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INFLUENCE OF COWPEA VARIETIES AND TIME OF INTRODUCTION OF COWPEA INTO MAIZE-COWPEA INTERCROPPING SYSTEM IN MAKURDI, SOUTHERN GUINEA SAVANNAH, NIGERIA

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ABSTRACT

Field studies were conducted in 2016 and 2017 cropping seasons from August to November at the Teaching and Research Farm of the University of Agriculture Makurdi to investigate the influence of cowpea varieties (Ife brown and IT90K 277-2) and Time of introduction of cowpea (planting at the same time, two weeks after planting maize and four weeks after planting maize) into maize-cowpea intercropping system. The experiment was a 2 x 2 x 3 split-split plot laid in a Randomized Complete Block Design with four replications. The result obtained showed significant reduction in all growth parameters and yield components tested as cowpea was intercropped. All growth parameters and yield components of cowpea (except 50% pod maturity and 100% physiological maturity) were significantly affected by cowpea varieties. Variety IT90K 277-2 was significantly different from variety Ife brown. All cowpea growth parameters and yield components (except 50 % pod maturity) were also significantly influenced by time of introduction of cowpea. These characters decrease with delay time of planting except days to 50 % flowering and days to 50 % pod maturity which increases with delay time of planting. Result on maize showed that all growth parameters and yield components (except shelling percentage, 100 seeds weight and Leaf area index) were significantly affected by intercrop. All growth parameters and yield components (except shelling percentage) were significantly influenced by time of planting, these characters increased with delayed time of introduction of cowpea. The highest LER (1.60); LEC (0.81) and % of land saved were obtained when cowpea was planted at the same time with maize using maize variety IT90K 277-2 which showed highest compatibility among the system.

Keywords: Cowpea variety, Time of introduction, intercropping, Yield advantage.

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1. INRODUCTION

Intercropping legumes and cereals is an important feature in many cropping systems in the tropics [1]. It is said to be a principal means of intensifying crop production and improving returns from small land holding [2]. Intercropping is wide spread agronomic practices in the tropics because it reduces losses cause by pests, diseases and weeds as well as guarantee better yield [3].

Southern Guinea Savannah of Nigeria is a major producer of legumes and cereals. The ecological characteristics of the zone have been describe by [4] as good for production of cereals and legumes. Legumes are integral components of the traditional cropping system of the Southern Guinea Savannah Agro ecological zone due to their beneficial effect on sustainability and as a source of nutritious food [5]. The importance of cowpea is predicated on its high nutritious quality with respect to its protein. Its ability to tolerate drought and the fact that it fixes atmospheric nitrogen with high efficiency which allows it to grow on and improves poor soils[6]. It is shade tolerant and is therefore compactible as an intercrop with many crops [7].

Maize is one of the oldest food sources; it is a productive food plant and has the highest potentials for carbohydrate accumulation per unit area per day [8]. It is the third ranking cereal in grain yield per hectare and second to wheat in total production [9]. Maize crop started as a subsistence crop in Nigeria and has gradually risen to a commercial crop on which many agro base industries depends on raw materials [10]. It is the most widely grown cereal crop in Guinea Savannah region of Nigeria and is the most widely distributed of any other cereals.

The production efficiency of any crop is determined by its variety, agronomic practices and the environment to which it is planted. The performance of a crop variety in mono culture may not be the same when it is intercropped. A number of studies indicated major difference in varietal performance under different agronomic systems such as intercropping [11], [12], and [13]. [14] and [15] are in agreement that different crops characteristics are appropriate for varieties intended for use in intercrop than those intended for use in sole crop.

