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The Performance of Maize- Cowpea Intercropping as Affected by Variety and Cropping Patterns in Mubi, Northern Guinea Savanna of Nigeria

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ABSTRACT
The field trials were conducted in 2010/2011 rainfall cropping season at the teaching and research farm of the Faculty of Agriculture, Adamawa state University Mubi to evaluate the effect as variety and cropping pattern on the growth and yield of maize-cowpea intercrop. Mubi, located in the Northern Guinea Savannah of Nigeria is situated between latitude 100 10^0 and 100 30^0 North of the Equator and between longitude 13^0 10 and 13^0 10 E of the Greenwich meridian and at an altitude of 696 m above mean sea level (MSL). Three varieties of maize V_1 (local variety),obtained from open market V_2 (Oba 94) and V_3 (Extra early white) obtained from Farm office of the University, were sown at four different sowing dates (4^{th} July, 14^{th} July, 24^{th} July and 3^{rd} August) for both 2010/2011 and were intercropped with cowpea (Ife brown) at 14days after sowing of maize. The experiment was laid out in a randomized complete block design (RCBD) and replicated three times in each replication, a sole maize and intercrop was grown for yield comparison, result shows that (maize varieties had significant effect on the yield and yield attributes least area index, cob length, cob diameter) of maize. Some plant characters such as grain yield were not significant (P> 0.05) affected by varietal differences). The cropping pattern had no significant effect on the maize characters except the stem height at harvest (12 Weeks after sowing. The outcome of this study showed that, the use of appropriate maize variety and cropping pattern resulted to higher yields. Oba 94 also gave the highest yields during the two cropping seasons of 2010 and 2011 with 1584kg/ha and 1407kg/ha respectfully and is therefore recommended to be used during maize cowpea intercropping in the study area.
Keywords: Intercrop, Variety, Cropping pattern.

INTRODUCTION

Maize (*zea mays* L.) is a priority crop of modern farmers as a staple food in many rural communities of west Africa and is one of the most important cereal crops grown in Africa (sanani etal 2010). It is an important dual purpose crop used in human diet and animal feed in Agro industries (Atunewa and Afolbi 2001). There are multitudes of maize varieties available. The choice of variety will depend on the environmental condition, market requirement, time of planting, maturity and level of disease resistance. Cowpea (*Vigna unguiculata (L.) Walp*) is an important grain legume in the dry savannah of the tropics covering 12.5 million hectares with annual production of about 3.3 million tons (FAO, 2005). Nigeria is one of the world's largest producers of cowpea with an average production of 2.92 million tons followed by Niger with 1.10 million tons (FAO, 2012).

Cowpea is a twining annual herbaceous plant. The root system consists of well-developed tap root with considerable number of lateral root. The stem is slightly ridged and almost glabrous. The leaves are trifoliate, alternate and with scattered shoot hairs (Chhidda,*et al.,* 2007). The flowers are white, yellow, pink, pearl blue and violet in color and are self-pollinated. The pods are long and cylindrical and constricted between the seeds. The seeds are bean-shape and many times spotted with different color such as brown, green, yellow, white and motted (Chhidda,*et al.*,2007). Germination is epigeal (ICAR, 2006). Many cultivars are known, including climbing, bushy, prostrate and erect forms mostly with indeterminate growth (CFOR, 1981).

Cowpea also plays an important role in providing soil nitrogen to cereal crops (such as maize, millet, and sorghum) when grown in rotation, especially in areas where poor soil fertility is a problem. It does not require a high rate of nitrogen fertilization; its roots have nodules in which soil bacteria called Rhizobia inhabit and help to fix nitrogen from the air into the soil in the form of nitrates (Sheahan, 2012).

Cowpea is well adapted to poor fertility and low rainfall conditions. Cowpea grows best on fertile, loam soils with rainfall of 760 - 1520 mm during the growing period, and thrives best on dry areas of Northern part of Nigeria and transported to the Southern part of Nigeria. Cowpea is an important crop because of its role in human and livestock nutrition. It reduces the shortage of food by making efficient use of water and nutrient. It is a source of protein and also less expensive than meat. Cowpea is of vital importance to the livelihood of several millions of people in east and central Africa.

