Influence of height of maize variety on the productivity of intercropped maize (*Zea mays* L.) and cowpea (*Vigna unguiculata* (L.) Walp)

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ABSTRACT

A 2-year field study was conducted to compare the productivity of intercropped and monoculture maize and cowpea as influenced by the height of maize in the intercrop. During the 1994 and 1995 cropping seasons, IT 84E-124, a semi-erect, early-maturing and photoperiod-insensitive cowpea cultivar, was planted with "Afo", a short (1.2 m), early maturing, less vegetative, and DMRSR-Y, a tall (1.5 m), improved open-pollinated and of medium maturity group maize cultivars in a row intercropping. Yield components and grain yield of maize and cowpea were lower under intercropping than in monoculture systems. Intercropped cowpea yields were decreased by 29 and 26 per cent, respectively, under the short and tall maize varieties, while the yields of intercropped maize were reduced by 11 and 33 per cent for the short and tall varieties, respectively, across the two seasons. Land equivalent ratio (LER) was, however, greater with the shorter maize variety than with the taller variety (1.60 vs 1.41), and was greater with the intercrops than with the monocultures (1.51 vs 1.00) across the two seasons. The results of this study indicate that although intercropping may result in decreases in the yield of one or both of the component crops in a maize-cowpea mixture, the productivity of a unit land area is higher with intercropping than with monocultures. The higher LER with the shorter maize variety in this study suggests that intercropping may be more remunerative when short and less vegetative cereal varieties are used in mixtures with legume crops.

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RÉSUMÉ

ABAYOMI, Y. A.: *Influence de la taille de variété de maïs sur la productivité de maïs (*Zea mays *L.) semé en lignes alternantes de dolique (*Vigna unguiculata *(L.) Walp).* Une étude de 2 années sur le champ s'est déroulée pour comparer la productivité de deux cultures et monoculture de maïs et dolique comme influencée par la taille de maïs semé en lignes alternantes de l'autre culture. Pendant les saisons des semailles de 1994 et 1995 IT 84E-124, une variété de dolique, de semi-debout, de maturation tôt et de photopériode insensitive était semé avec "Afo" une variété courte (1.2 m) de maïs, de maturation tôt et moins végétatif et avec DMRSR-Y une variété haute (1.5 m) de maïs amélioré de pollinisation libre et de groupe de maturation moyenne, en lignes alternantes. Les composants de rendement et le rendement de grain de maïs et de dolique tous deux étaient plus basses sous les semailles en lignes alternantes que dans les systèmes de monoculture. Les rendements de dolique semé entre les lignes d'une autre culture diminuaient par 29 et 26 pour cent respectivement sous la variété courte et haute de maïs, alors que les rendements de maïs semé entre les lignes d'une autre culture réduisaient par 11 et 33 pour cent respectivement pour les variétés courtes et hautes au cours des deux saisons. La proportion de l'équivalent de terre (PET) était, cependant, plus grande avec la variété courte de maïs qu' avec la variété haute (1.60 vs 1.41) et plus grande avec les deux cultures en lignes alternantes qu' avec les monocultures (1.51 vs 1.00) au cours des deux saisons. Les résultats de cette étude indiquent que malgré le fait que les semailles en lignes alternantes puissent mener aux diminutions en rendement de l'une ou de toutes deux cultures composantes dans le mélange de maïs-dolique, la productivité d'une unité de superficie de terre est plus élevée avec les deux cultures alternantes qu' avec les monocultures. PET plus élevée avec la variété plus courte de maïs comme obtenue dans l'étude en question suggérait que les semailles en lignes alternantes pourraient être plus rémunératrices lorsque les variétés de céréale moins végétatives et courtes sont utilisées dans les mélanges avec les cultures légumineuses.

