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PERFORMANCE OF DIFFERENT PEARL MILLET GENOTYPES UNDER IRRIGATED CONDITIONS

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Abstract

Thirty four genotypes of pearl millet(Pennisetum glaucum (L.) R. Br) were evaluated at Sudan. Including two released varieties, Ugandi and Ashana at Gezira Research Farm (GRF) and Rahad Research Farm(RRS) in the autumn of 2009. The experiment was arranged in randomized complete block design with three replications. Grain yield and some yield components including number of productive tillers and panicle length , varied significantly among the thirty four genotypes. Mean of grain yield for all genotypes across sites was 1.3 t/ ha-. Sadag Togo had the highest grain yield (1.7 ha-1)followed by Okashana-3 (1.6 t/ha-1),while IP 19745 had lowest grain yield (0.8 t/ha-1)across tow site.Okashana-3 out yielded the best than check (Ashana). The combined Result for Genotypic coefficient of variability and broad sense heritability estimates grain yield and head weight varied significantly among the thirty four genotypes.

Keywords: Pennisetum glaucum, Irrigated farm, Performance, Yield Components, Sudan.

Introduction

Pearl millet [Pennisetum glaucum (L.) R. Br.] belongs to the genus pennisetum, of the poaceae family and the paniceae tribe. It ranks sixth after wheat, rice, maize, barley and sorghum in importance in terms of contribution to global cereal supply. Pearl millet comprises of about 120 to 130 species grown principally for grain in the tropical and subtropical areas of Africa, yielding approximately 10 million tons of grain, about 70% of it being produced in West Africa. The important species are pearl millet, finger millet, porso millet, and foxtail millet (Payne, 1997). Ninety-four percent of the world's millet production is grown in developing countries (Gill and Turton, 2001). The grains of Pearl millet cultivars are of different coolers (grey, pale yellow white or slightly bluish in some types) and protrude from the floral scales. Pearl millet species is grown on 40 million ha around the world for both forage and grain yields (FAO, 1986; Hanna et al., 1998). It is found mainly in the tropics and sub-tropics and to a lesser extent in warm temperate areas. (Gill and Turton, 2001). The major Pearl millet producing countries in West Africa are Nigeria, Niger, Brukinafaso, Chad, Mali, Mauritania and Senegal. In Eastern Africa, it is grown commercially in Sudan and Uganda. In southern Africa, the commercialization of agriculture has resulted in maize partially or completely displacing this traditional food crop (Pearl millet). In Sudan, pearl millet is grown mainly for human consumption. It is a staple food for the vast majority of poor farmers in Western Sudan. Thus it remains an important component of the diets in Western Sudan; its use is reflected in many traditional dishes (Vogel and Graham, 1979). Pearl millet production in Sudan is concentrated in the warm and drier regions of Western Sudan (Darfur and Kordofan), with little in the central clay plains of the Sudan Gezira. (ICRISAT, 1985). Most of the varieties being grown by farmers are mostly farmers' selection of landraces or introductions from West African states of Niger and Nigeria. Many researchers focused their attention on characterization and multiplication and of West and Central African pearl millet land races (Haussamann et al., 2006).The objectives of this study were to identify genotypes with high grain yield in pearl millet germplasm under irrigated condition in Agriculture Research Condition Sudan.

Material and Method

Experiment site was during main season at Gezira Research farm (GRF), Gezira State and at Rahad Research Station (RRS)The Genetic materials used in this study were thirty four pearl millet genotypes from different genetic background These genotypes were introduced from International Crops Research Institute for the Semi- Arid Tropic (ICRISAT),Agricultural Research Corporation (Sudan) and West African and are presented in Table 1.

