Original Research Article

EVALUATION OF MAINTAINER AND RESTORER LINES FOR FLORAL, YIELD AND YIELD CONTRIBUTING TRAITS IN RICE

ABSTRACT

Developing high yielding rice varieties/hybrids is much needed to ensure food security to meet the requirement of increasing population across the world. Cytoplasmic male genetic sterility system is valuable technology to exploit heterosis and producing high yielding hybrid with nutritional quality. Forty rice genotypes which include 20 maintainer and 20 restorer lines were evaluated to study the variability and correlation between floral, yield and yield contributing traits. High significant variation was observed among the genotypes for all the studied traits. Number of grains per panicle, 1000 grain weight and duration of spikelet opening recorded high GCV values and high heritability coupled with high genetic advance which indicated the broad genetic base, less environmental influence and these traits are under control of additive gene action. The correlation analyses among the traits were further studied. Duration of spikelet opening, plant height, number of productive tillers, stigma breadth expressed positive significant association along with positive direct effect on grain yield per plant indicated that selection for these traits will be effective in crop improvement programme

Keywords: Correlation, Floral traits, Rice, variability

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the oldest cereal crops and it has been cultivated for 8,200–13,500 years Molina *et al.,* (2011) [1]. Rice is a staple food for around 2.5 billion people worldwide, with that number expected to rise to 4.6 billion by 2050. During 2020-21, the rice production of rice comprised 28.8% of the total global rice production. Compared with the average global rice production of 4.3 t ha^{-1}, the average yield of rice in the 30 million ha of China is 6.8 t ha^{-1}. However, the increasing frequency of biotic and abiotic stresses on rice crop it is essential to develop high-yielding, climate-resilient and high nutritional quality rice varieties/hybrids.?????????

Hybrid rice technology is a novel technology which utilizes the cytoplasmic genetic male sterility to break the yield barrier between kinds. The wild abortive (WA) is most important of three main CMS sources. The cytoplasmic male sterility (CMS) is associated with a mitochondrial mutation that causes an inability to produce fertile pollen. The fertility of CMS plants is restored in the presence of a nuclear encoded fertility restorer gene. In hybrid rice breeding, the pollen grains of the cytoplasmic male sterile lines (CMS) are sterile and the female organ of the CMS lines depends on the fertile pollen released from maintenance or restorer lines to produce seeds. The floral trait of parental lines, i.e., CMS lines, its corresponding maintainer, and restorer lines are the main factors in hybrid rice seed production because they influenced outcrossing between parental lines. However, the natural outcrossing rate in rice cultivars is extremely low and hybrid seed production, using male sterility or gametocides, presents some difficulties. The main problem is that Rf genes are found in only 2 to 5% of rice germplasm; therefore, only a very small number of rice germplasms can be explored as restorer lines for heterosis, which make it difficult to breed superior hybrids. Increasing the potential outcrossing rate would facilitate the use of hybrids in other areas of the world. Outcrossing in rice is primarily impacted by floral characteristics and anthesis, both of which play important roles in hybrid seed generation. The characterization of the parental lines of floral traits is an essential aspect of every breeder and this should be kept in mind while selecting the parental lines in a hybrid rice breeding program. The stigma exsertion, glume angle, and duration of spikelet opening of the seed parent, as well as anther size, filament length, and duration of spikelet opening of the pollen parent, all contribute to outcrossing efficiency Sheeba *et al*.,[2] (2006).

Any crop's development in breeding for yield and its contributing traits is influenced and defined by the quantity and nature of its genetic diversity, which is polygenically controlled, environmentally influenced, and determined (Wright, 1935) [3] The information about certain genetic parameters of variability for different traits of economic significance is important for plant breeders before releasing any variety. The presence and magnitude of genetic variability in a gene pool is the prerequisite of a breeding program. Heritability estimates provide information on the proportion of variation that is transmissible to the progenies in subsequent generations. Knowledge of heritability plays a major role in selection-based improvement of the crop because it indicates the extent to which traits can be passed on to future generations. Therefore, genetic variability is the prerequisite for making progress in crop breeding programs Similarly, strong genetic progress combined with high heritability provides the best conditions for selecting a specific feature.

It is important that future research focuses on understanding the nature and strength of the relationship between yield and its components, which will improve the efficiency of genetic selection in plant breeding programs. The correlation coefficient, may also help to know characters with little or no importance in the selection programme Singh *et al*., (2014).[4] The genotypic correlation on the other hand, which represents the genetic portion of the phenotypic correlation, is the only one of inheritable nature and therefore, used to orient breeding programmes. The existence of correlation may be attributed to the presence of linkage or pleiotropic effect of genes or physiological and development relationship or environmental effect or in combination of all Oad *et al*., (2002) [5]. Correlation in grouping with path analysis would give a better insight into cause-and-effect relationship between different pairs of characters (Jayasudha and Sharma, 2010) [6]. Partitioning of total correlation into direct and indirect effects by path coefficient analysis helps in making the selection more effective (Priya and Joel, 2009) [7]

The present investigation was designed to evaluate maintainer and restorer lines to determine the genetic parameters, correlation coefficient and path analysis among floral and yield traits for isolation of superior maintainer and restorer lines.

