

Original Research Article

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Estimation of GCV, PCV, Heritability and Genetic Gain for Yield and its Related Components in Sorghum [*Sorghum bicolor* (L.) Moench]

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ABSTRACT

The present investigation entitled was carried out with 1700 germplasm lines along with 4 checks *i.e.* CSV17, CSV20, CSV27 and CSV21F provided by National Bureau of Plant Genetic Resources (NBPGR) through ICAR- Indian Institute of Millet Research (IIMR) Hyderabad. The experiment was laid out in augmented RBD with 60 replications during *Kharif* 2015 at Instructional Farm, Rajasthan College of Agriculture, Udaipur. The populations were employed for the assessment of genetic variability, heritability and genetic gain and observations were recorded for nine quantitative characters viz., days to 50 per cent flowering, plant height (cm), number of leaves, leaf length (cm), leaf width (cm), panicle length (cm), panicle width (cm), 100- seed weight (g) and grain yield per panicle (g) on five competitive plants selected at random for each germplasm lines except early vigour and days to 50 percent flowering which were recorded on whole plot basis. Availability of genotypes in different replication at the time of observations was not conform on account of germinations and shoot fly dead hearts therefore, data were analysed in augmented CRD. Analysis of variance revealed significant difference between genotypes for nine quantitative characters. Mean square due to germplasm was significant for all the characters. CSV17 was the best check for days to 50 percent flowering. CSV27 was the best check for leaf length, leaf width, panicle length and grain yield per panicle. CSV21F was the best check for panicle width, plant height and number of leaves. GCV, PCV and genetic gain were high for grain yield per panicle and heritability for 100-seed weight.

Keywords

GCV, PCV,
Heritability and
Genetic Gain,
Sorghum bicolor.

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Introduction

Sorghum bicolor (L.) Moench (2n = 20) is one of the most important crop in the world because of its adaptation to a wide range of ecological conditions, suitability for low input cultivation and diverse uses (Doggett 1988 a). Sorghum belongs to family Poaceae and tribe Andropogoneae (Harlan & de Wet, 1972). Worldwide it is cultivated on 42.64 million ha with a production of 67.57 million tones in the year 2014-15 (Anonymous 2015a).

The crop is widely grown for food, feed, fodder, forage and fuel in the semi-arid tropics (SAT) of Asia, Africa, America and Australia. In India, sorghum is having 6.00 m ha area, 5.50 mt production and 917 kg/ha productivity in the year 2014-15 (Anonymous 2015b). The major sorghum growing states in our country are Maharashtra, Karnataka, Rajasthan, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Uttar Pradesh and Gujarat. In

Rajasthan, 6.61 lac ha area is under cultivation and production is 5.05 lac tones with 763 kg per ha productivity in the year 2014-15 (Anonymous 2015c). Major emphasis of farmers on fodder causes low grain productivity in this crop. Nutritional value per 100 g of grain is 1,418 kJ (339 kcal) energy, 74.63 g carbohydrates, 6.3 g dietary fiber, 3.30 g fat and 11.30 g protein.

Before planning any breeding programme, the assessment of genetic variability in germplasm and relationship between characters are necessary step. Genetic improvement for quantitative and qualitative traits depends on the nature and amount of variability present in the genetic stock, if desirable traits having high heritability more are the chances of improvement through selection. Indian sorghum possesses wide range of genetic variability. The present study is based on nine quantitative characters majored on 1700 germplasm lines and four checks. Information on the variability was majored by genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic gain for individual quantitative characters and through equilibrium distance over the characters.

Elimination of heterogeneity in one direction is possible in augmented randomized block designs (augmented RBD). Federer (1956 a, 1961 b) gave the analysis, randomization procedure and construction of this design by adding the new treatments to the blocks of RBD for evaluation of large number of germplasm. The analysis of augmented designs can be easily carried out by making use of the control treatments which are appearing in every block to compare the test treatments against control treatments. Even if control treatments are missing in own or other block data can be analysed in augmented CRD.