Table 1: Name and origin of thirty four pearl millet genotypes used for variability study carried out at Gezira and Rahad Research Stations in 2009

S/N	Genotype	Origin	S/N	Genotype	Origin
1	Sadc long	W. Africa	18	SDMV 95030	ICRISAT
2	Ugandi	ICRISAT	19	Sudan II	Sudan
3	SDMV 95032	ICRISAT	20	Dahabya	Sudan
4	IP 19745	ICRISAT	21	Baladi white	Sudan
5	Sadc Togo	W. Africa	22	Okashana-3	ICRISAT
6	Bauda	Sudan	23	Okshana-1	ICRISAT
7	ICMV 221	ICRISAT	24	ISC II	ICRISAT
8	IP 19706	ICRISAT	25	Ashana	ICRISAT
9	MCNELC	ICRISAT	26	Sudan I	Sudan
10	ICMV 155	ICRISAT	27	MCSRC ICMV155	ICRISAT
11	Baladi Yellow	Sudan	28	Brish ICMV155	ICRISAT
12	ISC III	ICRISAT	29	white	ICRISAT
13	IP 19854	ICRISAT	30	Dembi yellow	Sudan
14	Umgarfa	Sudan	31	ICMV 91059	ICRISAT
15	Top cross pollinator	ICRISAT	32	Sudan III	Sudan
16	IP 19743	ICRISAT	33	Sosat-C8	ICRISAT
17	GB8735	ICRISAT	34	IP 19827	ICRISAT

Two released varieties, Ugandi and Ashana, were used as check and were arranged in a randomized complete block design (RCBD) with three replications for each site. Each entry was planted on a two row plot, five meters long with inter-row spacing kept at 75 cm and between hills at 50 cm apart. All plots were thinned to 2 plants per hill three weeks after crop emergence. The exact sowing dates for the two sites were 9 August and 25 July 2009 at GRF and RRS, respectively. The first irrigation were given on same days of planting and later given at irrigation intervals between 10 to 15 days according weather conditions. All recommended cultural practices for pearl millet followed from crop growth till harvest. All data were collated on 2 rows in each plot, Days to 50% flowering Plant height (cm),Panicle length(cm),Productive tillers(no),Head weight (kg plot-1),Grain yield (t ha-1) and 1000seed weight(g). Relationships between grain yield and yield components and contributions of each component to total variation were analyzed using the statistical Analysis software SAS. Data were analyzed for each location separately and combined according to standard (ANOVA) methods and using Statistical Analysis for System (SAS, 1997).

Results and Discussion

Analysis across two sites revealed wide range of variation significant differences among the thirty four pearl millet genotypes for grain yield, TSW, days to 50% flowering, panicle length and productive tillers are presented in table (Table 2). The combined analysis of variance showed significant differences for genotypes and genotypes × site interaction for most of the character, panicle length , productive tillers, grain yield and TSW this variation could be attributed to genetic and environmental effects as well as their interaction . Substantial variations in pearl millet have been reported by Abdelrahman et al.(2002)

