per hectare. The crops were thinned to two plants per stand at two weeks after planting (WAP). Manual weeding was carried out at three and five weeks after planting (WAP) such that the experimental field was weed free. Lambda-cyhalothrin insecticide

was used to control pests at the rate of 40 ml/20 liters of water as recommended by the manufacturer. NPK (20:10:10) at the rate of 30.75 kg N ha^{-1} was applied to sorghum by side placement in two splits at 3 and 6 weeks after planting. Single super phosphate (SSP) was applied to cowpea at the rate of 20 kg P_2O_5/ha two weeks after planting.

The following data were collected from five tagged plants each of cowpea and sorghum, at the inner rows. Cowpea plant height at 4, 6, and 8 WAP, leaf area at 6 and 8 WAP, days to 50% flowering, number of branches and pods per plant, pod length, number of seeds per pod, the weight of 100 grains and grain yield/ha. Sorghum plant height at 4, 6, and 8 WAP, leaf area at 6 and 8 WAP, days to 50% booting, head length, the weight of 100 seeds, and grain yield/ ha.

LER a measure of the degree by which the intercropping gives a higher return to the land area than the pure stand was calculated as described by Willey (1985).

LER = Yij/Yii + Yji/Yjj

Where: Y= Yield per unit area

Yii and Yjj= Sole crop yield of component crop i and j

A measure of the level of interaction and productive potential at the intercrop was estimated using land equivalent index as proposed by Adetiloye and Ezedima, (1983) and used by Afe, (2020).

LEC = (Lc x Ls), where Lc and Ls are the partial LER for cowpea and sorghum, respectively.

Aggressivity (A) is a measure of how much a relative yield increase of one species (dominant) is greater than the other species (dominated or recessive) in the mixture. The value of A was calculated by the formula proposed by McGilchrist (1965) and used by Afe (2020):

$$\text{Aab} = \frac{\text{Yab} \_ \text{Yba}}{\text{Yaa} \times \text{Zab Ybb} \times \text{Zba}}$$

Where:

Aab = Aggresivity value for component crop a,

Yab = Intercrop yield of crop a,

Yba = Intercrop yield of crop b,

Zab and Zba = Sown proportions of crops a and b in the intercrop

Thus, if a value for crop A= 0, the two crops are equally competitive, but if A is positive then crop A is dominant and if A is negative, then crop A is weak or dominated.

The competitive ratio (CR) describes the degree of competition among component crops in the mixture. A higher CR value indicates a higher competitive ability. The competitive ratio (CR) was calculated using the formula proposed by Willey and Rao (1980) and used by Afe *et al.* (2020).

CR (sorghum) = Ls × Zsc / Ls × Zcs

CR (cowpea) = Lc × Zcs/ Ls × Zsc

Where: Ls and Lc are the partial LERs for sorghum and cowpea respectively

Zsc and Zcs = proportion of sorghum and cowpea respectively at the intercrop.

All the data collected were subjected to analysis of variance (ANOVA) and the treatment means where significant difference exists were separated using Duncan's Multiple Range Test at a 5 % level of probability.

Results and Discussion

The results of this study have shown that the growth and yield of cowpea cultivars were influenced by intercropping with sorghum. The growth and yield components varied among the cowpea cultivars at the intercrop as well as the sole. Such differences could have been due to differences in the growth habit among the cultivars and their adaptation to intercropping. A similar observation was reported by (Mohammed *et al*. (2008) in sorghum/cowpea intercrop. Significantly, higher grain yield (409.1, 396.6 and 408.5, 379.0 kg/ha respectively for Malete and NCAM) among the cultivars at intercrop were obtained by IITA-256 and Vital-5 cultivars (Table 3). This superiority is expected because of the superior yield components of these two cultivars at the intercrop suggesting that the cultivars have adapted to intercropping compared to others. This is corroborated by the higher leaf area exhibited by these cultivars for the production of assimilates. According to Xialolei and Zhifeng (2002), leaf area is a critical index for high photosynthesis rate and yield. The higher CR and positive A values of these cultivars further lend credence to their ability to compete at the intercrop which could be an adaptation to intercropping. Willey and Rao (1980) cited in Ajayi *et al*. (2020) have indicated that a higher CR value indicates a higher competitive ability. Similarly, McGilchrist (1965) cited in Afe (2020) positive A value at the intercrop showed that the crop is dominant and a higher value of A indicates a higher difference between the actual and expected yield.