In view of the above facts, an experiment entitled “Assessment of GCV, PCV, Heritability and Genetic Gain for yield and other quantitative characters in sorghum [*sorghum bicolor* (L.) Moench]” was plan in augmented RBD and conducted during *Kharif* 2015 at Instructional Farm, Rajasthan College of Agriculture, Udaipur to study the variability parameters.

Materials and Methods

The experimental material consists of 1700 germplasm lines of sorghum (given in Appendix-II) along with four checks *i.e.* CSV17, CSV20, CSV27 and CSV21F provided by National Bureau of Plant Genetic Resources (NBPGR) through ICAR- Indian Institute of Millet Research (IIMR), Hyderabad. The experimental material was planted in augmented RBD with 60 replications at. Inter and intra row spacing was 45 and 15 cm, respectively. Each genotype was grown in 2 m long single row plot. The populations were employed for the assessment of genetic variability, heritability and genetic gain and observations were recorded for nine quantitative characters viz., days to 50 per cent flowering, plant height (cm), number of leaves, leaf length (cm), leaf width (cm), panicle length (cm), panicle width (cm), 100- seed weight (g) and grain yield per panicle (g) on five competitive plants selected at random for each germplasm lines except early vigour and days to 50 percent flowering which were recorded on whole plot basis. The experiment was analyzed in augmented CRD.

The analysis of variance for different characters in augmented CRD was done following Federer (1956). The following genetic parameters were estimated for the character having significant mean square due to the germplasm.

Genotypic variance

It was calculated using following formula.

$$V_g = \text{MSG} - \text{MSE}$$

Where,

V_g = Genotypic variance,
MSG = Mean square due to germplasm
MSE = Error mean square

Phenotypic variance

It was calculated as follows:

$$V_p = V_g + V_e$$

Where,

V_p = Phenotypic variance,
 V_g = Genotypic variance, and
 V_e = Error variance *i.e.* MSE

Genotypic coefficient of variation (GCV)

It was calculated using the following formula as suggested by the Burton (1952).

$$\text{GCV} = \frac{\sqrt{V_g}}{\bar{X}} \times 100$$

Where,

$\sqrt{V_g}$ = Genotypic variance, and
 \bar{X} = Germplasm mean

Phenotypic coefficient of variation (PCV)

It was calculated using the following formula as suggested by Burton (1952).

$$\text{PCV} = \frac{\sqrt{V_p}}{\bar{X}} \times 100$$

Where,

$\sqrt{V_p}$ = phenotypic variance, and
 \bar{X} = Germplasm mean

Heritability (h^2)

It was estimated in broad sense by using following formula as suggested by Lush (1940).

$$h^2 = \frac{V_g}{V_p} \times 100$$

Where,

h^2 = Heritability in broad sense
 V_g = Genotypic variance
 V_p = Phenotypic variance

Genetic gain

It is percent expected genetic advance over the population mean. It was computed as follows using the formula of Johnson *et al.* (1955)

$$\text{GG} = \frac{\text{GA}}{\bar{X}} \times 100$$

Where,

\bar{X} = Germplasm mean
GA = Genetic advance = $\frac{K \cdot v_g}{\sqrt{v_p}}$

Where,

V_g = Genotypic variance
 V_p = Phenotypic variance
K = Selection differential at 5 per cent selection pressure *i.e.* 2.06

Experimental findings

The mean squares of augmented CRD design in respect of nine quantitative characters are presented in table 1. The mean squares due to treatment, check and germplasm were highly significant for all the characters. The mean square due to checks v/s germplasm was also highly significant for all the characters except leaf length.

The salient features of mean values (Table 3) for each character are described in ensuing paragraphs.