Cowpea is an important legume crop in the dry savannas of Africa, especially West Africa. Out of the 12.5 million hectares cultivated to cowpea worldwide, (Singh, *et al.*, 2011); estimated that eight million hectares is in West and Central Africa, distributed predominantly between Nigeria and Niger. In spite of the fact that grain yields are low, cowpea has continued to be a popular crop among farmers. This is because cowpea provides high protein food for people, especially children; it improves and sustains soil fertility, and provides high quality fodder for livestock.

Despite the dramatic increase in cowpea production in the sub – Saharan Africa, cowpea yields remain one of the lowest among all food legume crops, averaging at 450 kg/ha^{-1} in 2006 - 2008, which is half of the estimated yields in all other developing regions. Its yields are very low due to several constraints including poor soil fertility and use of low yield variety of seeds as planting material (Ecocrop, 2009).

Cowpea is also one of the most important food leguminous crops in the semiarid tropics in Africa. It is well adapted to the drier region of the tropics. It has the ability to fixed atmospheric nitrogen through its root nodules and it grow well in a poor soil with more than 85% and with less than 0.2% organic matter (scott, 2008). In addition, it is shade tolerant, so is compatible as an intercrop with maize, millet sorghum sugarcane and cotton. The use of intercropping by small holder farmers is a common practice (Ofuso-Amin J and N.V. Limbani, 2007) that dates back to ancient time (Dahmardeh, et al, 2009) in the tropics (Banik et al, 2000) and rain-fed areas worldwide (Dhima et al, 2007).Seran and Brimtha 2010 reported that intercropping offer several advantages is small scale farmers, by intercropping with appropriate crop at an appropriate sowing date, these may benefit from improved soil fertility, increase productivity and reduced risk of total crop failure. Andrew 1972 observed that different planting time of component crops improved the resource utilization and reduced competition, this is in contrast with that of Elemo 2013 Which reported that time of introducing cowpea in maize had no effect on growth attribute of maize, but delay in cowpea introduction beyond 14 days after sowing maize caused significant decrease in growth parameter of cowpea? In most cases local maize are grown in mixture with local cowpea which result in poor yield, this may be attributed to improper crop mixture and sowing date. The beneficial effects of intercropping maize-cowpea have not been fully exploited correct combination of intercropping, suitable variety and sowing date that will enhance growth and yield of the two components in intercrop. The aim of this study is to evaluate the performance of maize-cowpea intercrop as influence by variety and cropping pattern.

MATERIALS AND METHODS

The experiment were conducted at the teaching and research farm of the faculty of Agriculture, Adamawa state University Mubi during the 2010 and 2011 rainfed cropping season to determine the effect of variety and sowing date on the growth and yield of maize-cowpea intercrop in Mubi Northern guinea savanna of Nigeria. Mubi, located in the Northern Guinea Savannah of Nigeria situated between latitude 100 10^0 and 100 30^0 North of the Equator and between longitude 13^0 10 and 13^0 10 E of the Greenwich meridian and at an altitude of 696 m above mean sea level (MSL) (Adebayo, 1990). Average annual rainfall ranges between 998 mm and 1262 mm (Ray, 2007), and a minimum temperature of 18^0C during harmatan period and 40^0C as maximum in April (Adebayo, 1990).

Treatments and Experimental Design: Three maize variety V_1 (local variety), V_2 (Oba 94) and V_3 (Extra early white) and one variety of cowpea (Ife Brown) were used. The experiment was designed in a randomized complete block design with three replicates. The treatment comprised of four sowing dates 4^{th}, 14^{th}, 24^{th} July and 3^{rd} August in 2010 and 2011on each sowing date, three variety of maize (V_1, V_2, and V_3) were sown in an intercrop with cowpea 14 days after sowing of maize.

Plot size: Each plot size is 4m x 4m (16m2) with 1m alley way and 0.5m between plots.

Land Preparation and Cultural Operations: The land was prepared using tractor drawn plough once and labeled manually. The smoothened land was laid out according to experimental design.

Seed and Sowing: Seeds which was obtained from open market and farm office of the University were sown on 4^{th}, 14^{th}, 24^{th} July and 3^{rd} August respectively during the 2010 and 2011 cropping seasons. Each was intercropped with cowpea (Ife brown) 14 days after sowing of maize.

Harvesting:

Collection of Data and Plant Sampling: Data were collected and subjected to analysis of variance (ANOVA) with statistical analysis of variance (SAS), mean were separated using Duncan multiple range test.