Introduction

Intercropping of cereals and legumes is a common practice in tropical agricultural systems. However, there are conflicting reports about the effect of intercropping on the yields of the component crops. Gunasema, Sangakarva & Wrickemasinghe (1979) reported that intercropping cowpea with maize increased maize yield by up to 103 per cent, while Abayomi & Jatto (1998) showed that intercropping maize with cowpea resulted in about 74 per cent decrease in the yield of maize and a decrease of 36 per cent in the yield of cowpea compared to their monocultures. However, Ahmed & Sadik (1978) had earlier reported no significant yield differences between maize grain alone or intercropped with cowpea. Many other studies have shown that maize suppresses yield of intercropped legumes (Mutsaers, 1978; Francis, Flow & Prager, 1978; David & Garcia, 1983), while others have reported yield depression of maize intercropped with cowpea (Agboola & Fayemi, 1971; Enyi, 1973; Wien & Nangju, 1976; Fisher, 1977; Adetiloye, 1980). Remison (1978) reported an increase in maize yield as a result of intercropping with cowpea. Agboola & Fayemi (1971) attributed the yield reduction in maize in the intercrop to competition for moisture during the second season with intermittent drought spells of South-western Nigeria. Similarly, Fisher (1977) observed yield reduction in maize grain yield during the years of inadequate rainfall in the Kenyan highlands.

The reduction in the yield of component crops in an intercrop have been attributed to reduced N-fixation by the legume component due to decreased nodulation (Erikson & Whitney, 1984), thereby resulting in inter-specific competition for N; hence, reduced growth and yield (Abayomi & Jatto, 1998). Adetiloye (1980), however, suggested that the application of inorganic N to the intercrop can reduce such competition. Thus, many workers have shown the importance of N application on the productivity of intercropped cereals and legumes. Abayomi & Jatto (1998) showed that yield decreases due to intercropping maize and cowpea were from 79 to 25 per cent for maize, and 36 to 21 per cent for cowpea by applying 80 kg N/ha. Similar yield enhancement of intercropped cereals and legumes had been reported earlier by Beets (1977), Adetiloye (1980), and Ezumah, Nam Walker (1987).

In addition to the effect of inadequate N, cereal architecture is another important factor which influences the performance of the intercropped legumes. Profiles of light and leaf area indices in crop canopies indicate that a shorter cereal crop promotes productivity of legumes in intercrop over the tall types. Tarhalkar & Rao (1975) reported that dwarf sorghum (*Sorghum bicolor* (L.) Moench) varieties offer less competition to intercropped legumes than tall varieties. Similarly, Vorasoot *et al.* (1976) reported that soybeans (*Glycine max* L.) and peanuts (*Arachis hypogeae* L.) grown with tall sorghum yielded less than those grown with short sorghum. Wahua & Miller (1978a, 1978b) also reported that soybean yields with short and tall sorghum were reduced by 18 and 76 per cent, respectively, compared to monocrop yields, while Ezumah *et al.* (1987) showed that cowpea yield was higher when it was intercropped with a shorter maize cultivar than with a taller cultivar. The choice of correct cultivars and agronomic manipulations to ensure the most effective use of the limiting resources has been suggested to be a key element for high crop yield in intercropping systems (Fukai & Trenbath, 1993).

It was, therefore, the objective of this study to evaluate the effect of maize architecture on the productivity of intercropped maize and cowpea.

Materials and methods

Factorial experiments were conducted at the Teaching and Research Farm of the University of Ilorin, Bolorunduro (8° 29' N; 4° 35' E) in the southern Guinea savanna zone of Nigeria during the 1994 and 1995 cropping seasons. The soil of the experimental site was Alfisol (USDA taxonomy). Mean surface soil (0-15 cm) properties at the beginning of the study in 1994 were as follows: 1. the soil had a *p*H (1:1 H_2O) 6.5, 6 g/kg organic carbon, 1 g/kg N, and 1.2 cmol/kg (Bray No. 1 P); 2. the concentrations of the extractable cations were 4.31 Ca; 2.5 Mg and 0.2 K in cmol/kg; and 3. the particle size distribution was 465 sand, 394 silt and 150 clay in g/kg. In the 2 years of study, the experimental area was disc-ploughed, harrowed and ridged, after which plots measuring 30 m^2 consisting of five ridges, 1.5 m apart and 5 m long, were marked out with 1 m alley between plots.

The experiments were designed as a split plot in randomized complete block arrangement with the cropping system as the main plots and maize variety as subplots.