Days to 50 per cent flowering ranged from 47 days (IC-286827, IC-286828, IC-286998, IC-287157 and IC-287159) to 121 days (IC-287346) with a general mean of 86.54 days (non-adjusted mean). The best check for days to 50 per cent flowering was CSV17 (59.29 days). Out of 1700 germplasm, 1153 were flowered. Adjusted mean of 36 Germplasm lines were significantly superior over the best check CSV17 for earliness. The accession IC-286998 (39.90 days) was earliest to flower followed by IC-286992 and IC-286993 (42.90 days), IC-287000 (45.90 days), IC-286991 (46.90 days), IC-286827 and IC-286828 (49.82 days), IC-286990 (49.90 days), IC-287493 (51.07 days) and IC-286989 (51.9 days).

Plant height ranged from 88 cm (IC-288089) to 470 cm (IC-286736) with general mean of 253.24 cm. The best check for plant height was CSV20 (263 cm). Out of 1153 germplasm lines, adjusted mean of 600 lines were significantly superior over the best check CSV20. The accession IC-287324 having maximum plant height (441.73 cm) it was followed by IC-286736 (436.27 cm), IC-287054 (434.66 cm), IC-287557 (431.01 cm), IC-287328 and IC-287332 (421.73 cm), IC-288148 (420.48 cm) and IC-288121 (417.00 cm).

The numbers of leaves per plant ranged from 6 leaves (IC-286811, IC-286993, IC-287133, IC-287157 and IC-287165) to 25 leaves (IC-286811) with a general mean of 14.02 leaves. The best check for number of leaves was CSV20 (12.13). Out of 1153 germplasm accessions, adjusted mean of 832 germplasm lines were significantly superior over the best check CSV20. The accession IC-286811 (25.7) had maximum number of leaves followed by IC-286719 (24.54), IC-287316 (24.04), IC-286938 and IC-286939 (23.69), IC-288301 (23.58), IC-287081 (22.95 cm), IC-287054 (22.90) and IC-286666 (22.87).

Among the 1700 germplasm lines, 1153 lines reached up to the 7th leaf stage. Leaf length in these genotypes ranged from 24 cm (IC-288202) to 115 cm (IC-286890, IC-287238, IC-287490 and IC-288231) with a general mean of 79.74 cm. The best check for leaf length was CSV27 (88.81 cm). While comparing the adjusted means, 288 germplasm lines were significantly superior over the best check CSV27. The accessions IC-287814 having maximum leaf length (115.4 cm) followed by IC-287490 (114.90 cm), IC-288182 (113.43 cm), IC-286890 (112.57 cm), IC-287059 (112.19 cm), IC-286984 (111.57 cm), IC-287792 and IC-287793 (111.40 cm) and IC-287238 (111.35 cm).

Leaf width ranged from 4 to 13 cm with a general mean of 8.31 cm. The best check was CSV27 (8.28 cm). Out of 1153 accessions, adjusted means of 628 germplasm lines were significantly superior over the best check CSV27 on the basis of adjusted means. The accession IC-286982 (14.52 cm) was having maximum leaf width followed by IC-286900 (12.79 cm), IC-288297 (12.67 cm), IC-287537 (12.52 cm), IC-287054 (12.42 cm), IC-287919 (12.36 cm) and IC-288269 (12.35 cm).

Panicle length ranged from 6 cm (IC-287531 and IC-287863) to 45 cm (IC-287950) with a general mean of 19.69 cm (non-adjusted means). The best check was CSV27 (25.38 cm). Out of 1153 germplasm lines, adjusted means of 195 lines were significantly superior over the best check CSV27. The accession IC-287950 having maximum panicle length (43.42 cm) it was followed by IC-286922 (42.52 cm), IC-288160 (42.23 cm), IC-287253 (41.21 cm), IC-287866 (40.33 cm), IC-286852 (39.57 cm), IC-288161 (39.23 cm) and IC-288060 (36.56 cm). Panicle width ranged from 3 cm (IC-287039, IC-287238 and IC-288079) to 19 cm (IC-287681 and IC-

287144) with a general mean of 8.02 cm. The best check was CSV21F (9.33 cm). Out of 1153 germplasm lines, adjusted means of 324 lines were significantly superior over the best check CSV21F. The accession IC-287144 having maximum panicle width (19.93 cm) it was followed by IC-287145 (18.93 cm), IC-286921 (18.48 cm), IC-287681 (18.44 cm), IC-287019 (17.99 cm), IC-287169 (17.93 cm) and IC-287405 (17.65 cm), IC-287678 (17.44 cm).

