Yield Performance of Some Cowpea Varieties under Sole and Intercropping with Maize at Bauchi, Nigeria

Ibrahim Hamza Alhaji

Abstract

Field experiments were conducted during the 1997 and 1998 rainy seasons at the Abubakar Tafawa Balewa University Research Farm, Bauchi ($10^0$20'N and $9^0$48'E) to investigate the yield performance by some cowpea varieties under sole and intercropping with maize at Bauchi, Nigeria. Treatments consisted of three planting patterns (sole cowpea, cowpea/maize and sole maize) and ten cowpea varieties (IT89KD-391, IT93K-452-1, IT90K-277-2, IT86D-719, IT89KD-349, IT93K-734, IT93K-273-2-1, IT90K-372-1-2, and yar dunga (L)) combined factorially in a split plot design. Results revealed that cowpea plant height, days to fifty percent flowering; leaf area and leaf area indices were not significantly affected by intercropping in 1997 and 1998. The mean number of pod/plant, pod weight and seed yield of the cowpea varieties were significantly different in maize intercrop. Intercropping was also significant in affecting the plant height, leaf area and leaf area indices of maize in 1997 and 1998 cropping season. Similarly maize cob weight, stover and grain yield were significantly affected by intercropping. Land equivalent ratio greater than 1.00 and a maximum 2.11 were recorded in the two years of the investigation. For intercropping purpose, it is therefore suggested that varieties IT90K-372-1-2, IT90K-277-2, IT88D-867-11, IT89KD-391 and IT86D-719 are more suitable for high yield in Bauchi.

Introduction

In spite of the high productivity of crops when planted sole and the ease of efficient utilization of inputs for improved agronomic practices, intercropping system continued to dominate the cropping pattern of peasant farmers in Nigeria. Some of the advantages attributed to mix as compared to sole cropping include risk aversion,

extensive and intensive use of resources (land and labor), greater return per unit land area, reduction of pest and diseases and the possible improvement of soil fertility. Intercropping legumes with cereals especially maize is a common practice in the northern guinea savanna ecological zone of Nigeria.

In the West Africa savanna, the intensification of agricultural systems has resulted in declining nutrient availability, soil acidification, compaction and build-up of pest problems seriously affecting soil productivity and affecting soil fertility and the overall yield of crops (Webber et al, 1996). Recently there has been a renewed effort to address these problems through the introduction of legumes into the production systems (COMBS, 1993). In terms of land use growing crops in mixed stand is regarded as more productive than growing them separately. One of the justifications is the belief that some of the nitrogen fixed by the legume would be transferred to the associated crops. It has been reported that the inclusion of legumes in grass pastures often increase grass and protein yield as a result of the nitrogen fixed by the legume to the associated crop especially when they grow together for a long period (Goodman and Collinson; 1986). The yield advantages of legume- cereal intercropping system over sole have been reported (Pal et 'al, 1993). However results demonstrated varietal differences in the cowpea response to method of planting. Elemo and Olufajo (1991) observed that maize grain yield was not affected by the intercropped cowpea, but cowpea grain yield was reduced by 19% in the sole crop.

Planting pattern has been shown to differentially affect intercrop yield. Agboola and Fayemi (1971) found that there was no significant difference between alternating pure stand rows versus mixed stand rows, and that maize intercrop yielded significantly more when planted in alternate rows than when planted in the same row with cowpea.

In the guinea savanna zone of Nigeria, it has been found that, the highest maize yield from a mixture was attained when two stand of maize alternate with one stand of cowpea, and highest yield of cowpea were attained by alternating two rows of cowpea with one row of maize (Anonymous, 1983). Blade and Terao (1993) reported that an improved erect early variety, IT82D-716 produced higher grain yield in high density monocropping, but yield was low when intercropped with cereal. The local spreading type is more adapted to intercropping, although the grain yield was low relative to IT86D-716. Wanki et al (1982) reported an increased yield of maize and cowpea when intercropped than when grown as sole crops. Ofori and Stern (1982) reported an increased dry matter production, yield and leaf area index in maize-pigeon pea intercropping system as compared to sole crops. While intercropping maize with either beans or cowpeas decreased total yield of grain (cereal and legume) per hectare, intercropping sorghum with pigeon peas increased total grain yield per hectare (Enyi, 1973).