Two maize varieties, "Afo", a short (1.2 m), less vegetative and early maturing (80-90 days), and DMRSR-Y, an improved open-pollinated, downey mildew and streak-resistant tall (1.5 m) and of medium-maturity group (110 days), were evaluated under two cropping systems of monoculture and intercropping with an early-maturing (60-65 days), semi-erect, and photoperiod-insensitive cowpea variety, IT84E-124. Maize and cowpea were planted on the same day, 5 May 94 and 15 May 95, respectively, using an additive (1:1) model of row intercropping. Two rows of maize spaced at 0.75 m × 0.5 m were planted within three rows of cowpea spaced at 0.5 m × 0.3 m. Seeds dressed with Apron Plus (fungicide/insecticide) were planted at the rate of four seeds per hill, and later thinned to two plants per hill for populations of 53 333 and 133 333 plants ha^{-1} for maize and cowpea, respectively. Spacing and plant populations of the monocultures were the same as in the intercrop.

The monoculture and intercropped maize were given inorganic N at a rate of 80 kg N/ha by using NPK (20 : 10 : 10). The fertilizer was applied as top dressing in two splits at 2 and 6 weeks after planting (WAP). Weeds were controlled with the traditional hoe at 3 and 6 WAP. At full vegetative stage and before blooming, the cowpea plants in the two cropping systems were sprayed with an insecticide, Karate E.C 2.5 (a.i 25 g/l lambda - cyhalothrin), at 3 ml/l of water sprayed with a knapsack sprayer to protect them against sucking and boring insects. The concentration of the insecticide was increased to 5 ml/l of water at full flowering, and spraying continued at 10-day intervals until physiological maturity of pods.

At harvest, yield components such as ear length, ear circumference, number of kernel rows, number of kernels per cob, number of ears per plot, and 100-seed weight were recorded from 20 randomly selected maize plants per plot. Similar samples were taken for cowpea to measure number of pod-bearing branches, number of branches without pods, pod length, and number of seeds per pod. The remaining plants in a plot were later harvested and processed to determine grain yields of maize and cowpea. Relative yield (RY) and LER were calculated for each variety. RYs were determined by dividing the intercrop yields by their monoculture yields according to Elmore & Jackobs (1984). LER is a summation of the RYs for all varieties in a mixture. The effects of season, cropping system, and maize variety were tested by a combined analysis of variance of the 1994 and 1995 results using the split-split plots model. Differences among means were separated by Duncan's Multiple Range Test at 5 per cent probability level.

Results and discussion

Combined analyses of the 1994 and 1995 results showed that seasonal differences were not significant for maize yield components and grain yield (Table 1). However, the effects of cropping system and maize variety were significant for most yield components and grain yield. All the first and second order interactions were not significant, except Year × Maize variety interaction which was significant for the number of ears per plot. Similar analyses of cowpea yield components and grain yield showed that the effects of season and maize variety were not significant for any of the measured parameters, while the effects of cropping system were significant for most components and grain yield (Table 2). Only the effects of Year × Maize variety were also significant for the number of pod-bearing branches (PBB), pod length (PL), and number of seeds per pod

TABLE 1

Mean Squares from the Analyses of Variance for Maize Grain Yield and Yield Components

		Mean squares for						
Source of variation	*Df*	*CPP*	*CL*	*CC*	*KRC*	*KNC*	*SP*	*GYD*
Year (YR)	1	3719.9ns	5.28ns	4.50ns	11.28ns	28035ns	1.12ns	7454
Error (a)	3	458.6	3.28	2.58	13.37	13588	8.88	95270
Cropping system (CS)	1	205.0ns	26.28**	3.13ns	19.53*	28322ns	3.12ns	3197288***
YR × CS	1	225.8ns	2.53ns	1.13ns	11.28ns	1682ns	10.13ns	365867ns
Error (b)	6	607.2	0.91	0.88	2.57	5791	18.71	79359
Maize variety (MV)	1	2869**	5.28ns	8.00*	16.53ns	7626ns	264.5**	2933248***
YR × MV	1	3806***	7.03ns	0.50ns	0.03ns	1953ns	18.00ns	223613
CS × MV	1	16.50ns	0.78ns	1.13ns	3.78ns	8385ns	0.50ns	166993
YR × CS × MV	1	0.30ns	0.78ns	3.13ns	2.53ns	6555ns	8.00ns	178754
Error ©	12	190.03	3.8	1.02	4.47	4049	15.92	114203

CPP - cobs per plot; CL - cob length; CC - cob circumference; KRC - kernel rows per cob; KNC - number of kernels per cob; SP - shelling percentage; GYD - grain yield.
*, **, *** denote effects significant at 5, 1 and 0.1 per cent probability levels, respectively; ns = not significant.

