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Research Paper

GROWTH AND YIELD OF PEARL MILLET (*Pennisetum galaucum)* (L.) R. Br.) AS INFLUENCED BY VARIETY AND INTRA-ROW SPACING IN SOKOTO, NORTH-WESTERN NIGERIA

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Abstract

Field trials were conducted during 2010 and 2011 rainy seasons at Usmanu Danfodiyo University Dry land Teaching and Research Farm, Sokoto to study the effects of variety and intra-row spacing on growth and yield of millet. The treatments consisted of two varieties of millets, improved (SOSAT C. 88) and local (Zango millet), three intra-row spacing (25cm, 50cm and 75cm) with an inter- row spacing of 75cm. The treatments were combined and laid out in a randomized complete block design (RCBD) with three replications. Results revealed that variety had significant influence on growth and yield parameters. Local variety (Zango) had significantly (P≤ 0.05) higher plant height and panicle length than the improved variety (SOSAT C-88). On the other hand, SOSAT C-88 had significantly (p≤0.05) higher grain and Stover yield than Zango millet. Similarly, intra-row spacing had significant (p≤0.05) effect on tiller count, Stover yield and 1000 seed weight. The interaction between variety and spacing was not statistically significant (p≤0.05) on the parameters measured. From this study, It could be concluded that SOSSAT C-88 variety of millet could be cultivated using an intra-row spacing of 50cm for increased yield of millet under Sokoto agro-ecological conditions.

Key words: Growth ,Yield, Variety, Intra-row *Spacing, Millet, North-Western, Nigeria*.

INTRODUCTION

Pearl millet *(pennisetum glaucum* (L.) R. Br.) belongs to the family Poaceae, subfamily panicoideae, (ICRISAT, 2006). It is one of the oldest food crops known to man and possibly first cereal grains to be used for domestic purposes (Railey, 2006). Millet ranks as the sixth most important grain in the world and sustains one third of the world`s population and is an important part of the diet in former Soviet Union, Africa, India Egypt (Railey, 2006). In Africa, pearl millet is primary grown for human consumption serving as staple food in some of the poorest countries and region of the continent. The grain is among the most nutritious of the major cereal grains. almost all the grain is used for human consumption such as porridge or cakes (Raemaekers, 2001). Other diverse use includes, the use of straw to feed livestock as well as in house building, fencing and for fuel (Gibbon and pain, 1985).

Despite the immense important of millet to the world populace and Nigeria in particular, the yield recorded by the farmers in Nigeria is still very low (1. 55 t ha $^{-1}$) (FAOSTAT, 2006). Compared to global average yield (3.2 t ha $^{-1}$) (Railey, 2006) with the current increase in population especially in sub-Saharan Africa where millet is a reference crop, there is a need for measures that world increase its production to meet the demand of the growing population. Besides other factors like rainfall and pests problems, low Yield of millet is also attributed to use of inadequate plant population and low yielding seed varieties. Selection of varieties on the basis of yield and quality is important consideration (Harper, 1999). It is a known fact that, the performance of any crop at any particular location depends excessively on the spacing used. In tillering crops like millets, narrow spacing discourages the production of tillers (Anthony *et al.*, 1999). The ultimate yield from unit land area depends on the number of plants growing on it. It has been established that appropriate spacing and variety are some of the pre-requisite to successful millet production (Roe, 2006). Though farmers are aware of the advantages of these factors, quite large, number of them are yet to understand the appropriate use of these factors so as to optimize yields. The establishment of the optimum plant population in the most suitable arrangement pattern is the foundation to successful crop production system (Harper 1999). It is a fact that the performance of any crop at a particular location depends on the variety, spacing and the biotic and abiotic constraints obtainable at that location. This study therefore, aims at finding the influence of variety and intra-row spacing on the growth and yield of millet.