2. MATERIAL AND METHODS

The experimental material comprised of 40 rice genotypes (20 maintainer lines and 20 restorer lines) were evaluated for various floral traits, grain yield, yield contributing traits and some grain quality traits during *kharif*, 2021 at Regional Agricultural Research station, Jagtial, PJTSAU, Telangana State, India. Each entry was grown in three rows within each block in a randomized block design (RBD) with three replications. Each replicate consisted of 40 genotypes randomized and replicated within each block. Twenty-five-day-old seedlings were transplanted 20 cm apart between rows and 15 cm within the row. The complete recommended package of cultural practices was applied. Five random plants were from the middle rows in each replication and evaluated for floral traits, yield and yield contributing traits. The data was recorded on flag leaf length, flag leaf breadth, duration of spikelet opening, angle of flower opening, Stigma length, stigma breadth, stigma exertion rate, style length, anther length, anther breadth, panicle exersion days to 50 percent flowering, plant height (cm), number of productive tillers per plant, panicle length (cm), number of grains per panicle, grain yield per plant (g), 1000- grain weight (g), kernel length (mm), kernel breadth (mm), kernel L/B ratio. Data on stigma length, stigma breadth, anther length, anther breadth, style length was recorded with the help of Trinocular microscope. The data were statistically analyzed using the ANOVA analysis of variance based on the model proposed by (Panse and Sukhatme, 1961) [8]. The magnitude of the components of variances has been obtained from the analysis of variance to appraise the different genetic parameters as described by Singh *et al*., (1977) [9] and (Falconer,1989) [10]. The genotypic and phenotypic variances were calculated as per the formulae proposed by (Burton ,1952) [11]. The genotypic (GCV%)

and phenotypic (PCV%) coefficient of variation was calculated by the formulae given by (Burton ,1952) [11]. Heritability in a broad sense [h2 (bs)] was calculated by the formula given by (Lush, 1940) [12] as suggested by Jhonson *et al*. (1955) [13] From the heritability estimates, the genetic advance (GA) was estimated by the following formula given by Jhonson *et al.* (1955) [13]

3. RESULTS AND DISCUSSION

The analysis of variance revealed that the mean sum of square due to genotypes differed significantly for all the floral and yield traits (Table 1 and Table 2). High magnitude of genotypic coefficient of variation indicates presence of substantial amount of genetic variability in the population and there is little influence of the environment on the expression of character. Phenotypic coefficients of variation estimates were higher than the genotypic coefficient of variation for all characters. This is due to the occurrence of error variance into the phenotypic coefficient of variance. The coefficients of genotypic and phenotypic variabilities (Table 3) were comparatively high for Number of grains per panicle (37.240 and 37.460), grain yield /plant (27.622 and 29.816),1000 grain weight (24.044 and 26.960) and duration of spikelet opening (21.730 and 22.624). These results were in agreement with the findings of (Sudip and Chakraborty, 2019)[14] for number of grains per panicle and 1000 grain weight and Hasan *et al.* (2018)[15] for duration of spikelet opening.

The estimate of heritability and genetic advance can be utilized for the prediction of genetic gain, which indicates the genetic improvement that would result from the selection of best individuals. The broad sense heritability estimates were high for kernel breadth(99.70) followed by kernel length (99.60), Angle of flowering opening (99.50), Number of grains per panicle(98.80), L/B(98.60), Stigma exertion rate (96.30), Duration of spikelet opening(92.30), Days to 50% flowering(91.60), plant height (88.80),Flag leaf breadth (87),grain yield per plant(85),stigma breadth (79.90),1000grain yield (79.50), number of productive tillers (77.10),panicle exertion rate(68), flag leaf length (62) and stigma length (60.40).These results were consistent with the findings of (Sudip and Chakraborty,2019) [14] for Days to 50% flowering; Awad allah *et al.*,(2022) [16] for plant height , grain yield per plant and duration of spikelet opening ;Singh *et al.,* (2022)[17] for flag leaf length and breadth; Priyanka *et al*.,(2017)[18] for stigma length, stigma breadth, stigma exertion rate, panicle exertion rate. Heritability was moderate for style length (57.50), anther length (34.10), panicle length (52.40)

The estimates of genetic advance expressed as percentage of mean were high for number of grains per panicle (76.263), grain yield per plant (52.714), 1000 grain weight (44.174), duration of spikelet opening (42.997), stigma exertion rate (33.000), kernel breadth (32.683), stigma breadth (31.904), flag leaf breadth (29.483), number of productive tillers per plant (28.792), angle of flower opening (24.732), kernel length (24.434), L/B (24.003) and plant height (22.587).

