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COMPARATIVE PERFORMANCE OF PEARLMILLET GENOTYPES IN TERMS OF YIELD AND QUALITY UNDER DIFFERENT ENVIRONMENT

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SUMMARY

The present investigation was carried out at Research Farm of Crop Physiology, Department of Agronomy, CCS Haryana Agricultural University, Hisar, India for two consecutive years from 2011 to 2012. The treatments comprised pearlmillet genotypes HHB 67 (Improved), HHB 197, HHB 223 and HHB 234 and two environment viz., rainfed and irrigated. The experiment was laid down in factorial randomized block design with three replications. The results indicated that effective tillers (2.4), earhead length (22.8 cm), grain (31.18 q/ha) and stover yield (84.68 q/ha) were significantly higher under irrigated condition than rainfed environment. Interaction effect of environment and genotypes showed higher number of effective tillers, earhead length, grain and stover yield in the genotype HHB 223 under irrigated condition compared to other genotypes. Under rainfed condition these were higher in the genotype HHB 234. Zinc and iron content in grain was significantly higher under rainfed condition (58.03 ppm) than irrigated environment (53.31 ppm). Genotype HHB 67 'Improved' recorded significantly higher zinc (63.82 ppm) and iron content (45.84 ppm) in grain compared to all other genotypes.

Key words : Pearl millet, genotypes, rainfed and irrigated

The biggest challenge for agriculture in the present and future is to meet the food and fiber needs of the ever increasing world population. Increasing the production of cereals is, therefore, of paramount importance. Pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] is generally grown under rainfed conditions in arid and semi-arid regions of the world. In India, annual planting area under pearlmillet is 8.69 million hectares producing nearly 8.74 million tonnes of grain (Anonymous, 2012-13). It is primarily grown on marginal and sub-marginal land of Rajasthan, Maharashtra, Uttar Pradesh, Gujarat and Haryana. With the advent of pearlmillet hybrids in mid-sixties, the pearlmillet cultivation received a fillip. As a result, the productivity almost tripled from around 350 kg in mid sixties to around 1156 kg hectares in 2012. Much of the increased demand for balanced human diet and animal ration has to come from staple food crops and roughage, as they are major and cheap source of the nutrients. Micronutrient malnutrition arising from dietary deficiency of one or more essential micronutrients affects two-third of world's population (White and Broadley, 2009; Stein, 2010).

The mineral elements most commonly lacking in human diets are iron and zinc, which rank fifth and sixth, respectively, among the top 10 risk factors contributing to burden of disease, especially in the developing countries (WHO, 2002). A preliminary study conducted with a limited number of 27 pearlmillet genotypes at ICRISAT had shown high levels of and large variability for both iron (40 to 580 ppm) and zinc content (10 to 66 ppm) in pearlmillet grains (Jambunathan and Subramanian, 1988). These were much higher than those in other cereals. It is also the cheapest source of these micronutrients as compared to other cereals and vegetables.

The crop is mostly confined to low fertile water deficit soils. Because of its remarkable ability to withstand and grow in harsh environment, reasonable and nearly assured harvests are obtained. The usual effect of drought on the development of a plant is the lowered production of biomass and/or a change in the distribution of this biomass among the different organs. The drought resistance of a cultivated plant reflects its capacity to limit the impact on the economic yield of these changes in biomass production and distribution. This capacity will depend on the development phase affected by water deficit, as well as on the intensity and the length of the drought.

They affect development stages such as initiation of panicles, flowering which, in cereals, are generally sensitive to water deficit. Irrigation has been recognized as a basic necessity for sustaining high productivity of crops in arid and semi-arid regions prone to water deficit. The need is greater in most parts of India where rainfall is seasonal and not assured. Adequate water supply is one of the basic inputs for securing higher crop yields. Drought resistance among genotypes is determined on the basis of genotypic behaviour in the stressed treatment after accounting their flowering and yield potential differences. The success for tolerance to drought depends upon agro-physiological traits and their interaction with environment under these conditions. The present study was carried to know the effect of environment on yield and yield attributes of pearlmillet genotypes.

