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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(4): 1478-1484

www.thepharmajournal.com
Received: 16-01-2022
Accepted: 05-03-2022

Amit Kumar
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Sandeep Kumar Bangarwa
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Mukat Bihari Meena
Seed science, Garhwal, Uttarakhand, India

Mukesh Kumar Yadav
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Deepak Meena
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Goverdhan Lal Kumhar
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Dhirendra Singh
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Corresponding Author
Amit Kumar
Department of Genetics and Plant Breeding, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Ranking the pearl millet hybrids with respect to high yield and better stability in performance

Amit Kumar, Sandeep Kumar Bangarwa, Mukat Bihari Meena, Mukesh Kumar Yadav, Deepak Meena, Goverdhan Lal Kumhar and Dhirendra Singh

Abstract
An experiment was conducted on eighteen hybrids of Pearl Millet (*Pennisetum glaucum* L.) over three artificial created environments by providing different levels of fertilizers, during *kharif* 2018 in RBD with three replications to estimate genotype x environment interaction. The environment indices of each character had wide difference for grain yield ranging from -2.85 in environment-III to 1.76 in environment-I as well as for other characters. The hybrids chosen widely varied in their mean grain yield, ranging from 23.17 (MARU-TEJ) to 30.73 (KBH-108). The highest yielding hybrid were MPMH-17, HHB-197 and RHB-177. Mean grain yield was linearly influenced by the environments it was lowest in the environment-III. Hybrids HHB-197 and MPMH-17 were found relatively stable for grain yield. HybridsRHB-223, HHB-299 and 9001 have below average stability for grain yield and suitable for better environmental conditions. HybridsRHB-233, HHB-67, GHB-744 and 9450 have above average stability for grain yield and suitable for poor environmental conditions.

Keywords: G x E interaction, stability, regression, fertilizer

Introduction
Pearl millet [*Pennisetum glaucum* (L.) R. Br.] Locally known as bajra with 2n = 14 chromosome number belongs to the family Poaceae (Gramineae). It is an important coarse cereal crop of semi - arid tropics that does well on light textured soil with low moisture condition. It is believed to have originated in West Africa (Vavilov, 1950 and Murdock, 1959) [8] from where it spread into India and other countries. Pearl millet is highly cross pollinated crop with protogynous condition. Pearl millet grain contains 8.5 to 15 per cent protein, 5.03 to 6.0 per cent fat, 1.05 to 1.7 per cent crude fibre and 65.5 to 70 per cent carbohydrates. As a food crop, pearl millet grain possesses the highest amount of calories per 100 gram (Burton *et al.*, 1972) [2], which is mainly supplied by carbohydrates, fats and proteins (Flech, 1981) [4]. Important quality aspects of pearl millet forage are high protein (11.6 per cent), low lignin, high dry matter yield, easy to digestible and possesses less oxalic acid which is an anti-nutritional factor (Hanna *et al.*, 1999) [5]. Although, crude protein content (9.9-14 per cent) in pearl millet stover is less than sorghum, but it is more than wheat and rice. The toxic component HCN is quantitatively less in green fodder of pearl millet in comparison to sorghum (Hanna *et al.*, 1999) [5]. The realized productivity of pearl millet is below its potential. The main reasons of poor crop yield are low soil-moisture availability to crop usually at critical stages of growth during growing season and lack of proper nutrient management, and lack of instable varieties/hybrids The phenotypic expression of a character is resultant of the interactions between genotype and environment. The estimates of genetic parameters obtained in one environment are biased due to the confounding of the G x E interaction effect with the genotype effects. It is therefore, necessary to take into account the G x E interaction while determining the estimates of various genetic parameters to have unbiased picture in the expression of various characters. Looking these facts, the need is to develop varieties that would give stable production from year to year and place to place even under moisture stress conditions. The term stability analysis is often associated with the analysis of variety trials.

It refers to a method of assessing the variations of each variety between the tested environments. The yield of a variety in each environment can be regressed linearly on the average yields of all varieties to determine its stability across to the tested environments.

The resulting regression coefficient, or slopes, can be taken to indicate whether each variety is stable across environments or it is sensitive to the differences between them. The detection of significant genotype x environment (G x E) interaction indicates that phenotypic responses to changes in the environment are not the same for all genotypes. This means that the best genotype in one environment is not the best in another environment. If the interaction components are relatively large compared to the genotypic components, and if they are related to predictable environmental factors, the breeder searches for a cultivar that has general adaptability and universal performance over the range of environments (Abdelrahman and Abdalla, 2002) [1]. The present study was conducted to evaluate and identify the pearl millet hybrids with wider adaptation over a range of environments using stability analysis.

