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Growth and Development Components of Pearl Millet Varieties (*Pennisteum Glaucum L. Walp)* in Maiduguri, Sahelian Savanna of Nigeria

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Keyword: Sahelian, Savanna, *Pennisetum*, Growth and Development.

Abstract

Field trials were conducted in 2015 and 2016 at Department of Crop Production, Faculty of Agriculture, University of Maiduguri, Nigeria to determine the growth and development components of pearl millet varieties. Four pearl millet varieties SOSAT-C-88, ZATIP and LACRI-9707-C which were filled into RCBD design replicated three times. Pearl millet agronomic parameters, Number of tillers/plant, number of leaves/plant, plant height, number of days to 50% flowering were superior for ZATIP than SOSAT-C-88 and LACR-9702-IC. The number of tillers/plant, leaf area and grain yield/ha were significantly greater for SOSAT-C-88, tillers/plant, plant height and grain yield/ha were significantly least for LACRI-9702-IC which was the shortest and earliest flowering variety. Superior grain yields were realized for SOSAT-C88 and LACRI-9702-IC in both cropping season, except ZATIP, Although both the grain yield and straw yields were higher for SOSAT-C-88 which was the most suitable in the Sahelian Savanna.

Introduction

Millet (*pennisetum glaucum* (L.) R.Br.) is a staple diet. Although improved millet varieties have been developed which do not only provide grain for human but also straw for livestock and stalks for fencing. Pearl millet plays a key

role in food security, income generation and maintenance of the environment for smallholder farmers in the Sudan and Sahelian zones. The traditional cultivars, which are still widely in use in the zones, are late maturing and low yielding ICRISAT,(2011). An important consideration in pearl millet variety is the choice of appropriate millet variety and agronomic practices given the fast growth rate of millet production. In millet production in the Sudan Savanna- early flowering pearl millet varieties have been shown to yield higher than the tall and late maturing varieties (Mkamilo.2008). In contrast, Okigbo and Greenland (2004) found that in the Sahelien Zones short and early flowering varieties produced higher grain yield than the tall late flowering varieties, indicating that selection of pearl millet varieties should be based on compiatability of their growth and development components of companion crops. Few reports on the growth and development of pearl millet varieties in the Sahelian zone. Henrich (2013) observed that planting short pearl millet varieties was superior. IAPPS, (2007) reported superior yield of pearl when dwarf pearl millet varieties was grown. There appears to be opportunities for increasing pearl millet and system productivity by using suitable pearl millet varieties and manipulating cultural practices. The objective of this study therefore was to assess the growth and development components of some newly improved pearl millet varieties in increasing the productivity of cereal using different pearl millet variety in a semi-arid environment.

Materials and methods

The experiment was conducted during 2015 and 2016 cropping seasons at the Teaching and Research Farm Faculty of Agriculture, Department of Crop Production, Faculty of Agriculture University of Maiduguri ($11^0$53N; $13^0$16E and 352m above sea level) in the Sudan savanna ecological zone of Nigeria. The total rainfall received was 738.0 and 584.4 mm in 2015 and 2016, respectively DMA, (2016) The soil at the experimental site was typic ustipsamment, comprising of 80% sand, 14% silt and 5% clay. The treatments consisted of three pearl millet varieties SOSAT-C-88, ZATIP and LACRI-9702-IC. The pearl millet was grown at (3) three plants/stand (Dugje,(2004). The experimental was Randomized Complete Block Design (RCBD) replicated three times. Plot size was 3.0 x 5.0m ($15m^2$). An alley of 2.0m was allowed between the replicates, The pearl millet varieties was sown at 90cm x 50cm Seeds were treated with a pre planting fungicides Apron Star (42WS) at the rate of 5g of chemical to 1 kilogram of seeds Anaso *et al*.,(1998) The land was harrowed with tractor driven disc, after which the plots were laid out and leveled before sowing. Sowing of the plots was done after the rains on 9th July, 2015 and 6th July, 2016 respectively. The plots were hoe-weeded at 3 and 6 weeks after sowing millet while thinning was done manually at 2 weeks after sowing for the pearl millet component. Fertilizer was applied at the

recommended rate of 60kgN, 30kg P_2O_5 and 30kg K_2O/ha Fertilizer Procurement and Distribution Division, (FPDD, 2002) in 2 split dose. The first dose of 30:30:30 was applied at 2 weeks after sowing using urea (46%N). The same fertilizer rates and methods were applied each year. The component crops were harvested after physiological maturity and data collected on pearl millet include, plant height, number of leaves/plant, leaf area/plant, number of tillers/plant, days to 50% flowering, harvest index (%), grain yield kg/ hectare and straw yields. Data collected from the two experiments were subjected to Analysis of variance (ANOVA).Both the year wise and combined years analysis were run using a computer software, statistix version 8.0 (Statistix, 2005). Difference among treatments means were compared using the least significant difference (LSD) for separation of means at 5% level of probability.