100-seed weight ranged from 0.62 g (IC-288119) to 5.88 g (IC-287651) with general mean 2.92 g. The best check was both CSV21F and CSV27 (3.73 g). Adjusted means of 86 germplasm lines were significantly superior over the best check CSV21F and CSV27. The accessions IC-287651 having maximum 100-seed weight followed (6.12 g) it was by IC-287444 (5.17 g), IC-287529 (5.03 g), IC-288281 (4.95 g), IC-287454 (4.87 g), IC-287482 and IC-288006 (4.71 g), IC-288270 (4.63 g), IC-287769 (4.60 g) and IC-287743 (4.59 g).

Grain yield per panicle ranged from 2.77 g (IC-286709) to 103.67 g (IC-288008) with general mean 34.68 g. The best check was CSV27 (57.52 g). Adjusted means of 78 germplasm lines were significantly superior over the best check CSV27. Accession IC-287836 having maximum grain yield per panicle (111.65 g) it was followed by IC-287072 (118.25 g), IC-288215 (107.65 g), IC-288008 (104.35 g), IC-287078 (101.67 g), IC-287821 (99.76 g), IC-288009 (99.15 g), IC-287779 (98.57 g) and IC-288035 (98.54 g).

The estimate of phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h^2) and genetic gain (GG) are presented in table 2. It is apparent from the table that phenotypic coefficients of variation were invariably greater than the corresponding genotypic

coefficient of variation though the trend of both GCV and PCV was same. The parameter-wise findings are as follows:

On the basis of standard deviation (SD) characters were classified in three categories greater than mean + SD i.e. high in between mean \pm SD i.e. medium and mean - SD i.e. lower.

GCV was high for Grain yield per panicle (43.75 %), 100-seed weight (29.96 %), panicle length (25.45 %), number of leaves (23.69 %) and panicle width (22.32 %). Medium (between 9.42 to 22.28 %) GCV was observed for Plant height (21.31 %), days to 50 per cent flowering (15.55 %), Leaf width (14.81 %) and Leaf length (11.40 %) (Table 2).

The PCV was high for grains yield per panicle (62.89 %) and medium (between 14.51 to 43.11 %) PCV was observed for panicle length (32.57 %) followed by panicle width (31.62 %), 100-seed weight (31.49 %), number of leaves (24.99 %), plant height (24.18 %), leaf width (18.97 %), days to 50 per cent flowering (16.50 %), and leaf length (16.16 %) (Table 2).

Heritability was high for 100-seed weight (90.53 %), number of leaves (89.89 %), days to 50 per cent flowering (88.89 %) and plant height (77.64 %). Medium (between 17.21 to 66.57 %) heritability was observed for panicle length (61.08 %), leaf width (61.00 %), panicle width (49.96 %), leaf length (49.72 %) and grain yield per panicle (48.39 %) (Table 2).

Genetic gain was high for grain yield per panicle (62.70 %), 100-seed weight (58.72 %), number of leaves (46.28 %), panicle length (40.97 %) and plant height (38.67 %). Medium (between 7.65 to 35.91 %) genetic gain was observed for panicle width (32.50

%), days to 50 per cent flowering (30.21 %), leaf width (23.83 %) and leaf length (16.56 %) (Table 2).

Results and Discussion

Variability is a pre requisite for any breeding programme aimed at improving the yield and other characters. Thus, it is imperative to have information on both genotypic and phenotypic coefficients of variation. The information on phenotypic coefficient of variation and heritability are help full in prediction of the possible genetic advance by selection of genotypes for a character. Looking to the importance variability parameters viz., GCV, PCV, Heritability and Genetic Gain were studied.