Materials and methods

The present investigation was conducted at Research Farm, SKN College of Agriculture, Jobner (Rajasthan). Jobner is located at 26.97°N and 75.38°E. It has an average elevation of 400 metres (1312 feet).The materials for study consisted of eighteen hybrids of pearl millet taken from the R.A.R.I. Durgapura, Jaipur. The list of hybrids used in the study is presented in Table 1.

Table 1: List of hybrids

S. No.	Number of Hybrids	S. No.	Number of Hybrids
1	RHB-173	10	HHB-67
2	RHB-177	11	HHB-197
3	RHB-223	12	HHB-299
4	RHB-233	13	9450
5	RHB-234	14	9001
6	GHB-538	15	86-M-86
7	GHB-558	16	MCPH-17
8	GHB-744	17	MARU-TEJ
9	GHB-905	18	KBH-108

Experimental method

The experimental material were evaluated in randomized block design with 3 replications during *kharif* season 2018 in three artificially created environments by different dose of fertilizers as given below.

1. 150% Recommended dose of fertilizer (E1) i.e N_2@ 90 kg/ha, P_2O_5@ 45 kg/ha, K_2O @ 45 kg/ha.
2. 100%Recommended dose of fertilizer (E2) i.e. N_2@ 60 kg/ha, P_2O_5@ 30 kg/ha, K_2O @ 30kg/ha.
3. 50% Recommended dose of fertilizer (E3) i.e N_2@ 30 kg/ha, P_2O_5@ 15 kg/ha, K_2O @ 15 kg/ha.

In each environment/replication, each hybrid was sown in plot size 4.0 x 0.6 m^2 consisting two row of each hybrid. The row to row and plant to plant distances were kept 45 cm and 10 cm, respectively.

Statistical analysis

The data on each character for the varieties were subjected to standard statistical analysis of variance for each environment separately (Panse and Sukhatme, 1985) [6]. Later the data of each were subjected to pooled analysis of variance (Singh and Choudhary 1985) [7]. The source of variation, along with their degrees of freedom and expectations of mean squares for the joint analysis is given in Table 2.

Table 2: Pooled analysis of variance

Source	d.f.	SS	EMSS
Rep. within Env	e (r-1)		
Hybrids	(v-1)	MS1	$\sigma^2e + r\ \sigma^2vs + sr\ \sigma^2v$
Environments	(s-1)	MS2	$\sigma^2e + r\ \sigma^2vs + vr\sigma^2vs$
Var. x Env	(v-1) (s-1)	MS3	$\sigma^2e + r\ \sigma^2vs$
Errors	(r-1) (v-1)	MS4	σ^2e
Total	(vsr-1)		

The environment wise analysis of variance was also conducted for each character.

Stability analysis

The stability analysis was done according to Eberhart and Russell (1966) [3]. The basic model employed is as follows:

$$Yij = \mu_i + \beta i\ Ij + \delta ij$$

Where,

Yij = Mean of the i^{th} variety at j^{th} environment,

μ_i = Mean of the i^{th} variety over the environments

βi = Regression coefficient of i^{th} variety to varying environments indices.

Ij = Environmental index i.e. mean of all varieties at j^{th} environment minus grand mean

δij = Deviation from regression of i^{th} variety at j^{th} environment

The joint regression analysis was done as outlined below to determine the significance of each parameter.

Joint Regression Analysis

The table below gives the sources of the joint regression analysis along with the formulae used to obtained the sums of squares for each sources (Table 3) using the means over replication.

The significance of the variance due to varieties, environments, varieties x environments interaction, environmental (linear), varieties x environments (linear) was tested against pooled error. But the pooled deviation was tested against the pooled error for testing the pooled deviation which was derived by the following formula:

Pooled error for testing pooled deviation MS = Pooled error MSS \ r

Where,
r = number of replications

Stability parameters

According to Eberhart and Russell (1966) [3] model the stability of genotype is judged on the basis of mean, (x) regression coefficient (b_i) and deviation from the regression (S^2_{di}). These parameters were measured for each variety as follows:

$$\text{Mean}(\bar{x}) = \frac{\sum_j Y_{ij}}{svr}$$

where,
s = no. of environment, v = no. of varieties, r = no. of replications

$$\text{Regression coefficient (b)} = \frac{\sum_j Y_{ij} I_j}{\sum_j I_j^2}$$

Y_{ij} an Ii; refers to the performance of i^{th}variety at j^{th} environment and index, respectively as explained earlier.