TABLE 2

Mean Squares from the Analyses of Variance for Cowpea Yield and Yield Components

		Mean squares for							
Source of variation	*Df*	*PBB*	*BWP*	*PPLT*	*PL*	*SPP*	*100SWT*	*SP*	*GYD*
Year (YR)	1	1.53ns	7.03ns	144.5ns	5.28ns	0.00ns	63.08***	979.03*	156.0ns
Error (a)	3	0.7	0.36	24.17	0.7	0.08	0.15	31.78	4373
Cropping system (CS)	1	1.53ns	5.28**	112.50*	2.53ns	21.13**	0.98ns	132.03*	302018.0**
YR × CS	1	0.03ns	0.28ns	72.00*	0.78ns	4.50ns	0.22ns	26.28ns	10131.0ns
Error (b)	6	1.2	0.36	10.25	0.74	0.9	0.8	19.49	10526
Maize variety (MV)	1	0.78ns	0.03ns	10.13ns	0.03ns	3.13ns	0.49ns	16.53ns	1577.0ns
YR × MV	1	3.78*	0.28ns	55.13ns	3.78*	24.500***	1.68ns	101.53ns	6920.0ns
CS × MV	1	0.03ns	0.03ns	3.12ns	0.03ns	0.13ns	0.17ns	30.03ns	7540.0ns
YR × CS × MV	1	0.28ns	0.03ns	78.12ns	0.03ns	12.5***	0.002ns	30.03ns	7485.0ns
Error ©	12	0.3	0.18	16.62	0.72	0.73	0.92	33.86	8382

PBB - pod-bearing branches; BWP - branches without pods; PPLT - pods per plant; PL - pod length; SPP - seeds per pod; 100-SWT - 100-seed weight; SP - shelling percentage; GYD - grain yield.
*, **, *** denote effects significant at 5, 1 and 0.1 per cent probability levels, respectively; ns = not significant.

(SPP).

Table 3 shows that grain yield was slightly higher in 1995 than in 1994, due to higher number of ears per plot. Intercropped maize yield was significantly higher in DMRSR-Y (tall variety) than in 'Afo' (short variety). Longer ears, coupled with higher number of kernels per cob, contributed to the greater yield. This result agreed with the reports of Ezumah *et al.* (1987) which showed that short maize cultivars yielded less than tall cultivars under intercropping with cowpea. Similar reports (Elmore & Jackobs, 1984) showed that intercropped tall sorghum yields were greater than those of short sorghum under intercropping

TABLE 3

Effects of Seasons, Cropping Systems, and Maize Varieties on Yield and Yield Components of Maize

Treatment	*CPP (no.)*	*CL (cm)*	*CC (cm)*	*KRC (no.)*	*KNC (no.)*	*SP (%)*	*GYD (kg/ha)*
Season							
1994	89^{a}	12.50^{a}	14.13^{a}	15^{a}	379^{a}	78.8^{a}	1617^{a}
1995	110^{a}	11.69^{a}	13.38^{a}	14^{a}	320^{a}	79.1^{a}	1648^{a}
s.e.d	7.6	0.640	0.568	1.3	41.2	1.05	109.1
Cropping system							
Intercrop	97^{a}	11.19^{b}	13.44^{a}	14^{a}	320^{a}	78.6^{a}	1318^{b}
Monoculture	102^{a}	13.00^{a}	14.06^{a}	15^{a}	379^{a}	79.3^{a}	1948^{a}
s.e.d	8.7	0.337	0.331	0.6	26.9	1.53	99.6
Maize variety							
Afo (short)	109^{a}	11.69^{a}	14.24^{a}	15^{a}	334^{a}	81.8^{a}	1329^{b}
DMRSR-Y (tall)	90^{a}	12.50^{a}	13.25^{a}	14^{a}	365^{a}	76.1^{b}	1935^{a}
s.e.d	4.9	0.689	0.357	0.7	22.5	1.41	119.5

CPP - cobs per plot; CL - cob length; CC - cob circumference; KRC - kernel rows per cob; KNC - number of kernels per cob; SP - shelling percentage; GYD - grain yield.

with soybean. Averaged across seasons and maize varieties, monoculture maize yield was significantly higher than that of the intercrop by 32 per cent.