MATERIALS AND METHODS

A field experiment was conducted during **kharif** seasons of 2011 and 2012 at Research Area of Crop Physiology, Department of Agronomy, CCS Haryana Agricultural University, Hisar. It comprised two environments i. e. rainfed and irrigated and four pearl-millet genotypes i. e. HHB 67 (Improved), HHB 197, HHB 223 and HHB 234. The experiment was laid out in a factorial randomized block design with three replications. In irrigated plot three irrigations were applied at tillering, flowering and grain filling stages of crop. The crop was sown at the rate of 5 kg seed/ha in 45 cm apart from row to row and 10 cm plant to plant. The plots were fertilized as full dose of phosphorus (62.5 kg under irrigated and 20 kg/ha for rainfed condition) and half dose of nitrogen (62.5 kg for irrigated and 20 kg/ha under rainfed condition) were applied as per the treatments at the time of sowing and rest of the nitrogen was top dressed after thinning and gap filling. All agronomic practices were carried out uniformly for all treatments. The observations were recorded on number of effective tillers/plant, earhead length (cm), grain yield (q/ha) and stover yield (q/ha). Zinc and iron contents (mg/kg) of pearmillet grains were also analyzed using standard procedures.

TABLE 1
Effect of environment on effective tillers/plant and earhead length (cm) of pearlmillet genotypes at harvest

Genotype	2011			2012			Pooled		
	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean
				Effective tillers/plant					
HHB 67 Imp.	1.7	2.0	1.9	2.0	2.3	2.2	1.9	2.1	2.0
HHB 197	1.7	2.4	2.0	1.7	2.7	2.2	1.7	2.5	2.1
HHB 223	1.5	2.6	2.1	1.5	2.7	2.1	1.5	2.6	2.1
HHB 234	2.0	2.1	2.0	2.1	2.3	2.2	2.0	2.2	2.1
Mean	1.7	2.3		1.8	2.5		1.8	2.4	
				Earhead length (cm)					
HHB 67 Imp.	19.3	21.0	20.2	21.3	23.0	22.2	20.3	22.0	21.2
HHB 197	18.1	22.3	20.2	20.5	24.1	22.3	19.3	23.2	21.3
HHB 223	17.7	23.2	20.5	20.0	24.6	22.3	18.9	23.9	21.4
HHB 234	20.2	21.1	20.6	21.7	23.5	22.6	20.9	22.3	21.6
Mean	18.8	21.9		20.9	23.8		19.9	22.8	

	Effective tillers/plant			Earhead length (cm)		
	2011	2012	Pooled	2011	2012	Pooled
S. Em± for E	0.05	0.06	0.03	0.16	0.19	0.11
C. D. at 5% for E	0.16	0.18	0.08	0.49	0.56	0.34
S. Em± for G	0.07	0.08	0.04	0.23	0.26	0.16
C. D. at 5% for G	NS	NS	NS	NS	NS	NS
S. Em± for E × G	0.11	0.12	0.06	0.32	0.37	0.22
C. D. at 5% for E × G	0.32	0.35	0.18	0.98	1.13	0.68

NS–Not Significant.

RESULTS AND DISCUSSION

Yield Attributes

Effective tillers and earhead length were significantly higher under irrigated environment than the rainfed situation (Table 1). Interactive effect between environment and genotypes showed that earhead bearing tillers and earhead length under irrigated environment were significantly more in the genotypes HHB 223 and HHB 197 than HHB 234 and HHB 67 'Improved', whereas reverse trend was observed under rainfed environment. The differences in the yield attributing characters of these pearlmillet genotypes could be attributed to the differences in their genetic make up. Corroborative results have also been reported by Kumar *et al.* (2003) and Parihar (2005).

Grain Yield

Under irrigated environment condition higher grain yield (31.19 q/ha) was observed than rainfed condition (24.29 q/ha) (Table 2). The better performance of pearlmillet in terms of yield under irrigated environment might be due to increased soil moisture content which improved internal water status and growth of plant. Thus, higher rate of water flow from the soil to plant helps in better stomatal conductance and more leaf area which help to sustain better transpiration in pearlmillet thereby improving the earhead numbers, its size (in terms of length and girth), 1000-grain weight and final grain yield. Beneficial effects of irrigation on yield attributes, grain and stover yields of pearlmillet were also reported by Imma and Jose (2006) and Saifullah *et al.* (2011).

The genotypes behaved differently under two environments. Interaction effect showed that maximum grain yield of 34.11 q/ha was recorded by the genotype HHB 223 and it was statistically at par with genotype HHB 197 (31.81 q/ha) under irrigated environment (Table 2). However, under rainfed situation, this genotype was the lowest yielder. Under rainfed situation, the HHB 234 (26.72 q/ha) was highest yielder than all other genotypes

TABLE 2

Interaction effect between environment × genotypes on grain and stover yields (q/ha) of pearlmillet