Table 3: Joint regression analysis of variance (Eberhart and Russell, 1966) [3]

Source	d.f.	S.S.	M.S.
Hybrids (v)	(v-1)	$(1/s\sum iy^2 i)$ – C.F.	MS1
Env. + (Var. x Env.)	v(s-1)	$[\sum_I \sum j Y_{ij}^2 - (\sum Y^2 i. / s)]$	
Env. (Linear)	1	$1/v \sum i (Y.jIj)^2 / \sum jIj^2$	
Var. × Env. (Linear)	v-1	$\sum i [(\sum j\ Yij)^2 / \sum jIj^2]$ -Env. (linear) SS.	MS2
Pooled deviation	v(s-2)	$\sum i \sum j\ \sigma ij^2$	MS3
Pooled deviation Due to individual hybrid	(s-2)	$[\sum j\ Yij^2 - Yi.^2 / s)] - (\sum j\ Yij\ ij)^2 / \sum j\ j^2]$	
Pooled Error	s (r -1) (v-1)		MS4

Yij an Ii; refers to the performance of i^{th} variety at j^{th} environment and index, respectively as explained earlier.

Mean square deviation from linear regression =

$$S_d^2 = \left(\frac{\sum_j \delta_{ij}^2}{s-2}\right) - \frac{s_e^2}{r}$$

$$\sum_j \delta_{ij}^2 = \left(\sum_j Y_{ij}^2 - \frac{Y_{.j}^2}{s}\right) - \frac{\sum_j Y_{ij} I_j^2}{\sum_j I_j^2}$$

Where,
A stable genotype according to Eberhart and Russell (1966) [3] is one which has the regression coefficient (b) equal to unity (b_i = 1.0) and deviation not significantly different from zero (S^2_d =0). The desirability of a genotype is judged on the basis of these stability criteria together with the mean value of the characters.
The standard errors associated with mean (x) and regression coefficient (b_i) was calculated as follows

Standard error of mean ($\bar{x}$)

$$= \left(\frac{\text{MSS due to pooled deviation}}{\text{numberofenviornment} - 1}\right)^{1/2}$$

Standard error of regression coefficient (b_i) =

$$\left(\frac{\text{MSS due to pooled deviation due to i}^{\text{th}}\text{variety}}{\sum j I^2 j}\right)^{1/2}$$

Result and Discussion

The present investigation comprised of studies on genotype x environment interaction and stability parameters associated with different characters in 18 hybrids of pearl millet was taken from R.A.R.I. Durgapura,.
The mean days to 50 per cent flowering ranged from 44.56 (RHB-177) to 57.11 days (KBH-108). The regression coefficient ranged from 0.19 (GHB-558) to 1.64 (HHB-299). The S^2_{di} values of all the hybrids were non-significant (Table 6). The environmental indices ranged from -3.50 to 3.01 days (Table 4), indicating wide difference among the environments for this character. The mean days to maturity ranged from 79.73 (RHB-177) to 92.00 days (KBH-108). The regression coefficient ranged from 0.02 (GHB-558) to 1.60 (HHB-299). The S^2_{di} estimates of all the hybrids were non-significant (Table 6). The environmental indices ranged from -3.5 to 2.99 days. The mean value of plant height ranged from 133.66 (MARU-TEJ) to 185.91 cm (9450). The regression coefficient ranged from -0.20 (HHB-299) to 2.01 (HHB-197). The S^2_{di} estimates of most hybrids were non-significant except HHB-299 (s^2_{di}=151.17) (Table 7). The mean number of tillers per plant ranged from 2.31 (86-M-86) to 3.31 (9001). The regression coefficient ranged from -0.22 (KBH-108) to 1.95 (HHB-197). The S^2_{di} estimates of most hybrids were non-significant except RHB-173, GHB-744, GHB-558, HHB-67, HHB-197, 9001, MPMH-17, MARU-TEJ (Table 7). The average mean of panicles length ranged from 18.94 (MARU-TEJ) to 25.27 cm (RHB-233). The regression coefficient ranged from -0.29 (MPMH-17) to 2.29 (RHB-233). The S^2_{di} estimates of most of hybrids was non-significant except of GHB-558, HHB-299, 9001, 9450 and KBH-108, (Table 8). Environment indices varied from -1.24 to 1.96 (Table 4), indicating wide differences among the environments. The mean panicle diameter ranged from 1.88 (MARU-TEJ) to 2.94 cm (86-M-86). The regression coefficient ranged from -1.20 (MARU-TEJ) to 3.03 (9001). The environmental indices varied from -0.16 to 0.09 (Table 4). The S^2_{di} estimates were non-significant for most of the hybrids except HHB-67, HHB-299, 9450, MARU-TEJ, (Table 8). The weight of 1000 grain ranged from 8.69 (RHB-173) to 10.61 (GHB-744). The regression coefficient ranged from -0.55 (9001) to 2.61 (RHB-223). The S^2_{di} estimates were all the hybrids were non-significant (Table 9). The environmental indices ranged from -0.57 to 0.84 (Table 4), indicating differences among the environments. The mean biological yield per plant ranged from 71.44 (MARU-TEJ) to 81.44 g (86-M-86). The regression coefficient ranged from 0.21 (RBH-233) to 1.81 (KHB-108) (Table 9). The environmental indices ranged from