General of mean performance of the thirty four pearl millet genotypes at GRF and RRS are shown in (Table 3). The results of trial revealed significant differences for panicle length, number of productive tillers, grain yield and 100 seed weight In terms of maturity, the mean for days to 50% flowering for all genotypes was 56. Ashana was relatively early and attained 50% flowering at 54 days followed by MCSRC , while Dembi yellow attained 50% flowering after 61 days. Dembi yellow was a late maturity genotype and similar to Ugandi which demonstrated flowering pattern in a similar manner 50% flowering at 60 days after planting. SADAC Togo and Baladi white attained 50% flowering at 56 days indicating that they are intermediate yielding genotypes and would do well under marginal as well as favorable growing conditions. similar results have been reported by Muhammed et al.(2002) .Mean plant height of all genotypes was 170 cm; with Dembi yellow expressing short plant statue(158cm) and ICMV 155 Bristol was the tallest (180cm). Ashana and Ugandi had plant height of 173 and 159, respectively. Baladi white (173cm) and Okashana-3 (175cm) had similar to Ashana but both were taller than SADAC Togo (165cm). The results are supported by findings of Naeem et al. (2007).The panicle length and head weight of most genotypes were similar. The overall panicle length and head weight of most genotypes was 24.0 cm; IP19743 had the longest panicle length (28.2cm) followed by Dembi yellow (27cm), while ICMV91059 had the shortest panicle length (20.4cm). Regarding head weight, the overall mean head weight was 2.3kg. Okashana-3 and Sudan 1 had the heaviest head weight (2.7kg), while IP19745 had the lightest head weight (1.7kg). Ashana (2.3kg) and Ugandi (2.2kg) had relatively similar head weight. Considering the mean grain yield across sites the over all mean grain yield 34 pearl millet genotypes was 1.3 (t/ha) . Genotype Sadag Togo had the highest grain yield (1.7 t/ ha-1) followed by Okashana -3 (1.6 t/ha-1), while IP19745 had the lowest grain yield (0.8 t/ha-1). The check varieties, Ashana and Ugandi had grain yields of 1.4 and 1.3 t/ha-1, respectively (Table3). Sadag Togo had yield over the best check, ASHANA. The results suggest that SADAG TOGO and Okashana-3 can further be tested in multi- location trails to confirm their yield potential for a possible release in their own rights. These results agree with the findings of VanoOsteron et al. (2002) who reported that the number of productive tillers is associated with grain yield and changes with plant population. Grain yield potential and differences in pearl millet performance are associated with kernel number, panicle length, number of productive tillers and kernel weight. Evans and Wardlaw (1976) urge that environmental factors such as temperature and available water may influence yield components. Potential for yield compensation occurs early in plant life cycle through adjustment in the number of panicles per square meter and kernels per panicle.

Estimates of genotypic, phenotypic coefficient of variations and broad sense heritability Genotypes coefficient of variability was relatively high for grain yield and head weight only at GRF. Heritability estimates for these traits were also high at GRF (Table 4). These results indicate variability among thirty four pearl millet genotypes for grain yield, days to 50% flowering, panicle length, TSW and productive tillers. The yield components (panicle length, TSW and productive tillers) determine grain in pearl millet . These results increased the probability of isolating superior genotype for obtaining higher yielding genotype, since direct selection for grain yield alone could be misleading (Islam and Rasul, 1998).

Table 2: Genotypic, phenotypic variances and heritability estimates of 34 pearl millet genotypes tested at GRF and RRS in 2009

SOV	DF	Days 50% flowering (day)	Plant height (cm)	Panicle Length (cm)	Productive tillers (no.)	Head weight (kgplot1)	Grain yield (t/ ha-1)	1000seed weight (g)
Site	1	60.4**	5917.4**	637.1***	37.7**	2.4**	5.4***	13.6**
Rep x Site	4	11.4	800.4**	28.1**	3.8	2.3***	1.4***	3.1**
Genotype	33	23.1***	192.4	16.7**	4.9*	0.4	0.3*	1.4**
Genotype ×Site	33	0.9	184.5	12.7*	5.6**	0.4	0.7**	1.2*
Error	132	6.9	129.5	7.4	3.1	0.4	0.2	0.7
Mean		56.4	169.8	24	6.1	2.3	1.3	9.5
C.V.		4.7	6.7	11.3	28.8	26	20.5	8.7

***, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respective**

Table 3: Mean performance of 34 pearl millet genotypes across GRF and RRS during the rainy season in 2009