The significantly lower yield, 267.2 and 273.7 kg/ha respectively for Malete and NCAM of the IITA-288 cultivar at the intercrop is an indication that the cultivar had suffered severe competition from the companion sorghum (Table 3). This suggests that the cultivar has poor adaptation to intercropping. This observation is corroborated by the relatively low CR and negative A values of this cultivar (Table 7). In contrast, the highest grain yield of sorghum 530.3 and 488.4 kg/ha for Malete and NCAM respectively at the intercrop was recorded with this cultivar showing that sorghum was more competitive than cowpea (Table 5). This observation is expected because of the height advantage of sorghum that mutually shaded cowpea which could have reduced sufficient light penetration into cowpea for photosynthesis. This observation is supported with the tallest plant of sorghum in this treatment that could have led to the poor number of branches and pods per plant. This result is consistent with the findings of Ajeigbe *et al*. (2006) and Mohammed *et al*. (2008) which attributed the yield reduction to a lack of below-niche differentiation in root distribution and mutual shading of associated cereals.

The results of the study further showed that Vital-5 performed well at the intercrop as well as the sole at the two locations. The superior quality of the Vital-5 cultivar at both the sole and the intercrop (Table 3) suggests that the cultivar is suitable for intercropping and could be selected where the objective of the farmer balances the nutritional needs for both the protein and carbohydrates.

The plant height of sorghum and leaf area at 6 and 8 WAP as well as the grain yield of as influenced by intercropping with cowpea cultivars are presented in Table 4. Although the height of the sorghum at the sole was taller than the intercrop, it was not significantly different from the sorghum intercrop with cowpea cultivar IITA-288. Except for sorghum intercropping with IITA-288, similar plant heights of sorghum were obtained for sorghum intercropping with other cowpea cultivars. The leaf area of sorghum intercropping with cowpea cultivars followed a similar trend with the plant height.

Days to attain 50 % booting, head length, the weight of 100 seeds, and grain yield of sorghum as influenced by intercropping with cowpea cultivars are presented in Table 5. The sole significantly took longer days to attain booting compared to the intercrop except the sorghum intercropping with IITA-288 cowpea cultivar at the Malete location. There was no significant difference in the number of days to 50% booting among the sorghum at the intercrop at the NCAM location. Except for intercropping with the IITA-256 cultivar, there was no significant difference in the head length and seed weight in sorghum intercrop among the cowpea cultivars. Sorghum intercrop with IITA-256 and IITA-277 cultivars had similar head lengths and seed weights. The head length and seed weight of the sole sorghum was at par with the sorghum intercrop with the IITA-288 cowpea cultivar. The least grain yield of 489.95 and 513.70 kg/ha respectively for Malete and NCAM at the intercrop were obtained in sorghum intercropping with IITA-256 cowpea cultivar. Except for intercropping with the IITA-256 cultivar, there was no significant difference in the grain yield of sorghum at the intercrop in the Malete location. Irrespective of the location, the highest grain yield was obtained at the sole.

The significant effect of cowpea cultivars on the grain yield of sorghum as observed in this study did not conform to the earlier study (Mohammed *et al*. 2008) which reported that the yield and yield components of sorghum were not affected by cowpea genotypes. The contrast could be attributed to differences in the management practices in the two studies. In the previous study, following the farmer’s practice, the crops were not protected from insect pests but in the present study, the crops were sprayed against insect pests. Improving the agronomic practices in an intercrop was reported to enhance productivity (Martin-Guay *et al*. 2018).

The efficiency of intercropping and competitive behavior as measured by the land equivalent ratio (LER), land equivalent coefficient (LEC), Aggressivity (A), and competitive ratio (CR) are presented in Tables 6 and 7. The result indicates that all the intercrop demonstrated intercropping advantages over their respective sole crops at both locations using LER and LEC indices. The maximum LER and LEC values were obtained from intercropping involving the Vital-5 cowpea cultivar with sorghum. The Aggressivity values were positive for IITA-256, IITA-277, and vital-5 cowpea cultivars but negative for cultivars IT98K-491 and IITA-288 at the two locations. The highest A value was obtained with the IITA-256 cowpea cultivar. The CR values for cowpea cultivars IITA-256, IITA-277, and Vital-5 were higher than sorghum at the two locations.