-6.17 to 7.04 (Table 4). The S^2_{di} estimates of most hybrids were non-significant except HHB-197, 9450, MARU-TEJ. The mean harvest index ranged from 30.13 (RHB-173) to 36.93 % (RHB-233). The regression coefficient ranged from -1.12 (RHB-234) to 3.68 (9001) (Table 10). The environmental indices ranged from -1.93 to 1.82 (Table 4). The S^2_{di} value were non-significant except 9450, HHB-197, RHB-538, GHB-558, RHB-173 (Table 10), indicating that most of the hybrids were instable for this character. Thus, mean and regression coefficient was considered for the grading of hybrids for their stability. The mean grain yield per five plant ranged from 23.17 (RHB-173) to 30.73 g (KHB-108). The regression coefficient ranged from -0.49 (RHB-173) to 2.14 (86-M-86) (Table 4.10). The environment indices ranged from -2.85 to 1.76 (Table 4), indicating wide differences among the environments. The S^2_{di} associated with most of hybrids were non-significant except HHB-67, GHB-744, RHB-538. (Table 10). Hybrids RHB-177, HHB-197 and MPMH-17 were found relatively stable for grain yield per plant. Most of these hybrids were also found stable and desirable for one or other yield components e.g. HHB-197 were stable for tillers per plant, biological yield per plant and harvest index. MPMH-17 was stable for tillers per plant and panicle length.

Significant genotype x environment interaction were observed for all characters except days to 50% flowering, days to maturity, plant height (cm) and panicle length (cm). Hybrids RHB-177, HHB-197 and MPMH-17 were found stable for most of the characters which will be suitable for changing environmental conditions. The environment + (genotypes x environment) interaction was significant for most of the characters except plant height (cm), panicle length (cm), panicle diameter (cm). (Table 5).

Table 4: Environment indices for different characters of pearl millet hybrids

Environments	Days to 50% flowering	Days to maturity	Plant height (cm)	Tillers per plant	Panicle length (cm)	Panicle diameter (cm)	1000 grain weight (g)	Biological yield/plant (g)	Harvest index (%)	Grain yield/plant (g)
Environment-I (150% R.D.F.)	-3.5	-3.5	8.72	0.59	1.96	0.09	0.84	7.04	-0.117	1.764
Environment-II (100%R.D.F.)	0.48	0.53	6.61	-0.03	-0.72	0.06	-0.27	-0.87	1.821	1.088
Environment-III (50% R.D.F.)	3.01	2.99	-15.34	-0.56	-1.24	-0.16	-0.57	-6.17	-1.938	-2.853
Grand mean	50.06	85.00	156.67	2.88	21.23	2.39	9.88	76.36	33.33	26.05

Table 5: Joint regression analysis (Eberhart and Rusell, 1966) for different characters tested over three environments