Genotype	50%flowering (day)	Plant height (cm)	Panicle length (cm)	Productive tiller (no.)	Head weight (kg plot-1)	Grain yield (t ha-1)	1000seed weight (g)
SADC Long	59.5	169.6	24.1	5.5	2.2	1.5	9.5
SDMV95032	58.0	164.7	24.1	6.2	2.1	1.1	9.6
IP19745	56.2	166.7	25.2	6.7	1.7	0.8	9.1
SADC Togo	**56.3**	**165.0**	**26.9**	**5.0**	**2.6**	**1.7**	**9.9**
BAUDA	57.5	166.5	23.6	7.0	2.3	1.4	9.4
ICMV221	55.0	167.9	25.8	6.3	2.5	1.4	9.7
IP19706	55.2	179.3	23.6	5.9	2.2	1.3	9.3
MCNELC	55.5	167.0	25.8	6.1	2.1	1.2	8.6
ICMV155	54.8	175.5	24.3	7.8	2.6	1.2	9.3
BALADI Yellow	55.8	175.1	22.6	4.7	2.5	1.4	10.0
ISC III	56.2	166.6	24.5	5.4	1.8	1.1	9.9
IP19854	58.7	168.8	25.3	5.8	2.4	1.5	10.2
UMGARFA	57.5	175.3	25.4	7.1	2.0	1.1	9.7
Topcross poll.	57.7	170.4	24.3	8.5	2.5	1.4	9.1
IP19743	58.5	177.4	28.2	5.2	2.1	1.1	9.1
GB8735	52.0	164.2	23.8	5.1	2.0	1.2	9.8
SDMV95030	55.0	171.1	23.5	6.8	2.3	1.3	9.1
SUDAN II	55.3	179.0	23.3	5.5	2.7	1.5	9.4
DAHBAYA	54.5	171.5	22.6	5.7	2.3	1.3	9.8
BALABI White	56.3	173.1	25.6	6.2	2.1	1.3	9.8
Okashana-3	54.2	174.5	23.4	6.2	2.7	1.6	9.2
Okashana-1	56.7	175.9	25.3	5.2	2.4	1.5	9.6
ISC II	56.2	167.0	24.6	4.6	2.0	1.2	9.3
SUDAN I	58.0	166.3	21.5	7.7	2.7	1.4	9.6
MCSRC	54.0	172.5	24.5	6.2	2.6	1.5	9.9
ICMV155 Bris.	54.8	179.7	22.7	6.3	2.1	1.2	9.4
ICMV155 White	54.8	168.2	21.7	6.4	2.2	1.3	8.2
DEMBI Yellow	60.7	157.6	23.9	6.4	2.5	1.3	9.7
ICMV91059	55.8	160.3	20.4	6.8	2.1	1.2	8.8
SUDAN III	55.8	166.5	24.5	5.5	2.2	1.3	10.1
SOSAT C-8	59.7	173.2	25.9	4.9	2.0	1.2	10.4
IP19827	58.2	164.8	22.0	6.3	2.3	1.4	8.9
ASHANA	**53.8**	**173.1**	**21.0**	**5.9**	**2.3**	**1.4**	**10.2**
UGANDI	**59.7**	**159.4**	**23.3**	**5.2**	**2.2**	**1.3**	**10.0**
Mean	56.4	169.8	24.0	6.1	2.3	1.3	9.5
SE±	2.63***	11.38	2.71**	1.75*	0.59	0.40*	0.82**
Prob.< G x L	ns	ns	*	**	ns	*	*

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respectively
ns = not significant at P>0.05 probability level

Table 4: Genotypic, phenotypic variances and heritability estimates of 34 pearl millet genotypes tested at GRF and RRS in 2009

Character	Genotypic coefficient of variation			Phenotypic coefficient of variation			Broad sense heritability (h2 B)		
	GRF	RRS	Across	GRF	RRS	Across	GRF	RRS	Across
50% flowering (day)	2.9	2.3	4.1	5.1	5.2	6.2	33	19	43.8
Plant height (cm)	2.7	2.4	2.7	6.6	7.8	7.2	18	10	13.9
Panicle length (cm)	3.5	8.0	7.3	13.7	12.4	13.5	7	42	29.7
Productive tillers/hill (no.)	3.2	18.4	13.0	22.2	37.7	31.6	2	24	16.9
Head weight (kg plot-1)	9.1*	11.4	3.9	28.6	25.9	26.3	12*	19	2.2
Grain yield (t ha-1)	6.6*	10.5	6.4	28.9	31.8	30.9	05*	11	4.2
Thousand grain weight (g)	4.6	5.2	5.2	8.8	11.1	10.1	28	22	26.4