Results

Pearl millet Growth and Development Parameters

There was significant difference in pearl millet plant height at 6 and 9 WAS and at harvest in 2015, 2016 and the combined mean (Table 1). In 2015 and for the combined mean plant height did not significantly difference ($P \leq 0.05$) at 6, 9 WAS and at harvest for pearl millet variety LACRI-9702-IC and SOSAT-C-88. ZATIP produced significantly ($P \leq 0.05$) taller plants than SOSAT-C-88 or LACRI-9702-IC at 6, 9 WAS and at harvest in 2015, 2016 and the combined. Among the pearl millet variety it was ZATIP that produced significantly ($P \leq 0.001$) higher number of leaves when compared to SOSAT-C-88 or LACRI-9702-IC treatments at the sole crop systems in 2015, 2016 and the combined mean at 6, 9 Was and at harvest (Table 1)

Table 1: Effect of Pearl millet varieties on plant height (cm) and number of leaves per plant at 6, 9 WAS and harvest at Maiduguri, 2015, 2016 and combined mean

	Plant Height (cm)			Number of leaves per plant		
Sole pearl millet	6 WAS	9 WAS	Harvest	6 WAS	9 WAS	Harvest
2015						
ZATIP	101.06	185.32	265.12	13.7	17.8	10.1
SOSAT-C-88	88.22	160.41	230.09	11.0	15.4	9.4
LACRI-9702-IC	86.21	155.07	202.04	10.2	14.2	8.1
SE (±)	2.25	2.33	6.27	0.44	0.62	0.39
LSD (0.05)	NS	NS	0.44	NS	0.27	0.22
2016						
ZATIP	110.15	189.43	307.76	14.4	161	9.9
SOSAT-C-88	100.02	169.05	259.32	13.2	15.8	8.2

LACRI-9702-IC	89.32	158.21	227.17	10.1	13.7	7.6
SE (±)	1.89	3.52	7.33	0.35	0.25	0.33
LSD (0.05)	NS	0.28	0.61	0.16	NS	0.14
Combined mean						
ZATIP	105.10	187.06	286.08	13.7	16.9	10.0
SOSAT-C-88	94.00	164.08	244.25	12.1	15.6	8.8
LACRI-9702-IC	87.12	156.05	214.17	10.1	13.4	7.9
SE **(±)**	1.61	1.89	3.44	0.20	0.51	0.66
LSD (0.05)	NS	0.95	NS	NS	NS	NS

NS= Not significant,

Values for 2015 and 2016 are pooled means of three replicates of three pearl millet varieties, while values for combined mean are pooled means of three replicate and three pearl millet varieties for the two years.

Among the pearl millet variety SOSAT-C-88 produced significantly ($P \leq 0.001$) greater leaf area compared to SOSAT-C-88 or LACRI-9702-IC at 3, 6, 9 WAS and at harvest in 2015, 2016 and the combined mean. the lower leaf area was produced by ZATIP variety compared to LACRI-9702-IC or SOSAT-C-88 variety (Table 2). The performance of the pearl millet variety under the sole crop system showed that significantly ($P<0.05$) greater tillers were produced at the pearl millet variety SOSAT-C-88 compared to LACRI-9702-IC or ZATIP, at 6, and 9 WAS in 2015 and 2016 cropping seasons as well as combined analysis. Except in 2016 at 6 and 9 WAS when the tillers for LACRI-9702-IC variety were significantly higher and also for the combined mean at 9 WAS compared to ZATIP variety.

Significantly ($P<0.01$) days to 50% flowering was earlier in LACRI-9702-IC or SOSAT-C-88 compared to pearl millet variety ZATIP that produced significantly ($P \leq 0.01$) longer days to attain its 50% flowering days in 2015, 2016 and the combined analysis.