Source	d.f.	Days to 50% flowering	Days to maturity	Plant height (cm)	Tillers per plant	Panicle length (cm)
Hybids	17	56.89**	56.41**	865.21**	0.23**	9.12
Env. + (Gen.x Env.)	36	15.36*	15.32*	242.02	0.53**	6.20
Env. (Linear)	1	388.68**	383.72**	6395.41**	12.05**	107.20**
Gen. x Env. (Linear)	17	4.04	3.47	94.42	0.24**	2.41
Pooled deviation	18	5.32	6.05	39.56	0.16**	4.17**
RHB-173	1	6.26	6.71	100.52	0.93**	0.20
RHB-177	1	0.89	0.60	55.53	0.05	0.19
RHB-223	1	1.04	0.76	3.79	0.04	0.52
RHB-233	1	0.02	0.03	0.08	0.02	0.02
RHB-234	1	4.80	3.96	0.01	0.07	1.00
RHB-538	1	11.29	10.90	22.85	0.01	0.66
GHB-558	1	10.11	14.73	0.18	0.13*	14.56**
GHB-744	1	18.38	19.14	15.00	0.14*	2.95
GHB-905	1	0.58	0.71	24.05	0.01	1.79
HHB-67	1	10.58	11.10	8.79	0.16*	3.78
HHB-197	1	2.38	2.71	147.48	0.43**	1.80
HHB-299	1	11.88	11.55	193.50*	0.12	6.70*
9450	1	6.36	5.89	9.71	0.06	6.76*
9001	1	2.63	2.40	73.52	0.24**	16.36**
86-M-86	1	5.07	4.65	9.30	0.04	1.22
MPMH-17	1	2.68	10.25	5.24	0.14*	1.13
MARU-TEJ	1	0.12	1.90	0.09	0.22**	0.32
KBH-108	1	0.61	0.83	42.44	0.03	15.04**
Pooled error	102	15.52	15.61	127.01	0.10	4.26
Total	53	28.68	28.50	441.91	0.43	7.14

Source	d.f.	Panicle diameter (cm)	1000 grain weight (g)	Biological yield/plant (g)	Harvest index (%)	Grain yield/plant (g)
Hybrids	17	0.19*	1.14**	27.90**	14.94*	14.91**
Env. + (Gen. x Env.)	36	0.08	0.97*	57.90**	19.24**	13.49**
Env. (Linear)	1	0.70**	19.72**	1594.19**	127.57**	223.89**
Gen. x Env. (Linear)	17	0.04	0.79*	15.26*	19.34**	10.89**
Pooled deviation	18	0.07**	0.11	12.83*	13.12**	4.25*
RHB-173	1	0.06	0.01	0.11	51.13**	3.72
RHB-177	1	0.05	0.01	0.19	1.34	0.01
RHB-223	1	0.01	0.13	0.30	0.01	1.62

RHB-233	1	0.03	0.68	8.53	0.53	0.13
RHB-234	1	0.07	0.30	9.46	15.41	0.48
RHB-538	1	0.01	0.17	4.48	44.52**	13.29*
GHB-558	1	0.04	0.01	0.01	31.96*	12.09*
GHB-744	1	0.04	0.05	0.07	0.01	1.94
GHB-905	1	0.07	0.17	0.01	0.62	6.27
HHB-67	1	0.22**	0.03	10.46	5.67	12.26*
HHB-197	1	0.03	0.01	59.87**	20.70*	7.46
HHB-299	1	0.21**	0.05	0.65	17.87	0.05
9450	1	0.12*	0.01	47.98**	29.99*	2.67
9001	1	0.03	0.06	7.05	5.61	9.49
86-M-86	1	0.02	0.03	4.89	0.83	0.46
MPMH-17	1	0.01	0.23	8.17	1.35	3.84
MARU-TEJ	1	0.24**	0.02	50.10**	4.65	0.08
KBH-108	1	0.07	0.01	18.62	4.07	0.70
Pooled error	102	0.06	0.81	20.45	15.62	7.468
Total	53	0.11	1.03	48.28	17.86	13.948

*, ** = significant at 5% and 1% levels, respectively

Table 6: Mean values and stability parameters (b_i and s^2_{di}) of the Pearl millet hybrids for days to 50% flowering and days to maturity