*Significant at 0.05 probability level

Conclusion

This study has demonstrated Performance within thirty four pearl millet genotypes with different genetic backgrounds and origin. The significant differences were observed in panicle length, number of productive tillers, grain yield and 100 seed weight among the thirty four genotypes Ashana was the earliest variety to 50% flowering (54 days) followed by MCSRC, Dembi yellow was the short variety (158 cm) while Bristol was the tallest (180 cm) and Okashana-3 (175 cm) had similar to Ashana. The grain yield of all genotypes across sites was 1.3 t/ ha-1. Sadag Togo had the highest grain yield (1.7 ha-1) followed by Okashana-3(1.6 ha-1),while IP 19745 had lowest grain yield (0.8 ha-1)across tow site. These yield components contributed positively to grain yield as demonstrated broad sense heritability estimates grain yield and head weight varied significantly among the genotypes. Analysis of variance at each site and across sites showed significant variability among the genotypes for grain yield days to50% flowering, panicle length, number of productive tillers and TSW. Also significant differences were observed for genotypes and genotypes × site interaction for panicle length, productive tillers, grain yield and TSW. This evaluation would help in selection of parents for use in conventional breeding and contribution of the stability of different Pearl mille characters under a rang of environments and irrigated conditions.

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References

Abdelrahman, S.H. and Abdalla, A.H., 2002. Stability analysis in some upland (Gossypium Hirsutum L) genotype. University of Khartoum Journal of Agriculture science 14 (2) : 326-342.

Evans, L.T. and Wardlaw, I.F., 1976. Aspects of the comparative physiology of the grain yield in the cereals. Adv. Agron. 28:301-359.

FAO, 1986. Production yearbook. Vol. 40. FAO, United Nations, Rome. Kassam, A.H. and J.M. Kowal. 1975. Water use, energy balance and growth of gero millet at Samaru, Northern Nigeria. Agr. Met. 15:333-342.

Gill, G.J. and Turton, C., 2001. Pearl millet in developing countries. International Sorghum and Millets Newsletter 42:1-7.

Hanna, W.W., 1998. Pearl millet, pp 332-343 . In: Banga, S.S., and Banga, S.K.(Eds). Hybrid Cultivar Development. Narosa Publishing House, New Dalhi, India. Sorghum and Millets Newsletter 42:1-7.

Haussmann, B.I.G., Boureima, S.S. and Bidinger, F.R., 2006. Evaluation of medium maturity, high-tillering pearl millet population diallel in Niger. International Sorghum and Millets Newsletter 47:126-128

ICRISAT, 1985. International Crop Research Institute for Semi-Arid and Tropics Annual Report, pp: 130 - 131. Patancheru, Andhra Pradesh, India.

Islam, M.S. Rasul . 1998. Genetic parameters, correlations and path coefficient analysis in groundnut. Bangla.J. Sai. Indus. Res., 33:250-254.

Naeem, M., Shahid, M.S. and Khan, A.H., 2007**.** Performance of pearl millet Genotypes for Forage under irrigated conditions. Journal Agricultural Reseach Institute, Faisalabad, Pakistan, 45(3).

Muhammad, M.N., 2002. Performance of different Pearl Millet Varieties Under Rainfed Condition. Pakistan J. Agric. Res. Vol. 17 No.4.

Payne, W.A., 1997**.** Managing yield and water use for pearl millet in the sahel.Agronomy journal, 89 (3), 481- 490.Vol 171.

SAS Institute, 1997. SAS/STAT user's guide Version 6, fourth ed. SAS Inst., Cary, NC.

Van Oosterom, E.J., O´Leary, G.J., Carberry, P.S. and Craufurd, P.Q., 2002. Simulating growth, development, and yield of tillering pearl millet. III. Biomass accumulation and partitioning. Field Crops Res.79:85-106.
Van Oosterom, E.J., O´Leary, G.J., Carberry, P.S. and Craufurd, P.Q., 2002. Simulating growth, development, and yield of tillering pearl millet. III. Biomass accumulation and partitioning. Field Crops Res.79:85-106.
Vogel, S. and Graham, M., 1979. Sorghum and Millet: Food Production and use. Report of a workshop held in Nairobi, Kenya, 4-7 July 1979.