Date of sowing any crop is dictated by many factors including weather, soil condition, management and crop production systems [16]. [17] observed that the choice of planting date is determined by four factors, namely, the need to plant when soil condition including soil temperature are favourable for good seedling emergence, the need to provide adequate soil moisture throughout the crop growth to obtain high yield and the need to have dry period during maturation to obtain high seed quality and facilitate harvesting and drying. [17] recommended proper adjustment of time of sowing, spacing and plant types so as to minimize competition for light to enhance productivity, that, the growth habit and plant architecture must be considered

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when deciding to defer planting of any component crop, that, crop first introduced usually becomes more aggressive than when both crops are sown simultaneously, and only when there is a weak competitor in a mixture is it advisable to enhance its performance by sowing it early relative to the aggressor.

In Nigeria, cowpea is chiefly grown in southern guinea savannah by small farm holders who usually grow it sole and in mixture with cereals. Records have shown that the farmers have not been maximizing profit because of low productivity in mixture [7]. Previous works on cowpea/maize have addressed various factors that influence the performance of crops under varying population densities [18], Planting dates [19], [20], Spartial arrangement [21], Varieties [22] amongst others. However, there is dearth of information on the influence of cowpea/maize as affected by varieties and time of introduction of cowpea. Therefore, this work was design to investigate and provide available information.

2. MATERIALS AND METHODS

2.1 Study Area

Field experiments were conducted during the 2016 and 2017 cropping seasons to investigate the influence of time of introduction of cowpea and cowpea varieties in a cowpea/maize intercropping system at the Teaching and Research Farm of the University of Agriculture, Makurdi (7.41^{o}N; 8.28^{o}E) which falls within the Southern Guinea Savannah agro-ecological zone of Nigeria.

2.2 Treatment and Experimental Design

The experimental design was a 2x2x3 split - split plot laid in a randomized complete block replicated four times. Two cropping systems [sole cropping (cowpea and maize] and intercropping, two cowpea varieties (IT90K 277-2 and Ife brown) and three times of introduction (Simultaneous planting of cowpea with maize, two weeks after planting maize and four weeks after planting maize). Each experimental unit (plot size) measured 5m x 3m with four ridges of 5m long spaced 0.75m, spacing for maize sole and intercrop was recommended spacing of 0.75m x 0.5m at 2 plants per stand giving a population of approximately 53,333 plants per hectare using the additive mixture as stated by [23] . Spacing for sole and intercrop cowpea was 0.75m x 0.30m at two plants per stand giving a population of approximately 88,889 plants per hectare. Maize seeds were sown (4 seeds/hill) on the side of the ridges and thinned to two plants per stand, cowpea was sown (4 seeds/ hill) on top of the ridges, which were thinned to two plants per stand both for sole and intercrop.

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2.3 Agronomic Practices

The land was manually cleared and ridged using cutlasses and hoes. Fertilizer was applied based on recommended fertilizer rates for Benue State as follows-

Maize sole- 90kgN/ha, 45kgP2O5 and 45kgK2O/ha (300kg of NPK: 15:15:15/ha as first split application and 100kg urea/ha as second split application.)

Cowpea -- 10kgN/ha, 36kgP2O5/ha and 20kgK2O/ha (22kg of urea/ha, 200kg of SSP/ha and33kg/ha of MOP).

Intercrop – 200kg/ha of NPK-15:15:15 as first split application and 200kg/ha of SSP on cowpea and 100kg/ha of urea on maize as second split application [24].

2.4 Data Collection and Analysis

Data collected on maize were plant height, leaf area index, ear height at harvest, dry Stover weight per plant, number of ears per plant, number of seeds per ear, shelling percent, weight of 100 seeds and net yield. Data collected on cowpea were – leaf area index, number of leaves per plant, total dry matter per plant, number of days to 50% flowering, number of primary branches, number of pods per plant, number of seeds per pod, days to 50% pod maturity, days to 100% physiological maturity, weight of 100 seeds and net yield.

Maize crop was harvested when they were fully matured and dried while cowpea pods were harvest as they turn brown. All the data collected were subjected to analysis of variance using Genstat (version 5) statistical package.