Mean square due to germplasm was significant for all the nine characters. CSV17 was the best check for days to 50 per cent flowering. Total 36 germplasm lines were significantly superior over the best check CSV17 for early flowering (59.29 days). The accession IC-286998 (39.90 days) was earliest to flower followed by IC-286992 and IC-286993 (42.90 days), IC-287000 (45.90 days), IC-286991 (46.90 days), IC-286827 and IC-286828 (49.82 days), IC-286990 (49.90 days), IC-287493 (51.07 days) and IC-286989 (51.9 days). Therefore these genotypes can be used for inducing the earliness.

CSV20 was the best check for plant height and number of leaves. Total 600 germplasm lines were significantly superior over the best check CSV20 (263 cm) for plant height. The accession IC-287324 (441.73 cm) was having maximum plant height followed by IC-286736 (436.27 cm), IC-287054 (434.66 cm), IC-287557 (431.01 cm), IC-287328 and IC-287332 (421.73 cm), IC 288148 (420.48 cm) and IC-288121 (417.00 cm). Comparatively, 832 germplasm lines were significantly

superior over the best check CSV20 (12.13) for number of leaves per plant. The accession IC-286811 (25.7) had maximum number of leaves followed by IC-286719 (24.54), IC-287316 (24.04), IC-286938 and IC-286939 (23.69), IC-288301 (23.58), IC-287081 (22.95 cm), IC-287054 (22.90) and IC-286666 (22.87). Lines with more number of leaves along with plant height can be utilized for development of fodder varieties.

CSV27 was the best check for leaf length, leaf width, panicle length and grain yield per panicle. Total 288 germplasm lines were significantly superior over the best check CSV27 (88.81 cm) for leaf length. The accessions IC-287814 (115.4 cm) was having maximum leaf length followed by IC-287490 (114.90 cm), IC-288182 (113.43 cm), IC-286890 (112.57 cm), IC-287059 (112.19 cm), IC-286984 (111.57 cm), IC-287792 and IC-287793 (111.40 cm) and IC-287238 (111.35 cm).

In the germplasm 628 lines were significantly superior over the best check CSV27 (8.28 cm) for leaf width. The accession IC-286982 (14.52 cm) was having maximum leaf width followed by IC-286900 (12.79 cm), IC-288297 (12.67 cm), IC-287537 (12.52 cm), IC-287054 (12.42 cm), IC-287919 (12.36 cm) and IC-288269 (12.35 cm).

In the germplasm 195 lines were found significantly superior over the best check CSV27 (25.38 cm) for panicle length. The accession IC-287950 (43.42 cm) were having maximum panicle length followed by IC-286922 (42.52 cm), IC-288160 (42.23 cm), IC-287253 (41.21 cm), IC-287866 (40.33 cm), IC-286852 (39.57 cm), IC-288161 (39.23 cm) and IC-288060 (36.56 cm).

Seventy eight germplasm lines were significantly superior over the best check CSV27 (57.52 g) for grain yield per panicle.

The accession IC-287836 (111.65 g) recorded maximum grain yield per panicle followed by IC-287072 (118.25 g), IC-288215 (107.65 g), IC-288008 (104.35 g), IC-287078 (101.67 g), IC-287821 (99.76 g), IC-288009 (99.15 g), IC-287779 (98.57 g) and IC-288035 (98.54 g).

Total 324 germplasm lines were significantly superior over the best check CSV21F (9.33 cm) for panicle width. The accession IC-287144 (19.93 cm) were having maximum panicle width followed by IC-287145 (18.93 cm), IC-286921 (18.48 cm), IC-287681 (18.44 cm), IC-287019 (17.99 cm), IC-287169 (17.93 cm), IC-287405 (17.65 cm) and IC-287678 (17.44 cm).