Several different concepts have been developed to assess yield of intercrops. As yields of different crops cannot be compared directly with each other, but it is generally accepted that more than one yield analysis should be applied to intercropped data. Wiley (1979) proposed the land equivalent ratio (LER), which is the relative land required as sole crop to produce the same yield as intercropping, mathematically expressed as ;

$$\text{LER} = \frac{\text{intercropped yield of crop A}}{\text{Sole yield of crop A}} + \frac{\text{intercrop yield of crop B}}{\text{Sole yield of crop B}}$$

It provides a standardized basis for crops to be added to form "combined" yields.

In intercrop systems, the major soil nutrient for which component crops compete when in limited supply are nitrogen, phosphorus and potassium. Savanna soils are known to be low in organic matter and

since nitrogen has been known to be a most important limiting factor for cereal production, frequent addition of these nutrients is required for high yield maintenance. In the guinea savanna yields of crops under intercropping conditions is low due to poor standard of husbandry and factors related to fertilizer use.

The increasing high cost of chemical fertilizers and the scarcity of the commodity call for a relatively cheaper alternative to fertilizer application, so as to increase crop production while at the same time improving the fertility of the soil.

In view of the above, this research was undertaken in other to study the yield performance of some cowpea varieties and maize under sole and intercropping.

Materials and Method

Experimental site:

Field experiment was conducted during the wet season (May-October) of 1997 and 1998 at the Abubakar Tafawa Balewa University research farm, Bauchi (located at approximately $10^0$22'N and $9^0$47'E) with an elevation of 609.52M above sea level in the Northern guinea Savanna ecological zone of Nigeria. The soils of Bauchi state are mostly sandy loam, slightly to moderately acid in reaction; therefore the soil can be described as fragile.

Treatment and Experimental Design:

The treatment consisted of three planting patterns (sole cowpea, cowpea + maize, and sole maize) which make up the main treatments and ten cowpea varieties (IT89KD-391, IT93K-452-1, IT90K-277-2,IT86D-719, IT89KD-349, IT88D-867-11,IT93K-734, IT93K-273-2-1, IT90K-370-1-1 and Yar dunga (local variety) as control, constituting the sub-treatments combined factorially in a split plot design in three replications and randomly allocated to plots.

Planting and Planting Materials

The land was cleared and harrowed twice to obtain a fine tilt. The field was then marked out into sixty plots of $15m^2$ and $24m^2$ for sole

and intercropped plots respectively. A discard of 2m was allowed in between replications and 1m between plots.

Planting was carried out for the first and second cropping season on the 22nd June and 6th June 1997 and 1998 wet season respectively. The cowpea varieties were the improved type, high yielding and semi-upright, while maize variety TZE-DMR was used. The cowpea and maize were all sown simultaneously using a plant spacing of 75cm x 25cm row to row and plant to plant for cowpea and 75cm x 30cm for maize. In the intercropped plot two rows of maize was planted with four rows of cowpea.

Observation and Data Collection:
All observations on growth and yield components were made on five plants randomly sampled from two outer rows. Data collected on the growth of the crop included; plant height, leaf area and leaf area index, number of pods/plant, number of seeds/pod, seed weight, threshing percentage and weight of 1000 seed for cowpea were recorded. In the case of maize, number of cobs/plot, cob weight, shelling percentage, stover and grain yield were recorded using appropriate methods and procedure.

Analysis of Data:
The MSTAT statistical package was used to analyze the data. Whenever the treatment effects were significant, the Duncan Multiple Range Test (DMRT) was used to compare treatment means.

Results and Discussion
Statistical analysis of the data on maize plant height in 1997 and 1998 indicated that maize was significantly affected by intercropping with cowpea varieties. Intercropping maize with varieties IT90K-277, IT86D-719, and IT88D-867-11 leads to a significant reduction in maize plant height (Table 1). This investigation does not corroborate the finding of Desir and Pinchinat (1976), who reported that there was no significant difference between mixed or sole crops in terms of plant

height.. Maize leaf area and leaf area index were significantly affected by intercropping with cowpea varieties. The highest leaf area and leaf area index were recorded with varieties IT90K-277-2, IT89KD-391, IT90K-372-1-2, and the local control variety.