2.5 Evaluation of intercrop productivity

The productivity indices used to estimate the intercrop advantage were:

(i) Land Equivalent Ratio (LER) was computed as stated by [25]. LER was estimated as:

$$LER = (Yab/Yaa) + (Yba/Ybb)$$

Where, Yaa and Ybb are yields as sole crops of maize and cowpea and Yab and Yba as intercrops of cowpea and maize. LER figures greater than 1 are considered advantageous.

(ii) Competitive Ratio (CR) measures the degree with which one component crop competes with the other in intercropping situation. This was estimated using the formula proposed by [26], which was calculated as:

$$CRa = Xab/Xaa \times Zab \div Xab/Xbb \times Zba$$

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Where, Xaa = yield of pure stand of maize; Xab = intercrop yield of maze; Xbb = pure stand yield of cowpea; Xba = intercrop yield of cowpea; Zab and Zba are sown proportions maize and cowpea in the intercropping systems.

(iii) Land Equivalent Coefficient (LEC) as stated by [27]The LEC as describe by [27] was determined using the formula;

LEC= La x Lb

where La and Lb are partial LER of main crop and intercrop respectively The LEC can therefore be regarded as a measure of association or interaction when concerned with the strength of relationship. It assists in determining the biological efficiency of the cropping system in terms of intercrop compatibility because it effectively measures intercrop interaction that is a minimum productivity coefficient (PC) greater than 25 percent.

(iv).Percentage land saved indicates how much land is saved by intercropping as opposed to sole cropping. This was calculated as described by [28]:

% Land saved = 100 – 1/LER x 100.

3. RESULTS

Table 1: Physico-Chemical Properties of the Surface Soil (0-30cm) at the Experimental Site in Makurdi Before Planting

	Values		
Soil Parameters	**2016**	**2017**	**Method of Analysis**
Sand (%)	79.02	78.84	Hydrometer Method
Silt (%)	11.46	10.76	Hydrometer Method
Clay (%)	9.52	10.4	Hydrometer Method
Textural class	Sandy loam	Sandy loam	
pH (H_2O)	6.2	6.25	PH meter
Organic Carbon (%)	0.66	0.68	Walky-Black
Organic Matter (%)	0.51	0.48	Improved Chromic Acid Digestive and
Total Nitrogen (%)	0.86	0.92	spectrophotometric method
Available Phosphorus (ppm)	5.02	5.06	Kjeldah1 procedure
Cal^{2+} Cmol kg^{-1} soil)	2.62	2.66	Bray-1 method
Mg^{2+} (Cmol kg^{-1} soil)	2.44	2.5	AAS

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K^+Cmol kg^{-1} soil)	0.38	0.42	AAS
Na^+Cmol kg^{-1} soil)	0.23	0.26	Flame phhotometer
CEC Cmol kg^{-1} soil)	7.35	7.38	Flame phhotometer
Base Saturation (%)	94.4	95	Summation method

3.1 Cowpea Growth Parameters

Results of analysis of variance of main effects of varieties of cowpea, various period of introduction of cowpea and cropping systems on cowpea growth Parameters is as presented in Table 2. Cropping systems significantly affected all growth Parameters of cowpea. Sole cropped cowpea was taller than intercropped cowpea. Number of leaves and number of branches per plant were significantly increased in sole cropping system than intercropping system. There was significant reduction in leaf area index and total dry matter as cowpea was intercropped.

Cowpea varieties significantly affected all cowpea growth parameters (Table 2). Cowpea variety IT90K had significantly higher growth Parameters except in plant height where Ife brown was higher (Table 2). Time of introduction of cowpea significantly influenced all growth parameters of cowpea, these parameters decrease with delayed time of planting.

3.2 Cowpea Yield Components

Result on cowpea yield components (Table 3) showed that all yield components (except 50% pod maturity) were significantly affected by cropping system. 50% flowering and 100% physiological maturity were significantly delayed in intercropping system. There was significant decrease in number of pods and number of seeds per plant as a result of intercropping. Grain yield of sole crop cowpea was significantly higher than intercropped cowpea.