The productivity of the intercrop as measured by LER and LEC indices demonstrated intercropping advantage with all the cowpea cultivars with the highest values obtained when intercropping with Vital-5 cultivar. This observation is expected given the adaptation of this cultivar to intercropping as well as its superior grain yield at the sole. The LER above unity in cereal/legume mixture has been reported by several researchers (Mohammed *et al.,* 2008; Adeniyan *et al*., 2011; Namatsheve *et al*., 2020). The A and CR values that determine the competitive ability of crops in an intercrops differ among the cultivars which further showed that the cowpea cultivars responded differently to intercropping. For instance, the A and CR values for IITA-256, IITA-277, and vital-5 cultivars were respectively positive and higher than sorghum showing that they were more competitive and dominated sorghum at the intercrop. In contrast, the A and CR values were respectively positive and higher for sorghum an indication that sorghum was more competitive and dominated cowpea. The dominance of sorghum over cowpea conforms to results obtained by Oseni and Aliyu (2010), and Afe, 2020).

Conclusion

From this study, there were significant variations in the response of cowpea cultivars to intercropping with sorghum. Among the cultivars Vital-5 performed well at the intercrop as well as the sole. The growth and grain yield of sorghum were influenced by intercropping with cowpea cultivars. The least grain yield of sorghum at the intercrop was obtained in sorghum intercropping with IITA-256 cowpea cultivar. The efficiency of intercropping as measured by LER and LEC indices showed that the maximum LER and LEC values were obtained from intercropping involving the Vital-5 cowpea cultivar with sorghum. The Aggressivity values were positive for IITA-256, IITA-277, and vital-5 cowpea cultivars but negative for cultivars IT98K-491 and IITA-288 at the two locations. The highest A value was obtained with the IITA-256 cowpea cultivar. The CR values for cowpea cultivars IITA-256, IITA-277, and Vital-5 were higher than sorghum at the two locations. Although all the cultivars tested demonstrated an intercropping advantage over their respective sole, Vital-5 was more promising given its superiority at the intercrop as well as the sole and hence, recommended in cowpea/sorghum intercropping in the Southern Guinea Savannah of Nigeria.

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Table 1: Plant Height of cowpea cultivars at 4, 6 and 8 WAP as influenced by intercropping with sorghum.

Treatments			Plant	height (cm)		
		Weeks	After	Planting		
	4		6		8	
Intercrop	Malete	NCAM	Malete	NCAM	Malete	NCAM
IITA-256	12.7ab	16.7b	19.2c	23.6c	22.2b	24.3c
IITA-277	10.7d	13.9e	17.0f	19.2h	21.9b	21.7f
VITAL-5	12.8a	17.2a	21.1a	26.0a	23.2a	27.1a
IT98K-491	10.4de	15.1d	18.6d	20.8f	15.8h	19.3g
IITA-288	10.4de	13.2g	17.1ef	18.2i	19.2f	19.3g
Sole						
IITA-256	10.1e	12.6h	15.7g	17.2j	19.5g	19.9g
IITA-277	12.0c	15.7c	19.1c	21.9e	20.3d	21.8f
VITAL-5	12.4b	15.9c	20.3b	25.0b	21.9b	26.4b
IT98K4914	10.5d	14.7e	17.4e	19.9g	19.3e	22.5e
IITA-288	12.4b	15.9c	20.5b	22.3d	21.4c	23.0d
LSD (P<0.05)	0.303	0.11	0.35	0.17	0.30	0.16

Values with the same letter in the same column are not statistically different at 5% level of probability using Duncan's Multiple Range Test

Table 2: Number of branches and pods/plant, pod length and number of seeds/pod of cowpea cultivars as influenced by intercropping with sorghum.