Overall, 87 germplasm lines were significantly superior over the best checks both CSV27 and CSV21F (3.73 g) for 100-seed weight. The accessions IC-287651 (6.12 g) were having maximum 100-seed weight followed by IC-287444 (5.17 g), IC-287529 (5.03 g), IC-288281 (4.95 g), IC-287454 (4.87 g), IC-287482 and IC-288006 (4.71 g), IC-288270 (4.63 g), IC-287769 (4.6 g) and IC-287743 (4.59 g). These accessions can be used for the development of bold seeded varieties.

In general, estimates of phenotypic coefficient of variation (PCV) were slightly greater than corresponding genotypic coefficient of variation (GCV) indicating the role of environment in the expression of characters. Similar findings were reported by Chung and Liang (1970), Median and Choudhary (1980) and Godbharle *et al.*, (2010) in sorghum. The variability parameters were classified in three categories viz., high ($> \text{mean} + \text{SD}$), medium ($\text{mean} \pm \text{SD}$) and low ($< \text{mean} - \text{SD}$).

In present investigation, magnitude of GCV ranged from 11.40 to 43.75 per cent. GCV was high for (more than 22.28 %) grain yield

per panicle (43.75 %), 100-seed weight (29.96 %), panicle length (25.45 %), number of leaves (23.69 %) and panicle width (22.32 %). Medium (between 9.42 to 22.28 %) GCV was observed for Plant height (21.31 %), days to 50 per cent flowering (15.55 %), Leaf width (14.81 %) and Leaf length (11.40 %). On account of skewed distribution of GCV estimates of distribution was an equal.

In present investigation, magnitude of PCV estimates ranged from 16.16 to 62.89 per cent with SD of 14.29. The PCV was high ($> 43.11\%$) for grain yield per panicle (62.69%) and medium for all other characters. Among medium PCV characters more PCV was for panicle length (32.57 %) followed by panicle width (31.62 %), 100-seed weight (31.49 %), number of leaves (24.99 %), plant height (24.18 %), leaf width (18.97 %), days to 50 per cent flowering (16.50 %) and leaf length (16.16 %).

High PCV for grain yield per panicle was also reported by Sharma *et al.*, (2006) and Arun Kumar (2013).

Magnitude of heritability ranged from 48.39 to 90.53 per cent. Heritability was high ($> 66.57\%$) for 100-seed weight (90.53 %), number of leaves (89.89 %), days to 50 per cent flowering (88.89 %) and plant height (77.64 %). Medium heritability was observed for panicle length (61.08 %), leaf width (61.00 %), panicle width (49.96 %), leaf length (49.72 %) and grain yield per panicle (48.39 %).

The ultimate aim of studying the variability and heritability of any trait is to have an idea about the feasibility of selection. The improvement in the mean performance of progeny of the selected families over the base population is known as genetic advance, and when expressed as per cent of mean is called genetic gain (Johnson *et al.*, 1955).

Table.1 Mean square for different characters

SN Character	Treatment [1156]	Check [3]	Germplasm [1152]	C v/s G [1]	Error [206]
1. Days to flowering	264.50**	5397.25**	215.08**	41791.34**	23.90
2. Plant height	4831.60**	176848.45**	3986.03**	462880.67**	891.08
3. Number of leaves	15.06**	77.92**	13.20**	1972.87**	1.33
4. Leaf length	173.29**	2684.40**	166.75**	173.50	83.83
5. Leaf width	2.60**	12.98**	2.53**	50.83**	0.99
6. Ear head length	41.64**	271.54**	38.54**	2930.97**	15.00
7. Ear head width	6.66**	71.82**	6.48**	15.90*	3.24
	[598]	[3]	[594]	[1]	[202]
8. 100 Seed weight	0.94**	15.50**	0.75**	69.91**	0.07
9. Grain weight	492.07**	12449.15**	401.55**	18391.05**	207.23