MATERIALS AND METHODS:

Field studies were conducted in 2010 and 2011 rainy seasons at Usmanu Danfodiyo University, Teaching and Research Farm, Dundaye, Sokoto located on Latitude 13^0 $O1^1$ N; longitude 5^0 15^1E and at an altitude of 350m above sea level in the Sudan Savanna agro-ecological zone of Nigeria (Kowal and Knabe 1972). The annual rainfall of the area during the two trials were 1157.4mm and 558.4mm respectively. The soil type in the area is predominantly sandy and has been classified as Ustipsamment (Noma and Yakubu, 2002). Physical and chemical analysis of the samples collected from a depth of 0-15 cm and 15-30 cm according to page *et al.* (1982) are shown in Table 3. The treatments consisted of two varieties of millets, improved (SOSAT C. 88) and local (Zango millet), three intra-row spacing (25cm, 50cm and 75cm) with an inter- row spacing of 75cm. The treatments were combined and laid out in a randomized complete block design (RCBD) with three replications. Improve millet variety (SOSAT C-88) and local (Zango millet) were sourced from institute for Agricultural Research (IAR) Samaru, Zaria. A Randomised completed Block Design (RCBD) layout with three replicates was used. The area was ridged and the plots were separated by an area of 0.5m between plots, 1.0m between replicates. Each plot comprises five ridges with the three central ridges serving as the net plot. Seeds were sown on each ridge by dibbling. Thinning took place two weeks after sowing. Weeding was done at 2 and 4 WAS by hoeing to minimize weed completion.

Data collected included stand count, tiller count, plant height at maturity, panicle length, Stover yield, grain yield and 1000 seed weight. Stand count was taken at two weeks after sowing by counting plants in each plot and extrapolated to per hectare basis. Tiller count was taken at 3 and 6 WAS by counting tillers in each plot. Plant height from each plot was taken at maturity; this was done by measuring from the ground level to the tip of the sampled plant using metre rule. Panicle length was measured after harvest by cutting off from stalks five randomly selected panicles from

each net plot and measuring their length to obtain the average panicle length. Stover yield was obtained after removing the panicles from stalks and the values obtained were extrapolated to per hectare basis. Grain yield was determined after threshing the panicles from each net plot using mortar and pestle, winnowed to obtain the grains. The grains were weighed and extrapolated to per hectare basis. The 1000 seed weight were obtained by weighing one hundred seeds from each net plot. The values obtained were multiplied by ten (10) to give one thousand seed weight.
Data collected were subjected to analysis of variance (RCBD) using statistical analysis system (SAS). Duncan's Multiple Range Test (DMRT) was used to separate means where necessary.

RESULTS AND SISCUSSION

Stand count

Influence of variety: Variety had no significant effect in terms of stand count in both 2010 and 2011cropping seasons(Table 1). The varieties were statistically the same in terms of stand count ($p \leq 0.5$), this is in conformity with what was reported by Egharevba *et al*. (1984), that in cereals) millet and sorghum stand count hardly affected significantly by variety if both environmental and soil conditions are favourable.
Influence of Spacing: Spacing had significant effect ($P \leq 0.05$) on stand count. 25cm spacing had the highest stand count and differed significantly from the rest of the spacing (Table 1). This result is in contravention with the findings of Egharevba *et. al.* (1984) who reported that in cereals, spacing had little or no effect on plant population.

Tiller Count:

Influence of variety: Variety had no significant effect ($p \leq 0.05$) on tiller count at 3WAS and 6WAS in both 2010 and 2011 cropping seasons. This is due to the fact that varieties do not differ in their tillering ability. This is in line with what was reported by Egharevba *et. al.* (1984) that cereals (millet and sorghum) tiller count hardly affected significantly by variety if both environment and soil condition are favorable.

Influence of Spacing: Intra-row spacing had no significant effect tiller count at 3WAS in both seasons. However, significant effect of spacing on tiller count was recorded at 6WAS in 2010 and 2011 cropping seasons. All the spacing differs significantly from one another and 75cm had the highest tiller count than the rest of the spacing. This could be as a result of adequate space provided by wide spacing which enable the plants to effectively utilized the available resources (light, moisture and soil nutrients) for tiller formation. This in is line with what was reported by Anthony *et. al*. (1999) that in tillering crops like millet, narrow spacing discourage the production of tillers.

Plant height

Influence of variety: The results showed that there was no significant effect ($P \leq 0.05$) of variety on plant height in both 2010 and 2011 cropping seasons, but in comparing their means local Variety (Zango, millet) at maturity recoded significantly taller plants than improved variety (SOSAT C-88) in both 2010 and 2011 cropping seasons. This result is in line with that of Raemaekers (2001) who reported that local varieties are taller than the improved varieties.
Influence of Spacing: There was no significant effect of spacing ($P \leq 0.05$) on plant height at maturity in both cropping seasons. This is in line with the findings by Zarafi Emechebe (2006) who respected that intra-row spacing has significant increased on both plant height and panicle length. This could be due to the d inferences in environmental conditions.