On cowpea growth parameters, there was no significant intercropping effect on sole cowpea plant height and days to 50% flowering in 1997 and 1998 (Table 2). The leaf area and leaf area index of the various cowpea varieties were also not significantly affected by intercropping. Generally there was no significant varietal intercropping effect on all the growth parameters observed for cowpea. This result is in agreement with the finding of Singh (1981). Although non-significant, intercropping produced taller cowpea plants, with the local variety producing the tallest plants in 1998. Similarly, leaf area and leaf area index per plant of cowpea varieties were greatly improved when intercropped with maize. This agrees with the finding of Ofori and Stern (1987) who reported similar increases in dry matter production, leaf area and leaf area index under intercropping system.

The grain yield potential of cowpea is generally low when compared with cereal crops like maize and sorghum even when optimal agronomic practices are fully adopted. Result of this investigation show that cowpea performed better when grown as a sole crop than when grown in a mixture (Table 3). The number of pods/plant, pod weight and seed yield were significantly reduced when intercropped with maize. Although there was a general reduction in the yield of cowpea as a result of intercropping, highest grain yield was recorded with varieties IT86D-719, IT88D-867-11, IT90K-372-1-2, and IT89KD-319 when intercropped with maize. This corroborates the findings of Ofori and Stern (1987) who reported a yield depression of cowpea as a result of intercropping, but definitely not in agreement with the findings of Singh and Ahuja (1990) who have reported a yield increase as a result of intercropping sorghum with cowpea. The number of seeds/pod and threshing percentage revealed a non-significant effect of intercropping, however there was a decrease in

threshing percentage in 1997. This agrees with the finding of Blade and Terao (1993).

The result of the investigation on maize yield and yield component revealed a significant effect of intercropping with cowpea varieties on the cob weight of maize. In 1997 cropping season, a significant reduction in maize cob weight was observed when compared with the sole with the exception of varieties IT90K-277-2 and IT90K-372-1-2 which gave a higher cob weight of 3200kg/ha and 3300kg/ha respectively (Table 4). This is in agreement with the findings of Pal et al (1993) who reported yield advantages of legume-cereal intercropping over sole cropping. In 1998, highest cob weight was recorded for maize (3620kg/ha) when grown as sole crop compared to when grown in a mixture (Table 4). This yield advantage of the sole over the mixture can be attributed to competition among the intercrop maize with the cowpea for available nitrogen (Bonny 1990). Shelling percentage and 1000-grain weight of maize were non-significant. However 1000-grain weight was increased with intercropping in 1998 cropping season (Table 4). The effect of intercropping on maize stover yield in 1997 and 1998 was significant. In 1997, the highest stover yield for maize was recorded with varieties IT88D-867-11, IT90K-372-1-2 and IT90K-277-2 with corresponding yield values of 4350kg/ha, 4300kg/ha, and 3800kg/ha, while intercropping with variety IT89KD-349 significantly reduce maize stover yield. The grain yield of maize was also significantly affected by intercropping in 1997; this is in agreement with Pal et al (1993), who have reported a yield advantage of intercropping over sole cropping (Table 5). In 1998 the grain yield of maize was significantly reduced when grown in intercrop with cowpea varieties, highest grain yield was obtained in pure stand than in intercrop. Although maize grain yield was significantly reduced in 1998 cropping season, the land equivalent ratio shows an advantage of intercrops over the sole crop. This agrees with the findings of Burton et al (1983). The values of land equivalent ratio recorded were greater than 1.00 with maize intercrop, which

implies an advantage over sole cropping; this further corroborates the findings of Pal et al (1993) and Burton et al (1983).

Generally, yield in 1998 was highest for all the treatments compared to 1997.These is due to climatic variation, especially rainfall experienced during the two year period of the investigation.