*, ** significant at 5% and 1% level of significance respectively

Table.2 Variability parameters

Sr.N.	Character	GCV (%)	PCV (%)	h ² (%)	GG (%)
1	Days to 50 % flowering	15.55	16.50	88.89	30.21
2	Plant height (cm)	21.31	24.18	77.64	38.67
3	Number of leaves	23.69	24.99	89.89	46.28
4	Leaf length (cm)	11.40	16.16	49.73	16.56
5	Leaf width (cm)	14.81	18.97	61.00	23.83
6	Panicle length (cm)	25.45	32.57	61.08	40.97
7	Panicle width (cm)	22.32	31.58	49.96	32.50
8	100-seed weight (g)	29.96	31.49	90.53	58.72
9	Grain yield per panicle (g)	43.75	62.89	48.39	62.70

Table.3 Summary of mean values for days to 50 % flowering, number of leaves, leaf length, leaf width and panicle length, panicle width, plant height, grain yield per panicle and 100 seed weight

	Days to 50 % flowering		Plant height (cm)		Number of leaves		Leaf length (cm)		Leaf width (cm)		Panicle length (cm)		Panicle width (cm)		100-seed weight (g)		Grain yield per panicle (g)	
	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M	Mean	Ad M
Germplasm Mean	88.90	-	261.11	-	14.54	-	79.89	-	8.39	-	19.06	-	8.06	-	2.75	-	31.86	-
Minimum	47.00	-	88.00	-	6.00	-	24.00	-	4.00	-	6.00	-	3.00	-	0.62	-	2.77	-
Maximum	121.00	-	470.00	-	25.00	-	115.00	-	13.00	-	45.00	-	19.00	-	5.88	-	103.67	-
Checks																		
CSV 17	59.29	59.29	130.66	130.66	9.51	9.51	71.11	71.11	7.88	7.88	24.39	24.39	6.57	6.57	2.65	2.65	33.49	33.49
CSV 20	76.04	76.04	223.90	223.90	11.44	11.44	79.84	79.84	8.16	8.16	22.90	22.90	7.52	7.52	3.69	3.69	55.44	55.44
CSV 21F	80.33	80.33	263.11	263.11	12.13	12.13	77.60	77.60	7.17	7.17	20.12	20.12	9.33	9.33	3.73	3.73	26.13	26.13
CSV 27	80.11	80.11	228.22	228.22	11.91	11.91	88.81	88.81	8.28	8.28	25.38	25.38	7.67	7.67	3.73	3.73	57.52	57.52
Mean	73.57	-	210.06	-	11.20	-	78.90	-	7.85	-	23.12	-	7.76	-	3.42	-	42.82	-
Minimum	59.29	-	130.66	-	9.51	-	71.11	-	7.17	-	20.12	-	6.57	-	2.65	-	26.13	-
Maximum	80.33	-	263.11	-	12.13	-	88.81	-	8.28	-	25.38	-	9.33	-	3.73	-	57.52	-
SEd	0.89	-	5.45	-	0.21	-	1.67	-	0.18	-	0.71	-	0.33	-	0.05	-	2.63	-
CD 5%	1.76	-	10.75	-	0.42	-	3.30	-	0.36	-	1.39	-	0.65	-	0.10	-	5.18	-
CD 1%	2.32	-	14.17	-	0.55	-	4.35	-	0.47	-	1.84	-	0.86	-	0.13	-	6.84	-

Where, Ad M – Adjusted mean

Magnitude of genetic gain ranged from 16.56 to 62.70 per cent. Genetic gain was high (> 35.91 %) for grain yield per panicle (62.70 %), 100-seed weight (58.72 %), number of leaves (46.28 %), panicle length (40.97 %) and plant height (38.67 %). Medium genetic gain was observed for panicle width (32.50 %), days to 50 per cent flowering (30.21 %), leaf width (23.83 %) and leaf length (16.56 %). Using the variability parameters we can identify the characters having high response to selection whether it has any economic importance or not. Plant breeders are mainly interested in characters having economic importance. If these characters have less variability, improvement through direct selection is difficult. These characters can be improved by indirect selection. For indirect selection, identification of component character is essential. The genotypic and phenotypic correlation coefficients are helpful in identification of such characters.

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