Varieties of cowpea significantly affected all cowpea yield components (Table 3). All yield components of cowpea were significantly higher in IT90K than Ife brown variety. Time of introduction of cowpea also influence all yield components of cowpea (except 50% pod maturity). 100% physiological maturity, number of pods per plant, seed per pod and grain yield decreased with delay planting of cowpea (Table 3) whereas 50% flowering and 50% pod maturity increase with delay planting.

3.3 Maize Growth Parameters

Result of the effect of intercropping on maize growth parameters is as presented in Table 4. Maize plant height was significantly affected by intercropping. Sole crop maize was taller than intercrop maize. Intercropping maize with cowpea had no significant effect on maize leaf area

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index. There was significant reduction in maize grain yield in intercropping system compare to mono cropping system.

Cowpea varieties significantly affected all maize growth parameters (Table 4). All maize growth parameters were significantly reduce when inter crop with cowpea variety IT90K.

TABLE 2: MAIN EFFECT OF VARIETIES, TIME OF INTRODUCTION OF COWPEA AND INTERCROPPING ON COWPEA GROWTH PARAMETERS

Treatment/Factor	Plant height (cm)	Number of leaves/plant	Number of branches/plant	Total dry matter/plant (g)	Total dry matter/plant (g)	Leaf area index
	45 DAP	55 DAP	55 DAP	35 DAP	45 DAP	40 DAP
Cropping system						
Sole	48.88	53.22	5.01	33.78	42.47	3.50
Intercrop	46.22	40.66	3.45	28.85	36.38	3.52
LSD 0.05	0.68	0.67	0.24	1.19	2.49	NS
Cowpea Variety						
Ife brown	48.88	40.43	3.45	28.85	36.63	2.52
IT90K 277-2	46.22	53.22	5.01	33.78	42.21	3.78
LSD 0.05	0.68	0.67	0.24	1.19	2.47	0.22
Time of introduction						
T_i (Simultaneous)	49.53	48.08	4.89	35.25	43.73	3.43
T_2 (two weeks)	47.50	44.74	4.66	31.63	38.46	2.99
T_3 (four weeks)	45.61	36.66	3.46	27.06	36.08	2.29
LSD 0.05	0.85	0.82	0.30	1.46	3.05	0.27
Year						
1st (2016)	45.46	52.20	4.51	33.31	42.47	3.05
2nd (2017)	49.63	41.45	3.95	29.32	36.38	2.75
LSD 0.05	0.90	1.72	NS	NS	3.73	NS

Time of introduction of cowpea significantly influence maize plant height, leaf area index, ear height and stover weight per plant (Table 4). Maize planted simultaneously with cowpea produce

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lowest plant height, leaf area index, ear height and stover weight per plant. Simultaneous planting of cowpea with maize (T_1) significantly differed from delay maize planting (T_2 and T_3).

TABLE 3: MAIN EFFECT OF VARIETIES, TIME OF INTRODUCTION OF COWPEA AND INTERCROPPING ON COWPEA YIELD COMPONENTS

Treatment	50% Flowering	50% pod maturity	100% physiological maturity	Number of pods/plant	Number of seeds/pod	Net grain yield t/ha
Cropping system						
Sole	48.37	66.0	61.75	61.75	11.30	0.83
Intercrop	49.17	66.25	66.32	46.32	10.66	0.61
LSD 0.05	0.91	NS	2.24	3.11	0.40	0.17
Cowpea variety						
Ife brown	49.00	66.75	61.75	11.36	11.36	0.60
IT90K 277-2	49.50	68.25	56.32	16.89	10.66	0.83
LSD 0.05	0.35	2.46	0.46	0.60	0.40	0.08
Time of introduction						
T_1 (simultaneous)	49.00	66.50	54.65	17.11	11.60	0.87
T_2(two weeks)	49.50	67.25	53.87	14.46	11.01	0.73
T_3 (four weeks)	50.25	68.00	53.58	11.39	10.34	0.55
LSD 0.05	0.43	NS	0.56	0.74	0.49	0.19
Year						
1st (2016)	49.25	66.50	54.60	14.74	11.25	0.79
2nd (2017)	50.75	67.25	53.47	13.17	10.73	0.63
LSD 0.05	0.61	NS	0.70	1.16	0.42	0.17