Treatments	Number of branches/plant		Number of pods/plant		Number of seeds/pod		Pod length (cm)	
Intercrop	Malete	NCAM	Malete	NCAM	Malete	NCAM	Malete	NCAM
IITA-256	10.3b	9.3c	20.0c	17.1e	11.3d	11.9c	17.6bc	16.9abc
IITA-277	8.9c	8.2e	18.1e	16.2f	10.6e	11.6d	16.1e	16.4abc
VITAL-5	10.3b	8.7d	19.1d	17.0e	11.5cd	11.6d	17.1cd	16.9abc
IT98K-491	7.4d	6.9g	17.1f	15.3h	10.5e	10.2f	15.5ef	15.8bc
IITA-288	6.7d	6.8g	17.0f	14.4i	10.4e	10.1f	15.1f	15.1c
Sole								
IITA-256	8.9c	7.9f	17.8e	15.8g	10.6e	10.9e	15.6ef	16.4abc
IITA-277	10.4b	9.4c	20.2c	17.4d	11.6bcd	11.9c	17.8ab	17.2ab
VITAL-5	11.8a	10.9a	25.1a	23.0a	12.8a	13.7a	18.4a	18.2a
IT98K4914	11.0b	9.4c	22.2b	19.0c	11.9bc	12.8b	17.8ab	17.6ab
IITA-288	11.8a	10.1b	22.6b	20.7d	12.0b	12.9b	18.1ab	18.1a
LSD (P<0.05)	0.73	0.14	0.67	0.19	0.40	0.12	0.61	0.13

Values with the same letter in the same column are not statistically different at 5% level of probability using Duncan's Multiple Range Test.

Table 3: Days to 50 % flowering, leaf area at 8 WAP, weight of 100 seeds and grain yield of cowpea cultivars as influenced by intercropping with sorghum.

Treatments	Days to 50 %	flowering	Leaf area at	8WAP (cm)	Weight of	100 seeds (g)	Grain yield	(kg/ha)
Intercrop	Malete	NCAM	Malete	NCAM	Malete	NCAM	Malete	NCAM
IITA-256	40.3cde	35.3d	33.1e	42.8e	18.0ab	17.8b	409.1f	398.6e
IITA-277	40.7bcde	38.3b	29.5g	40.2g	16.1cd	16.1e	301.6g	298.8f
VITAL-5	39.0e	32.3h	32.8f	41.1f	18.5ab	17.8b	408.5f	379.0e
IT98K-491	41.0bcd	38.3b	28.2h	35.9i	15.7cd	15.7f	293.0i	280.7h
IITA-288	42.7a	38.7a	28.1h	34.8j	15.3d	15.2g	267.2j	273.7i
Sole								
IITA-256	42.3ab	36.3c	28.4h	38.0h	15.9cd	15.9ef	445.7	432.8g
IITA-277	41.3abcd	34.3f	37.8d	47.1d	17.1bc	17.0c	481.2d	434.2c
VITAL-5	39.7de	34.0g	50.3a	61.1a	18.9a	18.2a	591.3a	530.0a
IT98K4914	41.7abc	35.0e	39.8c	50.8c	17.0bcd	16.5d	509.7c	434.3c
IITA-288	40.0de	34.0g	41.2b	60.0b	17.8ab	17.6b	530.3b	488.4b
LSD	1.44	0.11	0.34	0.17	0.37	0.127	0.32	0.21

Values with the same letter in the same column are not statistically different at 5% level of probability using Duncan's Multiple Range Test.

Table 4: Plant height and leaf area of sorghum at 6 and 8 WAP as influenced by intercropping with cowpea cultivars.