Hybrids	Days to 50% flowering			Days to maturity		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
RHB-173	52.44	1.21*	1.09	87.44	1.21*	1.51
RHB-177	44.56	0.43*	-4.28	79.33	0.54**	-4.61
RHB-223	45.11	0.79**	-4.14	79.89	0.90**	-4.44
RHB-233	50.56	0.46**	-5.16	85.56	0.46**	-5.18
RHB-234	52.22	1.39**	-0.37	87.33	1.35**	-1.25
RHB-538	45.89	0.81	6.12	80.89	0.82	5.69
GHB-558	50.67	0.19	4.94	85.22	0.02	9.53
GHB-744	50.56	1.21	13.21	85.56	1.20	13.94
GHB-905	49.11	1.05**	-4.59	84.11	1.06**	-4.50
HHB-67	44.78	1.09	5.41	79.78	1.08	5.89
HHB-197	44.89	1.44**	-2.79	79.89	1.44**	-2.49
HHB-299	53.67	1.64*	6.71	88.56	1.60*	6.34
9450	54.67	1.30*	1.19	89.67	1.31*	0.69
9001	56.22	0.97*	-2.54	91.22	0.98*	-2.80
86-M-86	55.56	1.29*	-0.10	90.56	1.31*	-0.55
MPMH-17	48.22	1.63**	-2.49	82.11	1.18	5.04
MARU-TEJ	44.78	0.57**	-5.05	80.89	1.04**	-3.30
KBH-108	57.11	0.53**	-4.56	92.00	0.49*	-4.38
S.Em±	1.63	0.49		1.74	0.53	
Pop. Mean	50.60	1		85.00	1	

*, ** = significant at 5% and 1% levels, respectively

Table 7: Mean values and stability parameters (b_i and s^2_{di}) of the pearl millet hybrids for plant height (cm) and productive tillers per plant

Hybrids	Plant height (cm)			Tillers per plant		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
RHB-173	156.11	0.80	58.18	3.03	1.36	0.90**
RHB-177	151.63	1.40**	13.19	2.64	0.74*	0.02
RHB-223	144.07	1.09**	-38.54	2.84	1.95**	0.01
RHB-233	168.31	1.52**	-42.26	3.18	0.30	-0.02
RHB-234	146.78	0.95**	-42.33	3.00	0.50	0.04
RHB-538	155.10	0.96**	-19.49	3.07	1.05**	-0.02
GHB-558	143.99	1.10**	-42.16	2.47	0.67	0.09*
GHB-744	167.23	1.73**	-27.34	2.80	1.02*	0.11*
GHB-905	136.78	0.67*	-18.28	3.01	1.59**	-0.02
HHB-67	141.93	1.10**	-33.54	3.31	1.58**	0.13*
HHB-197	156.61	2.01**	105.14	3.00	1.95*	0.39**
HHB-299	146.73	-0.20	151.17*	2.78	1.59	0.08
9450	185.91	0.91**	-32.63	2.96	0.45	0.02
9001	178.11	1.27*	31.18	3.31	1.19	0.21**
86-M-86	181.98	0.77**	-33.03	2.31	0.39	0.01
MPMH-17	140.83	0.24	-37.10	2.93	1.02*	0.11*
MARU-TEJ	133.66	0.56**	-42.25	2.71	0.89	0.19**
KBH-108	184.29	1.11**	58.18	2.53	-0.22	0.01
S.Em±	4.47	0.33		0.28	0.48	
Pop. Mean	156.67	1		2.88	1	

*, ** = significant at 5% and 1% levels, respectively

Table 8: Mean values and stability parameters (b_i and s^2_{di}) of the pearl millet hybrids for panicle diameter and panicle length (cm)

Hybrids	Panicle length (cm)			Panicle diameter (cm)		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
RHB-173	23.09	0.89**	-1.22	2.34	2.15	0.04
RHB-177	20.22	0.72**	-1.23	2.16	0.52	0.03
RHB-223	20.09	0.79*	-0.90	2.48	1.47**	-0.02
RHB-233	25.27	2.29**	-1.40	2.55	0.90	0.01
RHB-234	20.91	1.48*	-0.42	2.34	0.17	0.05
RHB-538	19.80	1.59**	-0.76	2.21	1.51**	-0.02
GHB-558	21.10	0.96	13.14**	2.41	-0.08	0.02
GHB-744	20.84	1.16	1.53	2.27	0.85	0.02
GHB-905	22.39	1.16	0.37	2.33	0.75	0.05
HHB-67	19.51	1.70*	2.36	1.98	-0.46	0.20**
HHB-197	21.01	1.20*	0.38	2.47	2.59**	0.01
HHB-299	19.32	0.49	5.28*	2.59	1.20	0.19**
9450	23.48	1.09	5.34*	2.57	1.44	0.10*
9001	22.30	0.15	14.94**	2.56	3.03**	0.01
86-M-86	23.34	-0.02	-0.20	2.94	0.08	0.01
MPMH-17	19.60	-0.29	-0.29	2.22	1.87**	-0.02
MARU-TEJ	18.94	1.21**	-1.10	1.88	-1.20	0.22**
KBH-108	22.89	1.43	13.62**	2.65	1.22	0.05
S.Em±	1.44	0.83		0.19	1.36	
Pop. Mean	21.23	1		2.39	1	