Genotype	2011			2012			Pooled		
	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean
Grain yield									
HHB 67 Imp.	24.47	28.50	26.49	26.90	29.63	28.27	25.69	29.07	27.38
HHB 197	21.55	31.26	26.40	24.20	32.37	28.28	22.88	31.81	27.34
HHB 223	20.47	33.48	26.98	23.30	34.73	29.02	21.89	34.11	28.00
HHB 234	25.77	29.55	27.66	27.67	30.00	28.83	26.72	29.78	28.25
Mean	23.07	30.68		25.52	31.68		24.29	31.19	
Stover yield									
HHB 67 Imp.	68.33	78.87	73.60	76.00	82.33	79.17	72.17	80.60	76.38
HHB 197	61.00	82.33	71.67	70.67	90.57	80.62	65.83	86.45	76.14
HHB 223	58.67	86.67	72.67	67.66	91.00	79.33	63.17	88.83	76.00
HHB 234	70.67	79.00	74.83	77.30	82.66	79.98	73.98	80.83	77.41
Mean	64.67	81.72		72.91	86.64		68.79	84.18	

	Grain yield			Stover yield		
	2011	2012	Pooled	2011	2012	Pooled
S. Em± for E	0.52	0.58	0.39	1.23	1.28	0.74
C. D. at 5% for E	1.57	1.77	1.18	3.72	3.89	2.25
S. Em± for G	0.73	0.83	0.55	1.73	1.82	1.05
C. D. at 5% for G	NS	NS	NS	NS	NS	NS
S. Em± for E × G	1.03	1.17	0.78	2.45	2.57	1.48
C. D. at 5% for E × G	3.14	3.55	2.38	7.44	7.79	4.50

NS–Not Significant.

TABLE 3
Effect of environment and genotypes on zinc and iron content of pearlmillet grain

Treatment	Zinc content (mg/kg)			Iron content (mg/kg)		
	2011	2012	Pooled	2011	2012	Pooled
Environment						
Rainfed	59.89	56.20	58.05	40.45	38.42	39.43
Irrigated	54.19	52.42	53.31	37.19	35.54	36.37
S. Em ±	1.07	0.95	0.76	0.91	0.85	0.68
C. D. (P=0.05)	3.27	2.90	2.31	2.75	2.59	2.05
Genotypes						
HHB 67 Imp.	64.81	62.83	63.82	46.35	45.33	45.84
HHB 197	48.47	45.37	46.92	30.90	28.33	29.62
HHB 223	58.76	55.67	57.21	40.23	37.48	38.86
HHB 234	56.13	53.37	54.75	37.80	36.77	37.28
S. Em ±	1.52	1.35	1.08	1.28	1.21	0.96
C. D. (P=0.05)	4.62	4.10	3.27	3.90	3.66	2.91

except HHB 67 'Improved' (25.69 q/ha). The genotypes HHB 234 and HHB 67 'Improved' had significantly higher grain yield under rainfed condition as these genotypes thrive well under moisture stress condition. Higher grain yield of HHB 223 under irrigated condition might be attributed to better earhead length and more test weight and higher biomass content under irrigated situation. Similarly, significant differences in pearl millet genotypes with respect to grain yield under different condition were also reported by Patil (2005) and Maqsood and Ali (2007).

Stover Yield (q/ha)

Irrigated environment recorded significantly higher stover yield (84.18 q/ha) than rainfed condition (68.79 q/ha). Under the irrigated environment interaction effect showed maximum stover yield of 88.83 q/ha in the genotype HHB 223 but it was statistically at par with HHB 197 (86.45 q/ha). Under rainfed condition, these genotypes produced lower stover yield and HHB 234 realized significantly higher stover yield than all other genotypes except HHB 67 'Improved'. The differences in biomass production among the genotypes of pearl millet might be attributed to the effect of the genetic traits of the crop genotypes. These findings were supported by Jibran *et al*. (1998), Yogendra *et al*. (1999) and Saifullah *et al*. (2011). Maman *et al*. (2003), as they found that millet and sorghum responded to irrigation with linear increase in yield as water use increased. There was positive correlation of plant height, leaves/tiller, tillers/plant and leaf area, with green fodder yield/ha of pearlmillet as reported by Imran *et al*. (2007).

Zinc Content in Grain (mg/kg)

Zinc and iron content in grain was significantly higher under rainfed environment than irrigated situation (Table 3). Hariprasanna *et al*. (2012) also observed differential response of sorghum to environment in respect to Zn and Fe content. The genotype HHB 67 'Improved' showed highest zinc and iron content and lowest Zn and Fe content was recorded in genotype HHB 197. Similar genotypic differences were also found by Velu *et al*. (2007) in pearlmillet and Hariprasanna *et al*. (2012) in sorghum.

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