Treatments	Plant height (cm)				Leaf Area (cm)			
	6 WAP		8WAP		6 WAP		8WAP	
Intercrop	Malete	NCAM	Malete	NCAM	Malete	NCAM	Malete	NCAM
IITA-256 + Samsorg47-Skv8	17.33b	18.23c	31.77b	19.27c	76.47b	71.11c	82.49c	115.67c
IITA-277 + Samsorg47-Skv8	17.37b	19.23c	35.80b	19.27c	88.23ab	71.59c	107.63bc	123.32c
Vital-5 + Samsorg47-Skv8	19.10ab	19.50c	37.23b	21.67bc	98.84ab	79.28bc	109.44bc	129.09c
1T98K-491 + Samsorg47-Skv8	20.23a	20.77bc	47.53a	22.40bc	100.20ab	80.88abc	119.66ab	136.45bc
IITA-288 + Samsorg47-Skv8	20.57a	23.63ab	47.63a	24.27ab	121.80ab	85.02ab	130.70ab	154.29ab
Sole	20.70a	25.03a	48.20a	27.07a	134.30a	89.30a	142.50a	161.20a
LSD	3.29	0.27	15.26	0.27	73.28	0.20	43.77	0.15

Values with the same letter in the same column are not statistically different at 5% level of probability using Duncan's Multiple Range Test

Table 5: Days to 50 % booting, head length, weight of 100 seeds and yield of sorghum as influenced by intercropping with cowpea cultivars

Treatments	Days to booting	50%	Head (cm)	Length	Weight Seeds	100 (g)	Grain (kg/ha)	Yield
Intercrop	Malete	NCAM	Malete	NCAM	Malete	NCAM	Malete	NCAM
IITA-256 + Samsorg47-Skv8	69.33c	64.33b	17.67c	18.33c	4.10c	3.70c	489.95c	613.70d
IITA-277 + Samsorg47-Skv8	71.33bc	65.33b	20.80bc	21.90bc	4.17bc	3.80bc	730.80bc	653.75cd
Vital-5 + Samsorg47-Skv8	71.33bc	65.33b	22.63ab	22.30abc	4.57abc	3.83bc	807.79bc	935.05bcd
1T98K-491 + Samsorg47-Skv8	72.00b	65.33b	23.13ab	24.00ab	4.67ab	4.32ab	882.89b	987.60abc
IITA-288 + Samsorg47-Skv8	72.67ab	67.93a	23.67ab	25.17ab	4.93a	4.37a	898.50b	1076.87ab
Sole	74.67a	68.32a	25.20a	26.20a	5.01a	4.57a	1246.70a	1541.32a
LSD	3.78	0.21	5.53	0.25	0.84	0.20	568.30	0.29

Values with the same letter in the same column are not statistically different at 5% level of probability using Duncan's Multiple Range Test.

Table 6: Evaluating intercropping advantages in cowpea-sorghum intercropping.

Treatments		**Partial**	**LER**		**LER**		**LEC**	
	Malete		**NCAM**		**Malete**	**NCAM**	**Malete**	**NCAM**
Intercrop	**Cowpea**	**sorghum**	**Cowpea**	**sorghum**				
IITA-256	**0.92**	**0.39**	**0.91**	**0.33**	**1.31**	**1.30**	**0.35**	**0.30**
IITA-277	**0.63**	**0.57**	**0.69**	**0.42**	**1.20**	**1.10**	**0.35**	**0.29**
VITAL-5	**0.69**	**0.65**	**0.72**	**0.61**	**1.34**	**1.32**	**0.45**	**0.43**
IT98K-491	**0.57**	**0.71**	**0.64**	**0.64**	**1.28**	**1.29**	**0.40**	**0.41**
IITA-288	**0.50**	**0.72**	**0.56**	**0.70**	**1.22**	**1.26**	**0.36**	**0.39**
Sole					**1.00**	**1.00**	**0.25**	**0.25**

Table 7: Evaluation Competitive Behaviors in Cowpea-Sorghum Intercropping

Treatment	CR				A			
	Malete		NCAM		Malete		NCAM	
	Cowpea	Sorghum	Cowpea	Sorghum	Cowpea	Sorghum	Cowpea	Sorghum
IITA-256	2.36	0.42	2.76	0.36	0.53	-0.53	0.52	-0.52
IITA-277	1.11	0.90	1.64	0.61	0.04	-0.04	0.27	-0.27
VITAL-5	1.06	0.94	1.18	0.85	0.04	-0.04	0.11	-0.11
IT98K-491	0.80	1.25	1.00	1.00	-0.14	0.14	0.01	-0.01
IITA-288	0.69	1.44	0.80	1.25	-0.22	0.22	-0.14	0.14
Sole								

CR=Competitive ratio, A=Aggressivisity