Conclusion and Recommendation

Cowpea growth parameters were not significantly affected by intercropping in both 1997 and 1998. Number of pods/plant, pod weight and seed yield of cowpea were significantly reduced when intercropped with maize. For maize intercropping with cowpea varieties was significant in affecting the growth parameters, cob weight, stover and grain yield. Land equivalent ratio greater than 1 and a maximum of 2.29 was recorded in the two years of the investigation.

Based on the result of the two year field investigation, it may therefore be suggested that for intercropping purposes, cowpea varieties IT90K-372-1-2, IT90K-277-2, IT88D-867-11, IT89KD-391 and IT86D-719 are more suitable with maize for high yield in Bauchi environment. However research is needed on nitrogen fixation and factors influencing N-transfer between the crops.

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Table 1: Effect of Intercropping Cowpea Varieties on the Growth Parameters of Maize in a Mixture at Bauchi In 1997 and 1998.

Treatment	1997			1998		
	Plant height(cm)	Leaf area (cm^2)	Leaf area Index	Plant height(cm)	Leaf area (cm^2)	Leaf area Index
Sole	198.3	1570.2	4.2	248.6	1976.2	5.3
IT89KD-391	194.5b	1231.3c	3.3c	220.0c	1531.3b	4.1c
IT93K-452-1	190.3b	998.4b	2.7b	203.3b	1159.7a	3.1a
IT90K-277-2	160.3a	1095.6b	2.9b	206.7b	1456.0b	3.9c
IT86D-719	167.1a	882.5a	2.4a	161.7a	1279.1b	3.4b
IT89KD-349	195.8b	905.3a	2.4a	208.3b	1017.0a	2.7a
IT88D-867-11	169.2a	798.4a	2.1a	175.0a	1210.8b	3.2b
IT93-734	187.2b	801.2a	2.1	193.3b	1219b	3.3b
IT93K-273-2-1	187.9b	798.9a	2.1a	165.0a	887.5a	2.4a
IT90K-372-1-2	200b	687.6a	1.8a	208.3b	1326.1b	3.6b
Yar Dunga (L)	204.3b	1100.2b	2.9b	216.7b	1184.9ab	3.2a
SE	14.2	108.4	0.42	20.2	180	0.32

Means followed by the same letters are not significantly different at 5% level of significance, according to the Duncan Multiple Range Test (DMRT

Table 2: Effect of Intercropping Cowpea Varieties with Maize on Cowpea Growth Parameters at Bauchi in 1997 and 1998

	MAIZE							
	1997				1998			
Treatment	Plant height(cm)	DFF	Leaf area (cm^2)	Leaf area Index	Plant height(cm)	DFF	Leaf area (cm^2)	Leaf area Index
IT89KD-391	48.6	50	19.9	0.26	68.7	48	29.3	0.39
IT93K-452-1	51	45	20.5	0.27	62.3	46	30.2	0.40
IT90K-277-2	39.4	46	21.6	0.29	64.3	46	29	0.38
IT86D-719	59.4	44	25.1	0.33	69.8	45	29.8	0.39
IT89KD-349	49.2	45	24.1	0.32	58.5	44	28.9	0.38
IT88D-867-11	53.8	45	23.4	0.31	64.9	45	27.9	0.37
IT93-734	61.8	43	21.3	0.28	61.7	42	30	0.40
IT93K-273-2-1	59	42	22	0.29	70.0	42	31.1	0.41
IT90K-372-1-2	52.3	43	21.7	0.29	68.1	43	33.4	0.44
Yar Dunga (L)	83.4	64	25.0	0.33	82.2	65	33.9	0.45
Significance level (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
SE	3.69	2.05	0.58	0.0078	2.08	2.13	0.61	0.008

NS – Not significant DFF – Days to 50% flowering

Means followed by the same letters are not significantly different at 5% level of significance according to the Duncan Multiple Range Test (DMRT).