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3.4 Maize Yield Components

Result of this investigation on maize yield components (Table 5) revealed significant effect of intercropping (except shelling percentage and 100 seeds weight). Higher numbers of ears were produced by mono crop maize than intercrop maize. There was significant reduction in maize grain yield in intercropping system compare to mono cropping system. Cowpea varieties significantly influence all yield components of maize (Table 5) except numbers of ears per plant and shelling percentage. All maize yield components (except number of ears) were reduced as maize was intercropped with cowpea variety IT90K

TABLE 4: MAIN EFFECT OF VARIETIES, TIME OF INTRODUCTION OF COWPEA AND INTERCROPPING ON MAIZE GROWTH PARAMETERS

Treatment	Plant height (cm) 35 DAP	Plant height (cm) 60 DAP	Leaf area index	Ear height at harvest	Stover weight per plant
Cropping system					
Sole	94,43	227.36	3.65	120.90	121.80
Intercrop	90.46	211.86	3.75	118.41	117.10
LSD (0.05)	0.74	1.78	0.03	0.74	2.11
Cowpea variety					
Ife brown	94.43	227.36	2.77	120.90	121.25
IT90K 277-2	90.46	211.02	3.25	119.41	117.10
LSD (0.05)	2.25	1.78	0.25	0.74	4.24
Time of Introduction					
T_1(simultaneous)	90.95	218.88	2.52	101.10	118.04
T_2(two weeks)	92.34	220.05	2.71	101.14	119.50
T_3(four weeks)	92.58	221.65	2.79	101.15	120.43
LSD (0.05)	1.24	1.46	0.09	0.04	0.90
Year					
1st (2016)	94.95	208.47	2.75	109.96	111.32
2nd (2017)	94.20	229.91	3.07	129.35	127.80
LSD (0.05)	NS	5.50	NS	3.15	4.05

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All maize yield components (except shelling percentage and 100 seed weight) were significantly affected by time of introduction of cowpea (Table 5). Result also showed significant difference between simultaneous planting of cowpea (T_1) and other time of introduction (T_2 and T_3) for ear number and number of seeds per ear (which increase with delay introduction) whereas for grain yield, T_3 (4WAP) was significantly different from the other time of introduction(T_1 and T_2).

3.5 Yield Advantage

Evaluation of yield advantages of varieties and Time of introduction of cowpea into a maize/cowpea mixture as measure by Land Equivalent Ratio (LER), Land Equivalent Coefficient (LEC), Competitive Ratio (CR) and Percentage of Land saved is as indicated in table 6, 7 and 8. Generally, LER values were greater than unity (1.00), however, simultaneous planting of cowpea with maize produced highest LER values for the two cowpea varieties.

TABLE 5: MAIN EFFECT OF VARIETIES, TIME OF INTRODUCTION OF COWPEA AND INTERCROPPING ON MAIZE YIELD COMPONENTS

Treatment	Number of ear per plant	Number of seeds/Ear	Shelling percentage	100 seeds weight (g)	Grain yield (t/ha)
Cropping system					
Sole	1.11	667.67	65.40	23.55	2.27
Intercrop	1.23	547.43	64.69	23.15	2.09
LSD (0.05)	0.02	14.09	NS	NS	0.12
Cowpea variety					
Ife brown	1.14	614.21	66.40	23.55	2.27
IT90K 277-2	1.14	611.36	65.69	22.15	2.09
LSD (0.05)	NS	NS	NS	0.96	0.09
Time of Introduction					
T_1(simultaneous)	1.12	568.78	65.79	22.05	2.09
T_2(two weeks)	1.20	591.21	66.28	22.97	2.19
T_3(four weeks)	1.26	611.06	66.36	23.52	2.25
LSD (0.05)	0.05	12.24	NS	NS	0.09
Year					
1st (2016)	1.20	427.23	62.59	22.74	