It has been observed that in the intercropping system, the relative yield of the individual crop is largely determined by the competitive ability of component crops. The result of this study therefore suggests that cowpea actively competed with the maize. The competitive ability of the cowpea may have been enhanced by a mild water stress resulting from inadequate rainfall during the study period. Allen & Obura (1983) and Rees (1986) had earlier explained that in a dry environment, sorghum or maize intercropped with cowpea was greatly affected by its associate, probably as a result of the more rapid root development of cowpea. In wet season, however, the authors showed that the cereal yield was little affected by the associated legume. Similar interactions between cereal/legume performance and water availability have been found in other combinations by Natarajan & Willey (1985) and Stoop (1986). The ability of cowpea to develop strong roots that can penetrate deep into the soil to extract water made it a more aggressive competitor.

The results of this study were in accord with the report of Enyi (1973) in Tanzania, which indicated that intercropping reduced length and weight of ear head and cob of sorghum and maize, respectively, when intercropped with cowpea. The results also agree with those reported in Costa Rica, where Decir & Pinchinat (1976) showed that the association of climbing bean affected maize yield. However, Fisher (1977) showed that the yield of intercropped maize did not differ significantly from that of pure stand at all maize densities evaluated in his study. Similarly, Agboola & Fayemi (1971), in southern Nigeria, showed that intercropping maize with cowpea did not affect yield. However, in contrast to the results of this study, Adetiloye (1980) reported an increase in maize yield due to intercropping with cowpea. Similarly, Gunasema *et al.* (1979), in their studies on the cereal-cowpea intercrop system, concluded that intercropping cowpea with maize increased maize yield by 103 per cent.

Cowpea yield components, and consequently grain yield, were similar for the two seasons of the study (Table 4). Similarly, the responses of cowpea yield components and grain yield were not significantly different for the tall and short maize pod. Nevertheless, intercropping resulted in significantly higher shelling percentage. These results agree with most of the research findings of maize-cowpea intercropping in the tropics

TABLE 4

Effects of Seasons, Cropping Systems, and Maize Varieties on Yield and Yield Components of Cowpea

Treatment	*PBB (no.)*	*BWP (no.)*	*PPLT (no.)*	*PL (cm)*	*SPP (no.)*	*100-SWT (g)*	*SP (%)*	*GYD (kg/ha)*
Season								
1994	4^{a}	0.4^{b}	20^{a}	13.19^{a}	10^{a}	13.10^{a}	72.6^{a}	610^{a}
1995	3^{a}	1.4^{a}	15^{a}	14.00^{a}	10^{a}	10.29^{a}	16.6^{b}	614^{a}
s.e.d	0.3	0.21	1.7	0.295	0.1	0.138	1.99	23.4
Cropping system								
Intercrop	3^{a}	1.3^{a}	16^{b}	13.31^{a}	9^{a}	11.52^{a}	69.1^{a}	515^{b}
Monoculture	4^{a}	0.5^{b}	19^{a}	13.88^{a}	11^{a}	11.87^{a}	65.1^{b}	709^{a}
s.e.d	0.4	0.21	1.1	0.304	0.3	0.317	1.56	36.3
Maize variety								
Afo (short)	3^{a}	0.9^{a}	17^{a}	13.56^{a}	10^{a}	11.57^{a}	66.4^{a}	619^{a}
DMRSR-Y (tall)	4^{a}	0.9^{a}	18^{a}	13.63^{a}	10^{a}	11.82^{a}	67.8^{a}	605^{a}
s.e.d	0.2	0.15	1.4	0.300	0.3	0.339	2.06	32.4

PBB - pob-bearing branches; BWP - branches without pods; PPLT - pods per plant; PL - pod length; SPP - seeds per pod; 100 - SWT - 100-seed weight; SP - shelling percentage; GYD - grain yield.

varieties. Nonetheless, intercropped cowpea yield was about 3 per cent higher under short maize variety than under the tall variety. This result agrees with that of Ezumah *et al.* (1987) who showed that cowpea yield was highest when intercropped with a short maize cultivar, while yields with tall cultivars were lower. In an earlier study, Elmore & Jackobs (1984) also reported that intercropped soybean yield was greater with short sorghum than with tall cultivars. These agree with the observation that short cereal offers less competition to intercropped legumes than tall cultivars (Tarhalkar & Rao, 1975; Vorasoot *et al.*, 1976; Wahua & Miller, 1978a; 1978b).