Panicle Length

Influence of variety:- There was significant effect (P≤0.05) of variety on panicle length in both 2011 and 2011 cropping seasons (Table 2). Zango millet from both trials recoded longer panicles which were significantly higher than what was recorded in the improved (SOSAT C-88). This agrees with Jennis (2006), who reported that millet plant vary in panicle length, seed size colour and plant height depending on the cultivars and environment.

Influence of spacing:- There was no significant difference among the spacings in terms of panicle length in both cropping seasons as indicated in Table 2. This result is not in line with the findings of Zarafi and Emechebe (2006) who reported that intra-row spacing has significant effect on both plant height and panicle length. This may be due to the differences in environmental condition.

Stover Yield

Influence of variety: Stover yield in 2010 and 2011 cropping seasons was significantly affected by variety as shown in Table 2. The improved variety (SOSAT C-88) had higher Stover yield than the local variety (Zango millet).The higher stover yield recorded by the improved variety was due to the fact that it is more photosynthetic efficient than the local variety. This is not in line with the findings of Raemaekers (2001) who reported that improved varieties, has low stover weight compared to the land races.

Influence of spacing:- Stover yield in both season was significantly affected by intra-row spacing . 25cm and 50cm respectively recorded higher yield than 75cm. This concurs with findings of Anthony *et. al.(1999)* who reported that the ultimate yield from a unit land area is contributed by all the plants growing on it, excessively wide or narrow spacing leads to reduction in yield.

Grain Yield

Influence of variety:- The results indicated a significant effect of variety on grain yield in both seasons. SOSAT C-88) recorded the highest yield compared to the local (Zango millet). The higher grain yield recorded by Sossat variety may be as a result of the compact arrangement of the Sossat grains as opposed to the loose arrangement found in Zango variety. This variation in grain yield is in accordance with the report of Raemaekers (2001), that improved varieties have higher grain yield per unit area than the local varieties.

Influence of spacing:- Grain yield was significantly affected by spacing in both cropping seasons as shown in Table 2. Spacing at 25cm and 50cm recorded higher grain yield than 75cm in both cropping seasons. This higher grain yield may be attributed to their close spacing and corresponding grain yield per unit area.. This is in line with the finding of Anthony *et. al.* (1999) who reported that the ultimate yield a unit land area is contributed by all the plant growing on it, excessively wide or narrow spacing leads to reduction in yield

1000 Seed Weight

Influence of Variety:- Results obtained as shown in Table 2 indicated that there was no significant effect of varieties ((P≤ 0.05) on 1000 seed weight in both years. However, when comparing their means, the improved variety (SOSAT C-88) had the higher values 9.86g and 9.80g in 2010 and 2011 seasons respectively while local variety (Zango millet) had 9.7g in both years. This is in accordance with the finding of Ustimenko Bakumovsky (1983) who reported that 1000 seed weight of pear millet seeds weight of 6.02 to 12.0 grammes

Influence of spacing: The results in Table 2 revealed that 1000 seed weight in 2010 season was significantly different among the varieties but shows no significant

difference in 2011 season. The results revealed that wide spacing 50 and 75cm recorded higher 1000 seed weight than narrower spacing of 25cm. The significant variation observed in 1000 seed weight might be due higher amount of rainfall(1157.4mm) received in 2010 compared to (558.mm) recorded in 2011.

CONCLUSION:

From the results obtained from this study, it could be concluded that SOSSAT C-88 millet varieties could planted in Sokoto, North-western Nigeria using intra-row spacing of 50cm for optimum growth and yield of millet.

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Table 1: Stand Count, Tiller Count and Plant Height at maturity as Influenced by Variety and Spacing in 2010 and 2011 Cropping Seasons at Usmanu Danfodiyo University Teaching and Research Dry Land Farm, Sokoto.