Table 2: Effect of Pearl millet varieties on pearl millet number of tillers/ plant and leaf area (cm) at 6, 9 WAS and harvest and Days to 50 % flowering at Maiduguri, 2015, 2016 and combined mean

	Leaf Area (cm)			No. of tillers/ plant		Days to 50 % flowering
Sole pearl millet	**6 WAS**	**9 WAS**	**Harvest**	**6 WAS**	**9 WAS**	
2015						
ZATIP	137	158	145	2.6	3.4	68

SOSAT-C-88	174	199	158	3.3	4.7	54
LACRI-9702-IC	148	183	149	2.4	3.1	49
SE (±)	1.66	1.92	1.92	0.12	0.88	0.33
LSD (0.05)	4.67	NS	2.11	NS	0.03	0.17
2016						
ZATIP	152	162	149	2.9	3.6	63
SOSAT-C-88	196	203	166	3.8	4.9	55
LACRI-9702-IC	188	194	151	2.9	3.8	47
SE (±)	0.15	1.11	2.53	0.14	0.56	0.65
LSD (0.05)	NS	3.45	1.33	0.29	0.21	NS
Combined mean						
ZATIP	145.0	161.0	147.0	2.8	3.5	65
SOSAT-C-88	185.0	201.1	162.1	3.6	4.8	56
LACRI-9702-IC	168.1	181.0	150.0	2.7	3.5	50
SE **(±)**	0.11	1.90	3.21	1.89	3.44	0.32
LSD (0.05)	NS	2.11	NS	NS	NS	0.93

NS= Not significant,

Values for 2015 and 2016 are pooled means of three replicates of three pearl millet varieties, while values for combined mean are pooled means of three replicate and three pearl millet varieties for the two years.

Pearl Millet Yield and Yield Components

The performance of the pearl millet varieties on the expression of panicle length showed that, significantly (P≤0.01) greater panicle length was produced at ZATIP compared to SOSAT-C-88 or LACRI-9702-IC that produced relatively lower panicle length in both the years and the combined mean (Table 3). In 2015, 2016 and the combined mean results showed that pearl millet variety SOSAT-C-88 produced significantly (P≤0.01) greater panicle diameter compared LACRI-9702-IC. ZATIP among the millet treatments produced statistically lower panicle diameter (Table 3). Performance of pearl millet varieties showed that, panicle weight for the sole millet was produced significantly (P≤0.001) higher at SOSAT-C-88 or LACRI-9702-IC compared to ZATIP. The lowest panicle weight were produced significantly (P≤0.001) at pearl millet variety ZATIP.

Number of grains per panicle was significantly (P≤0.05) greater for pearl millet variety in 2015, 2016 and the combined meant at SOSAT-C-88 compared to the two sole millet variety. The lower grains number were produced at pearl millet variety ZATIP compared to pearl millet variety LACRI-9702-IC. Number of panicle per plant among

the millet plants showed that, significantly (P≤0.001) greater number of panicle per plant was produced at SOSAT-C-88 or LACRI-9702-IC compared to pearl millet variety ZATIP in both years and the combined mean (Table 3).

Table 3: Effect of Pearl millet varieties on millet panicle length, panicle weight, panicle diameter, grain yield plant, number of grains/ panicle and number of panicle /plant at Maiduguri, 2015, 2016 and combined mean

Sole pearl millet	Panicle length	Panicle diameter	Panicle weight	Grain yield/ plant	Number of grains/ panicle	Number of panicle /plant
2015						
ZATIP	69.2	2.8	30.7	31.5	1989	1.2
SOSAT-C-88	39.7	4.7	43.2	46.7	2735	1.7
LACRI-9702-IC	27.6	3.1	37.4	39.2	2110	1.4
SE (±)	0.05	0.32	0.50	2.11	83.13	0.29
LSD (0.05)	3.21	1.12	1.11	0.32	189.34	NS
2016						
ZATIP	73.8	2.9	33.5	41.3	2216	1.7
SOSAT-C-88	41.6	4.8	66.1	59.6	3318	1.9
LACRI-9702-IC	29.1	3.5	48.9	45.5	2915	1.8
SE (±)	0.09	0.11	0.43	3.42	92.12	0.18
LSD (0.05)	2.66	0.19	NS	0.15	NS	NS
Combined mean						
ZATIP	71.5	2.7	32.1	36.4	2102.5	1.5
SOSAT-C-88	40.7	4.4	54.7	53.2	3026.5	1.8
LACRI-9702-IC	28.4	3.3	43.2	42.4	2512.6	1.6
SE **(±)**	1.61	1.89	0.52	0.88	76.57	0.21
LSD (0.05)	NS	2.12	NS	1.21	199.44	NS

NS= Not significant,

Values for 2015 and 2016 are pooled means of three replicates of three pearl millet varieties, while values for combined mean are pooled means of three replicate and three pearl millet varieties for the two years.