*, ** = significant at 5% and 1% levels, respectively

Table 9: Mean values and stability parameters (b_i and s^2_{di}) of the pearl millet hybrids for biological yield (g) and 1000 grain weight (g)

Hybrids	1000 grain weight (g)			Biological yield (g)		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
RHB-173	8.69	2.34**	-0.27	79.78	1.34**	-6.70
RHB-177	9.39	1.22**	-0.27	79.56	0.99**	-6.62
RHB-223	9.56	2.61**	-0.14	78.33	1.39**	-6.51
RHB-233	8.95	1.47	0.41	73.89	0.21	1.72
RHB-234	9.43	1.06	0.03	73.11	1.07**	2.64
RHB-538	10.31	1.10*	-0.10	76.56	1.34**	-2.33
GHB-558	10.07	0.58**	-0.27	71.78	0.45**	-6.81
GHB-744	10.61	0.39	-0.23	73.78	0.75**	-6.74
GHB-905	10.56	1.10*	-0.10	79.44	0.78**	-6.80
HHB-67	10.16	0.76**	-0.24	76.44	1.60**	3.65
HHB-197	10.17	0.22**	-0.27	76.67	0.83	53.05**
HHB-299	10.09	0.68**	-0.22	76.33	0.37**	-6.16
9450	10.27	1.61**	-0.27	78.11	0.94	41.17**
9001	9.51	-0.55	-0.21	77.00	0.97**	0.24
86-M-86	10.51	1.25**	-0.24	81.44	1.03**	-1.93
MPMH-17	8.85	-0.45	-0.04	72.00	1.12**	1.36
MARU-TEJ	10.14	1.37**	-0.25	71.44	0.97	43.28**
KBH-108	10.51	1.26**	-0.27	78.78	1.84**	11.80
S.Em±	0.23	0.31		2.532	0.38	
Pop. mean	9.88	1		76.36	1	

*, ** = significant at 5% and 1% levels, respectively

Table 10: Mean values and stability parameters (b_i and s^2_{di}) of the pearl millet hybrids for biological yield (g) and harvest index (%)

Hybrids	Harvest index (%)			Grain yield per plant (g)		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
RHB-173	30.13	-1.05	45.92**	23.71	-0.49	1.23
RHB-177	33.90	2.07**	-3.87	27.09	1.89**	-2.49
RHB-223	34.71	3.17**	-5.20	27.86	2.10**	-0.87
RHB-233	36.93	-0.73	-4.68	28.84	-0.32	-2.36
RHB-234	32.88	-1.12	10.20	23.80	0.01	-2.01
RHB-538	31.99	1.64	39.32**	24.65	0.49	10.80*
GHB-558	31.22	-1.06	26.75*	23.61	0.54	9.60*
GHB-744	33.30	-0.27	-5.20	24.51	0.47	-0.55
GHB-905	32.15	-0.71	-4.59	25.51	0.33	3.78
HHB-67	30.24	-0.31	0.46	24.26	0.54	9.77*

HHB-197	34.91	1.24	15.50*	27.99	1.78*	4.97
HHB-299	34.47	2.91	12.66	26.59	2.09**	-2.44
9450	33.06	0.52	24.78*	25.78	0.11	0.18
9001	36.82	3.68**	0.40	28.28	2.05*	7.00
86-M-86	34.96	2.36**	-4.38	28.36	2.14**	-2.03
MPMH-17	31.44	3.17**	-3.86	24.19	1.69**	1.35
MARU-TEJ	30.33	1.00	-0.56	23.17	0.63**	-2.41
KBH-108	36.58	1.49	-1.14	30.73	1.96**	-1.79
S.Em±	2.561	1.360		1.458	0.584	
Pop. Mean	33.33	1		26.05	1	

*, ** = significant at 5% and 1% levels, respectively

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