Treatment	Stand count		Tiller count				Plant hight at maturity(CM)	
Variety	2010	2011	2010		2011		2010	2011
			3WAS	6WAS	3WAS	6WAS		
SOSAR C-88	112345	111851	3.8	12.8	3.0	11.2	1832.3	178.6
Zango Millet	112592	111984	4.6	14.0	3.6	12.7	191.7	186.1
SE	385.70	301.84	0.3	0.7	0.3	0.6	2.9	
Significance	ns	Ns	ns	ns	ns	ns	Ns	ns
Spacing(s)								
25cm	175184[a]	174629[a]	4.5	8.1	3.7	6.4[c]	184.1	181.0
50CM	94444[b]	94258[b]	3.7	13.0b	2.9	10.9[b]	190.8	185.2
75cm	67777[c]	66851[C]	4.2	19.3[a]	3.2	18.5[a]	187.8	180.8
SE±	472.39	36.68	0.3	0.8	0.3	0.7	3.5	3.2
Significance	*	*	ns	*	ns	*	Ns	ns

Means in a column followed by similar letter(s) are not significantly different at 5% level of significance using Duncan's multiple Range Test (DMRT ns – not significant, * = significant at 5% level.

Tables 2:- panicle length, Stover. Yield, Grain yield and 1000 seed weight as influenced by variety and spacing in 2010 and 2011 cropping seasons at Usmanu Danfodiyo University Teaching and Research Dry Land, Sokoto.

Treatments	Panicle length(cm)		Stover yield		Grain yield(kg)		1000 seed weight(g)	
Variety	2010	2011	2010	2011	2010	2011	2010	2011
SOSAT C-88	39.0[b]	37.5[b]	15871[a]	15722[a]	2687[a]	2592[a]	9.9	9.8
Zango millet	47.1[a]	45.a[b]	13755[b]	13634[b]	2332[b]	2251[b]	9.7	9.7
SE ±	0.8	0.8	536.52	537.27	88.36	86.67	0.08	0.07
Significance	*	*	*	*	*		ns	ns
Spacing (S)								
25cm	42.5	41.1	15420a	15335[a]	2668[a]	2572[a]	9.5[b]	9.6
50	44.0	42.2	16024a	15801[a]	2671[a]	2681[a]	9.9[a]	9.8
75cm	42.7	40.9	12996[b]	12898[b]	2190[b]	2113[b]	10.0a	9.9
SE ±	42.7	0.9	657.10	658.10	108.21	106.15	0.09	0.08
Significance	ns	ns	*	*	*	*	*	ns

Means in a column followed by similar letter(s) are not significantly different at 5% level of significance using Duncan's multiple Range Test (DMRT) ns = not significant, * = significant at 5% level

Table 3: Physical and Chemical Characteristics of the Soil at the Experimental Site of the Usmanu Danfodiyo University dry land Farm, Sokoto during 2010 and 2011 rainy seasons

Parameters	2010		2011	
	0-15cm	15-30cm	0-15cm	15-30cm
Physical properties:				
Sand (g Kg -1)	910	890	870	831
Silt (g kg -3)	47	67	87	126
Clay (g kg -1)	43	43	43	43
Textural class	Sand	Sand	Sand	Sand
Chemical properties				
Soil pH(H20) 1:2	5.8	5.9	5.8	5.4
Soil pH(Cac12) 1:2	5.6	5.2	5.7	5.3
P (mg kg^{-1})	1.45	1.43	0.40	0.40
N (g kg^{-1})	0.42	0.56	0.35	0.28
Mg (cm01 kg^{-1})	0.45	0.20	0.65	0.15
Ca cmo1 kg-1)	0.50	0.35	0.50	0.35
K (cmol kg^{-1})	1.51	1.59	1.62	1.60
Na (cmo1 kg^{-1})	0.48	0.39	0.39	0.39
Org. carbon (g kg^{-1})	12.3	3.20	3.8	2.4
C.E.C. (cmol kg^{-1})	5.60	7.40	5.30	4.84
C. (us/cm)	219.1	193.4	225.1	197.8

Table 4: Mean monthly rainfall distribution in Sokoto during 2010 and 2011Rainy Seasons.

YEAR	**2010**	**2011**
Month	**Rainfall (mm)**	**Rainfall(mm)**
March	10	0
April	0.4	1.0
May	129	92.9
June	126	161
July	322.8	29.3
August	358	174
September	88.2	93.2
October	123	7.0
Total:	**1157.4**	**558.4**

Source: NIMET (2011).