Pearl millet produce significantly (P≤0.001) greater grain yield/ha under the pearl millet variety SOSAT-C-88 or LACRI-9702-IC in 2015, 2016 and the combined analysis(Table 4). Among the pearl millet variety, it was ZATIP that produced significantly (P≤0.001) lower grain yield in both the years. Among the pearl millet variety in the sole millet treatments, significantly (P≤0.05) greater 1000 grain weight were produced at LACRI-9702-IC compared to SOSAT-C-88 or ZATIP. Variety ZATIP produced significantly (P≤0.05) lower 1000 grain weight when compared to the two pearl millet varieties in the sole plots (Table 4). Effects of cropping system on sole millet showed that, greater harvest index were produced at SOSAT-C-88 or LACRI-9702-IC compared to ZATIP in 2015. Similarly, in 2016 and the combined analysis greater harvest index was produced at SOSAT-C-88 when compared to ZATIP or LACRI-9702-IC treatment (Table 4). The lower harvest index was produced at ZATIP than the other treatments. In both the years and the combined analysis of the sole pearl millet showed that, straw yield/plant was significantly (P≤0.05) greater at SOSAT-C-88 or LACRI-9702-IC compared to the ZATIP that produced relatively lower straw yield/plants (Table 4).

Table 4: Effect of pearl millet varieties on pearl millet grain yield/ ha, 1000 grain weight, harvest index (%) and straw yield per plant at Maiduguri, 2015, 2016 and combined mean

Sole Millet	Grain yield (Kg/ha)	1000 grain weight	Harvest index (%)	Straw yield
2015				
ZATIP	2696	7.5	42.1	49.1
SOSAT-C-88	3962	9.1	59.4	62.2
LACRI-9702-IC	2981	11.3	49.3	57.3
SE (±)	103.22	0.22	0.71	1.17
LSD (0.05)	212.9	0.69	3.1	2.11
2016				
ZATIP	4346	9.1	49.8	60.3
SOSAT-C-88	6582	10.3	60.4	88.1
LACRI-9702-IC	5189	11.6	55.7	72.7

SE (±)	137.43	0.33	2.5	1.55
LSD (0.05)	257.12	NS	6.7	2.20
Combined mean				
ZATIP	3521	8.3	46.5	54.7
SOSAT-C-88	5272	9.7	60.1	75.2
LACRI-9702-IC	4085	11.6	52.5	66.1
SE **(±)**	93.1	0.19	3.4	0.87
LSD (0.05)	NS	NS	NS	2.11

NS= Not significant,

Values for 2015 and 2016 are pooled means of three replicates of three pearl millet varieties, while values for combined mean are pooled means of three replicate and three pearl millet varieties for the two years.

Discussion

The result of this two-year study have shown effect of pearl millet variety on the grain yield and yield component of pearl millet indicating that pearl millet was not adversely affected by the competition for water (Willey and Rao, 1981). It had been noted that in the semi-arid zone, pearl millet yield is only reduced if legume is planted simultaneously with millet (Baker, 1996). Dugje and Odo,(2006) opined that in pearl millet in the semi arid-zone, at about latitude 12^0 the greater the duration of between the components, the smaller the yield of tall variety components. On the other hand, at about latitude 13^0 where the length of the rainy season is shorter, early introduction of the millet on set season results to higher yields. The highest mean of 1000 grain weight of the LACRI-9702-IC compared with the other varieties presumably because of higher solar radiation capture as results of sparse canopy of LACRI-9702-IC which allow transmission of photosynthetic energy to the lower toward grain development. ZATIP yielded poorly compared with the two varieties (Dugje, 2004) attributed the poor yield potential of tall pearl millet varieties is due to inadequate root system. Among the pearl millet varieties, SOSAT-C-88 had the highest grain yield and this could be attributed to its relatively greater leaf area, panicle diameter and high grain yield. According Bassi and Dugje (2016) an appropriate pearl millet in the dry savanna would be the one that is highly competitive and yields both grain and straw yield. The present results demonstrated that there is a scope for famers to increase pearl millet system productivity in the Sudan savanna, productivity of the system could be further enhanced by adopting pearl millet variety SOSAT-C-88 to increased pearl millet

productivity and also offered an opportunity for selective input manipulation Reddy et al.,(2003).

Conclusions

Grain and straw yields can be optimized by growing pearl millet variety SOSAT-C-88. This variety had the highest competitive ability and grain yield advantage compared to the other varieties, while monetary returns can be optimized by LACRI-9702-IC in the Sudan savanna region**.** When the objective is to obtain near 'full' yield of pearl millet and near 'full' straw yield then, growing SOSAT-C-88 will be ideal in the region.

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