Plant Height (cm): Plant height of maize was taken at 8WAS and 12WAS during the 2011 and 2012 rainy season and recorded using meter rule.

Cob length: Maize cob length was taken randomly from maize plants during the two years under study and measured using a ruler.

Cob diameter: Maize cob diameter was also measured using a measuring tape.

Leaf Area (cm2): Leaves area of the whole sampled plants was determined by measuring the individual leaf length and width and multiply by factor 0.64, their mean was determined, and the result obtained was recorded.

Fresh Plant Weight (kg ha^{-1}): Fresh weight of both maize and cowpea were also weight and results recorded.

Grain Yield (kg ha^{-1}): Grain weight of maize was measured using a weighing scale from a quadrat and converted to yield per hectare. The same procedure was applied to cowpea.

Table 1: Soil physical and chemical properties of the experimental site

Particular	**2010**	**2011**
I. Physical properties		
A. Particles' size distribution (%)		
Sand	47.95	47.93
Clay	23.7	23.8
Silt	28.24	28.25
B. Textural Class	Sandy loam	Sandy loam
II. Chemical Properties		
Soil pH	5.708	5.706
Organic carbon (kg^{-1})	1.003	1.003
Available phosphorus (mg P kg^{-1})	0.603	0.604
Available calcium [c mol (+) kg^{-1}]	551.334	551.333
Available sodium [c mol (+) kg^{-1}]	0.870	0.870
Available potassium [c mol (+) kg^{-1}]	2.917	2.918
Water holding capacity	68.995	68.919

Table 2. Effect of maize- cowpea intercropping as affected by variety and cropping patterns on Maize Plant height at 8WAS and 12WAS, LAI and cowpea LAI in 2010 and 2011

2010

	Maize Plant height			
Variety	8WAS	12WAS	Maize LAI	Cowpea LAI
V_1	168^a	218^a	2.40^a	0.60
V_2	160^b	207^b	2.00^b	0.56
V_3	158^b	165^c	0.78^c	0.57
SE±	0.5	0.3	0.09	0.02
LS	*	*	*	Ns
Cropping pattern				
Intercrop	161	191^b	1.66	0.51
Sole crop	165	205^a	1.83	0.64
SE±	0.5	0.5	0.82	0.01
LS	Ns	*	Ns	Ns
2011				
V_1	165^a	208^a	2.37^a	0.50
V_2	164^a	202^b	2.00^b	0.49
V_3	160^b	164^c	0.58^c	0.50
SE±	0.3	0.2	0.08	0.005
LS	*	*	*	Ns
Cropping pattern				
Intercrop	162	194^a	1.60	0.49
Sole crop	162	187^b	1.87	0.51
SE±	0.3	0.3	0.17	0.004
LS	Ns	*	Ns	Ns

Table 3. Effect of maize- cowpea intercropping as affected by variety and cropping patterns on maize cob length, cob diameter, grain weight, cowpea seed per pod and grain yield in 2010 and 2011

	Maize			Cowpea	
Variety	Cob length	Cob diameter	Grain weight(kg/ha)	No seed per pod	Grain yield (kg/ha)
2010					
V_1	12^a	4.6^b	1438.10	11.6	216.00
V_2	13^a	4.8^a	1584.40	11.8	221.50
V_3	10^b	4.4^c	1429.80	11.5	230.30
SE±	0.3	0.03	50.83	0.08	4.75
LS	*	*	Ns	Ns	Ns
Cropping pattern					
Intercrop	12	4.6	1565.28	11.6	215.40
Sole crop	12	4.6	1426.25	11.7	229.80
SE±	0.5	0.02	10.65	0.06	1.76
LS	Ns	Ns	Ns	Ns	Ns
2011					
V_1	12^a	4.6^b	1359.00	11.6	221.20
V_2	13^a	4.8^a	1407.40	11.8	225.10
V_3	10^b	4.4^c	1138.59	11.5	231.00
SE±	0.3	0.03	47.30	0.07	4.76
LS	*	*	Ns	Ns	Ns
Cropping pattern					
Intercrop	12	4.6	1428.89	11.6	213.40
Sole crop	12	4.6	1339.42	11.7	238.10
SE±	0.5	0.04	31.53	0.06	4.51
LS	Ns	Ns	Ns	Ns	Ns

RESULTS:

The result of the of the soil physical and chemical properties of the study area indicates that, the soil is sandy loam as presented in Table 1.