2nd (2017)	1.32	544.11	69.50	22.93
LSD (0.05)	0.06	17.73	NS	NS

CR values of simultaneous planting of maize with cowpea were lowest (0.77 and 0.60) for both varieties (Ife brown and IT90K) and increase with delayed introduction of cowpea (table 7). The LEC of all time of introducing cowpea were above 0.25 (25%) signifying compatibility (table 8). This work indicated that it is advantageous to have the crops in mixture since the farmer will need as much as 1.48 and 1.60 hectare of land when crops are grown sole in order to achieve the same level from one hectare of land when crops are sown in mixture, thereby saving 32.43% and 37.50% of land (table 8).

TABLE 6: LAND EQUIVALENT RATIO OF MAIZE/ COWPEA RATIO

Time of Introduction	Sole cowpea (t/ha)	Sole maize (t/ha)	Intercrop cowpea yield(t/ha)	Intercrop maize yield(t/ha)	Partial LER for maize	Partial LER for cowpea	Total LER
Ife brown							
T_1	0.87	2.29	0.50	2.07	0.90	0.58	1.48
T_2	0.82	2.29	0.41	2.21	0.97	0.50	1.47
T_3	0.78	2.29	0.22	2.27	0.99	0.28	1.27
IT90K 277-2							
T_1	1.02	2.29	0.74	2.00	0.87	0.73	1.60
T_2	1.02	2.29	0.62	2.04	0.89	0.61	1.50
T_3	1.00	2.29	0.38	2.13	0.93	0.38	1.31

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TABLE 7: COMPETITIVE RATIO OF MAIZE/COWPEA MIXTURE

Time of Introduction	PARTIAL LER		
	LER Maize	LER Cowpea	C R
Ife brown			
T_1(simultaneous)	0.91	0.59	0.77
T_2(two weeks)	0.97	0.50	0.97
T_3(four weeks)	0.99	0.28	1.77
IT90K 277-2			
T_1(simultaneous)	0.87	0.72	0.60
T_2(two weeks)	0.89	0.62	0.72
T_3(four weeks)	0.93	0.38	1.22

TABLE 8: LAND EQUIVALENT RATIO (LER), LAND EQUIVALENT COEFFICIENT (LEC) AND PERCENTAGE LAND SAVED OF MAIZE VARIETIES INTERCROPPED WITH COWPEA

Variety	Land Equivalent Ratio	Land Equivalent Coefficient			Percentage Land Saved
		D1	D2	D3	
Ife brown	1.48	0.52	0.49	0.25	32.43
IT90K 277-2	1.60	0.81	0.54	0.36	37.50

4. DISCUSSIONS

4.1 Cowpea

The significant reduction in intercropped cowpea height could be as a result of shading effect of maize which most have reduces the amount of solar radiation reaching the cowpea crop. This result is in consonance with [29] who reported that because of the availability of light sole cropped cowpea has the potential to grow taller than that of intercrop. The increased in cowpea number of leaves and branches is consistent with the earlier report of [29] that sole crop cowpea has the potential to harvest more light, produce more leaves, branches, pods and grains. Reduction in LAI and total dry matter could be due to competition for above and below ground