Table 3: Effect of Intercropping on Yield and Yield Component of Cowpea Varieties in a Cowpea/Maize Mixture in 1997 and 1998 at Bauchi

Treatment	1997					1998				
	No of pods/ plant	No of seeds/pod	Pod wt (kg/ha)	Threshing %	Seed yield(kg/ha)	No of pods/plant	No of seeds/pod	Pod wt (kg/ha)	Threshing %	Seed yield(kg/ha)
IT89KD-391	35b	10	1440c	74	1077b	32b	14	1580b	79	1262b
IT93K-452-1	40c	11	892a	76	680a	35b	15	1260a	78	989ab
IT90K-277-2	42c	11	1075b	80	860a	42c	13	1500b	79	1199b
IT86D-719	38bc	12	1392bc	75	1050b	38b	15	2240c	76	1723c
IT89KD-349	37bc	13	960a	78	754a	36b	12	1554b	78	1226b
IT88D-867-11	45c	11	1402c	79	1120b	39b	13	2062c	77	1592c
IT93-734	33b	10	832a	76	640a	40c	14	1120a	79	895a
IT93K-273-2-1	36bc	11	934a	77	721a	36b	13	1320b	79	1049b
IT90K-372-1-2	42c	12	1580c	75	1196b	44c	13	1825c	80	1460c
Yar Dunga (L)	21a	8	840a	64	542a	19a	10	1190a	66	791a
Significance level (0.05)		NS		NS			NS		NS	
SE	2.11	0.43	181.4	2.78	145.4	2.20	0.47	237.2	2.60	191.4

Means followed by the same letters are not significantly different at 5% level of significance according to the Duncan Multiple Range Test (DMRT).

N S – Not significant

Table 4: Effect of Intercropping Cowpea Varieties on Yield Components of Maize In1997 and 1998 at Bauchi

Treatment	MAIZE					
	1997			1998		
	Cob wt(kg/ha)	Shelling (%)	1000-grain wt(g)	Cob wt(kg/ha)	Shelling (%)	1000-grain wt(g)
Sole	2980	77	264	3620	83	303
IT89KD-391	2540b	78	278	2640b	78	298
IT93K-452-1	1980a	75	274	1870a	75	300
IT90K-277-2	3200c	79	276	3420c	78	301
IT86D-719	2170a	79	274	2470ab	78	299
IT89KD-349	1900a	79	280	2100a	77	302
IT88D-867-11	2900b	78	280	3170c	76	299
IT93-734	2650b	77	278	2980c	76	300
IT93K-273-2-1	2100a	77	279	2200b	77	303
IT90K-372-1-2	3300c	78	280	3200c	77	297
Yar Dunga (L)	2180a	76	276	1980a	74	302
Level of significance(0.05)		NS	NS		NS	NS
SE	320.8	0.45	0.75	355.8	0.38	0.59

Means followed by the same letters are not significantly different at 5% level of significance according to the Duncan Multiple Range Test (DMRT).

N S – Not significant

Table 5: Effect of Intercropping Cowpea Varieties on the Yield of Maize and LER in 1997 and 1998 at Bauchi

Treatment	MAIZE					
	1997			1998		
	Stover yield(kg/ha)	Grain yield(kg/ha)	LER	Stover yield(kg/ha)	Grain yield(kg/ha)	LER
Sole	3500	2298	-	6583	3005	-
IT89KD-391	3380a	1991b	1.86	5070a	2070b	1.61
IT93K-452-1	3125a	1485a	1.62	3612a	1412a	1.40
IT90K-277-2	3800b	2558c	2.09	5066b	2668c	1.78
IT86D-719	3480b	1720a	1.70	4640b	1930b	1.62
IT89KD-349	3002a	1500a	1.63	4100ab	1623b	1.42
IT88D-867-11	4350c	2262c	2.01	5800c	2425c	1.6
IT93-734	3980b	2046bc	1.78	4975b	2288c	1.51
IT93K-273-2-1	3400a	1623a	1.73	3980a	1700b	1.49
IT90K-372-1-2	4300c	2600c	2.11	5733c	2467c	1.54
Yar Dunga (L)	3180a	1676a	1.66	3750a	1477a	1.51
SE	305.4	193.2	-	747.1	282.0	-

Means followed by the same letters are not significantly different at 5% level of significance according to the Duncan Multiple Range Test (DMRT).

N S – Not significant