Intercropping cowpea with maize significantly reduced cowpea grain yield by about 27 per cent across maize variety and seasons of study (Table 4). The reduction in grain yield was due to significant reduction in number of pods per plant resulting from the increased number of branches without pods, and reduced number of seeds per which showed that maize depressed intercropped cowpea yield (Agboola & Fayemi, 1971; Haziel, 1974; Francis *et al.*, 1978; David & Garcia, 1983). The depression of intercropped cowpea yield in intercrop with cereals has been attributed to the percentage incoming radiation that reached cowpea due to shading by the tall cereal plants (IITA, 1975, 1976). However, studies involving the association of maize and legumes in southern Nigeria showed that one cowpea cultivar, the local brown mottle, a prostrate plant type, was more tolerant to maize shade, thereby spotlighting the need to select varieties adapted to intercropping.

Land equivalent ratios across seasons of this study were significantly higher with the short than with the tall maize variety (Table 5). This was in contrast with the observation of Elmore & Jackobs (1984) who reported that LERs were greater in intercropped tall sorghum cultivars than with short cultivars. Nevertheless, in agreement with the reports of the earlier workers, the result of this

TABLE 5

Yield, Relative Yield (RY), and Land Equivalent Ratios (LERs) of Intercrop and Monoculture Maize and Cowpea (Data are Means of Two Seasons)*

Cropping system	*Crop species*	*Maize*		*Cowpea*		
		Yield (kg/ha)	*RY*	*Yield (kg/ha)*	*RY*	*LER*
Intercrop	Maize (short)	1396	0.89	507	0.71	1.60[a]
	Maize (tall)	1547	0.67	523	0.74	1.41[b]
Monoculture	Maize (short)	1574	1.00	-	-	1.00[c]
	Maize (tall)	2323	1.00	-	-	1.00[c]
	Cowpea	-	-	710	1.00	1.00[c]
	s.e.d.	-	-	-	-	0.063

*RY (Intercrop yield/monoculture yield) for each crop.
**LER = sum of the RY for all crops in a mixture.

study showed that intercrop LERs were significantly higher than monoculture LERs. Statistical test of LER data showed that LERs were significantly higher under intercrop than in the monocultures, and with the short maize variety than with the tall variety. Cowpea relative yields (RYs) were similar for the two maize varieties, while the maize relative yield was higher with the shorter maize variety; hence, the observed significant difference in the LERs of the intercropped tall and short maize varieties. These results were, however, in contrast with the report of Elmore & Jackobs (1984), which showed that legume relative yield was higher with short than in tall cereal intercrops, while RYs were larger in taller cereal intercrops; hence, the reported no significant differences in LERs of the tall and short cereals.

Mustsaer (1978) indicated that when optimum population of groundnut was intercropped with 1/3 or 2/3 optimum population of maize, the LER was 1.4 or 40 per cent yield advantage for the mixture. De Singh (1979) used LER as a means of determining the productivity of small hectarage to obtain LER of 1.35 by intercropping sorghum with pigeon pea. In this study, intercropping maize with cowpea produced LER of 1.41 and 1.60 across seasons for tall and short maize varieties, respectively. This means that on a unit of land area basis, the two crops produced 41 and 60 per cent more yield when intercropped with the tall and short maize than in the monocultures. The LER for this study was higher than those reported earlier by other workers (Mustsaer, 1978; Jatto, 1997; Abayomi & Jatto, 1998). This was probably due to the application of 80 kg N/ha to the intercrop and monoculture maize. Earlier workers had observed that inadequate N reduced the performance of intercropped maize and cowpea (Adetiloye, 1980; Ezumah *et al.*, 1987) due to reduced nodulation in intercropped cowpea (Erikson & Whitney, 1984), which may result in competition for N under intercropping system. Thus, the application of inorganic N to the intercrop has been suggested to moderate such competition (Beets, 1977; Adetiloye, 1980). More recently, Abayomi & Jatto (1998) showed that grain yield decreases resulting from intercropping with cowpea were drastically reduced from 69 to 25 per cent by applying 80 kg N/ha.

Conclusion

Intercropping may result in decreases in yield of one or both of the individual crops in a mixture. Nevertheless, the productivity of a unit land area is improved by intercropping rather than monocultures. This yield advantage of intercropping seemed influenced by the architecture of the component cereal crops, being better with shorter cereal genotype, thereby stressing the need for adequate evaluation of crop components in a mixture.

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