The result of the performance of maize- cowpea intercropping as affected by variety and cropping patterns on plant height and LAI (Table 2) shows that, plant height was significantly affected in both 2010 and 2011. V_1 had higher plant height at 8 and 12WAS with a mean score of 168 and 218 while V_3 recorded the shortest height in 2010 with a mean score of 158 and 165, however, V_1 and V_2 were at par in 2011 with mean scores of 165 to 208 and 164 to 204 at 8 and 12 WAS and were rated highest while V_3 which had 160 and 164 at 8 and 12 WAS were recorded the shortest plant heights. Cropping pattern had no significant effect at 8WAS in 2010 and 2011 respectively, but was significant at 12WAS in both years. Also the result of maize LAI (table 2) indicated that V_1 had the widest LAI in both years with 2.37 while the narrowest was that of V_3 which recorded 0.58. In terms of cowpea in the intercrop the LAI were not significant on both variety and cropping pattern in both cropping season.

The effect of variety and cropping pattern on maize cob length, cob diameter, grain weight and cowpea seed per pod and grain yield as presented on table 2.0 shows that, maize cob length were significantly influenced by variety in both 2010 and 2011. V_1 and V_2 were at par in both years and were rated longest while V_3 had the shortest. The cob diameter was also significant in both 2010 and 2011. V_1 recorded the widest cob diameter of 4.6 while V_3 had the narrowest cob diameter of 4.4. The maize grain weight, cowpea seed per pod and cowpea grain yield had no significant effect on variety and cropping pattern in the two cropping seasons (Table 3.).

DISCUSSIONS

The growth parameters of maize growth in intercrop with cowpea in Mubi 2010 and 2011 rainfed cropping seasons indicated that variety and cropping pattern were significantly influence maize plant height, LAI and cowpea LAI. This could have been as a result of variation in the genetic composition of the maize variety and other resources as reported by Squire (1990), who mentioned that, plant height measurements are used as an indicator of vegetative growth. This occurrence was earlier observed by Kaiser and Piltz, (2002), who reported that maize growth and maturity may depend on the variety. These also agrees with the work of Stewart and Dwyer (1999) which stated that, LAI within a plant canopy are the major factors that determine total light interception which affects photosynthesis, transpiration and dry matter production. Cob length and cob diameter were significant among maize variety. V_2 (Oba 94) recorded the longest cob length and widest cob diameter while V_3 (Extra early white) had the least in both years. These agree with the findings of Dahmardeh, (2010). Who stated that the physiological growth changes with cultivars and this may be due to the favorable agro climatic conditions? However cropping pattern recorded no significant effect on crop yield and yield characters (cob length, cob diameter and grain weight). Maize recorded higher yield in intercrop in both years than sole crop yield. This is in conformity with Hamza, (2008). Who obtained various increase in grain yield of maize in mixture over sole crop. Similarly, Berhane et al, (2015), reported that sorghum-cowpea intercropping was highly superior to and more advantageous over sole cropping. This was in contrast with the work of Takim, (2012) who observed that, intercropping Maize and Cowpea in different pattern and mixture may affect grain yield due to competition between the two crops compared to sole cropping. The yield of cowpea on the other hand was higher in sole than in intercrop. This was in conformity of the work of Undie et al, (2012) who reported that plant and shading effect reduces cowpea yield. Also Degri et al (2012) reported that, the success of a plant is influenced by some factors such as soil fertilizer, management practice and radiation interception during tasseling or flowering. This means that, in respective of variety it is good to plant the crop in mixture.

CONCLUSION

Intercropping maize-cowpea in Mubi guinea Savanna indicated that Oba 94 grown in mixture perform better than the local variety and extra early variety with yield of 1584kg/ha; 1407kg/ha and 1429kg/ha; 1138kg/ha during 2010 and 2011 cropping seasons respectively. The cropping pattern had no effect on the yield and yield components of both the maize and cowpea.

RECOMMENDATIONS

Based on the findings of this study, it is therefore recommended as follows:

i. Cowpea maize intercropping should be encouraged amongst farmers as it produce higher yields and assist in maintaining soil fertility.
ii. Appropriate cropping patterns resulted to higher yield.
iii. Oba 94 variety of maize is also recommended to be grown by farmers in the study area as it produces the highest yield, outperformed the local variety and even the extra yielding variety mostly used by local farmers.

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