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resources that limits growth in intercrop cowpea. This result is in accordance with [21] who observed reduction in cowpea dry matter as a result of intercrop. [30] reported decreased in leaf area index of intercropped bean in maize – bean intercrop also [31] on effect of crop combination revealed that intercropping reduces vegetative growth. The delayed in 50% flowering and 100% physiological maturity in intercropping system could be as a result of the shading effect of the taller maize plant which must have delayed flowering and maturity in cowpea. [32] Opined that cowpea in intercrop flower later than those planted sole and he also observed late physiological maturity in intercrop cowpea than sole cowpea. The significant decrease in number of pods and number of seeds per plant as a result of intercropping was consistent with previous findings of [33] and [34] who reported generally that intercropping reduces number of pods and number of seeds per plant of legume crops. Increased in yield of sole cropped in this study could be due to increase in number of pods in sole crop as number of pods is said to significantly influence yield [33]; [22].

Significant effect of cowpea varieties on 50% flowering, number of pods/plant, number of seeds/pod and grain yield could be attributed to varietal yield contributing traits. Decline in cowpea yield was highly visible in cowpea variety IT90K than Ife brown. The vigorous and higher LAI of IT90K made it more competitive than Ife brown, this confirm the report of [35] that genetic characteristics of variety contribute to their yield components differences. Furthermore, the higher number of pods of IT90K contributes to its higher yield as number of pods is said to influence yield [33]. Decreased in cowpea yield components as time of introduction was delayed could be due to competitive effect from the already establish maize crop. [36]has recommended simultaneous planting of maize with bean as this will ensure little competition for light before the initiation of flowering of the bean crop.

4.2 Maize

Sole crop maize was taller than intercrop maize which could be as a result of inter-specific competition for natural resources in the mixture. This result collaborates [22] who opined that there was significant difference between mixed and sole crops of maize in terms of height; also [37] found that mono cropped maize was taller than intercropped. The significant reduction in ear height and stover weight of maize in mixture could be due to reduction in plant height resulting from competition for growth factors such as light, moisture and soil nutrients. Others have shown reduction in ear height [37] and reduction in stover weight [38]; [39]; [40]. All maize growth parameters were significantly affected by cowpea varieties. [11], [12] and [13] have reported differences in varietal effect in intercropping, furthermore, the vigorous higher LAI IT90K was more aggressive and competitive, thus, reduces all maize growth parameters than Ife brown. The significant increase in maize growth parameters with delayed time of

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introduction maybe as a result of reduce competition for resources on maize as time of introduction was delayed [32] observed the same trend in his investigation.

Intercropping significantly reduces ear/plant, number of seeds/ear and 100 seeds weight which could be due to intra and inter competition for natural resources. Higher number of ears in mono cropping system was reported by [36]. Other studies observed reduced seeds/ear in intercrop [38], lower grain in intercrop [22]; [21] and [40].

The significant reduction in 100 seeds weight and grain weight as maize was intercrop with IT90K variety of cowpea could be attributed to the variety's aggressive and competitive ability which imposed serious competitive effect on maize.

Maize yield components (except number of ear/plant and 100 seeds weight) significantly increased with delay time of introducing cowpea, this could be as a result of inter- specific competition and variation in the weather condition especially in terms of solar radiation which gave the maize plant enough ground to establish before much competition sets in. [42] found maize to consistently increase with increasing delayed in cowpea introduction.

4.3 Yield Advantages

Yield advantage was also observed by [36] and [21] when cowpea was intercrop with maize [12] investigated the variability to intercrop adaptation and observed suitable genotypic traits that are necessary for compatibility in cowpea-maize intercrop. [36] and [43] also reported increased in percentage of land saved in intercrop.

5. CONCLUSIONS

From the result obtained, it can be concluded that, in Makurdi, Nigeria which falls within Southern Guinea Savannah Agro- ecological zone, the highest yield of maize/cowpea intercrop was obtain when cowpea was planted at the same time with maize. The highest LER, CR and LEC values were obtained when cowpea was planted at the same time with maize using cowpea variety IT90K which showed highest compatibility among the system. Also, greater percentages of land area saved were obtained when cowpea was planted at the same time with maize.

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