These results were consistent with the findings of Rukmini *et al.,* (2019) [19] and (Sudip and Chakraborty,2019) [14] for number of grains per panicle and grain yield per panicle; Awad *et al.,* (2022) [16] for duration of spikelet opening; Singh *et al.,* (2022) [17] for flag leaf breadth and plant height; Priyanka *et al.,* (2017) [18] for stigma breadth and stigma exertion rate.

Moderate genetic advance for flag leaf length (15.098), stigma length (16.325), anther length (10.757), style length (17.080), panicle exertion rate (16.221), Days to 50% flowering (14.595) These results are in confirmity with findings of Manjunatha *et al*., (2018) [20] for Days to 50% flowering.

High heritability accompanied by high genetic advance indicated the predominance of additive gene action for the traits viz., Flag leaf breadth, Duration of spikelet opening, Angle of flower opening, Stigma breadth, Stigma exertion rate, Plant height, Number of productive tillers per plant, Number of grains per panicle, Grain yield per plant ,1000- grain weight, Kernel length, Kernel breadth, Kernal L/B ratio. The high estimates of heritability coupled with moderate genetic advance as percent of mean were observed for flag leaf length, stigma length, panicle exertion rate, Days to 50% flowering.

Genotypic correlation coefficients between morphological, floral and yield traits are presented in (Table.4) The results revealed that Duration of spikelet opening, plant height, Number of productive tillers indicated positive significant correlation with grain yield/plant at genotypic level which was earlier supported by Devi *et al*.,[21] (2022) for plant height and number of productive tillers while stigma breadth, flag leaf length , flag leaf breadth, stigma exertion rate, panicle exertion rate, panicle length, number of grains per panicle, 1000 grain weight, kernel length, kernel breadth indicated positive non-significant correlation with grain yield per plant at genotypic level while stigma length, style length, anther length , anther breadth, angle of flower opening, Days to 50% flowering and L/B revealed negative correlation with grain yield per plant .

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations (Wright, 1921) [22] for better interpretation of cause-and-effect relationship.

Path coefficient analysis was carried out using genotypic correlation, using grain yield/plant as a dependent variable. Path coefficients are rated as per the scales given by (Wright ,1921[22]; Dewey and Lu 1959 [23]). The estimates of path coefficient are furnished in (Table 5)

The path coefficient analysis of different traits contributing towards grain yield/plant revealed that stigma length, style length, angle of flower opening, flag leaf breadth, panicle exertion rate, plant height, number of productive tillers per plant, number of grains per panicle,1000 grain weight, kernel length showed positive direct effect on grain yield per plant. while stigma breadth, anther length, anther breadth, flag leaf length, stigma exertion rate, duration of spikelet opening, days to 50% flowering, panicle length, kernel breadth and L/B showed negative direct effect on grain yield per plant.
Critical analysis of results obtained from character association and path analysis indicated that plant height and number of productive tillers per plant possessed both positive significant correlation and positive direct effects on grain yield per plant

Table 1. Analysis of variance for floral traits

	DF	Flag leaf length (cm)	Flag leaf breadth(cm)	Duration of spikelet opening	Angle of flower opening	Stigma length (mm)	Stigma breadth (mm)	Stigma exertion rate (%)	Style length (mm)	Anther length (mm)	Anther breadth (mm)	Panicle exertion rate
Replications	2	44.148	0.059	32.189	0.087	0.020	0.001	6.678	0.001	0.092	0.001	10.037
A	43	43.654***	0.223***	269.356***	34.831***	0.135***	0.014***	421.353***	0.004***	0.209***	0.003**	53.500***
Error(A)	86	7.408	0.011	7.329	0.058	0.024	0.001	5.386	0.001	0.082	0.001	6.993

	DF	Days to 50 percent flowering	Plant height (cm)	Number of productive tillers per plant	Panicle length (cm)	Number of grains per panicle	Grain yield per plant (g)	1000-grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	Kernal L/B ratio
Replications	2	4.455	42.680	0.328	6.870	13.846	4.663	10.715	0.002	0.001	0.005
A	43	157.377***	521.256***	5.253***	6.284***	15946.140***	44.229***	77.741***	1.135***	0.205***	0.420***

Table 2: Analysis of variance of rice for yield and yield related traits

Error(A)	86	4.679	21.123	0.472	1.462	62.796	2.308	6.140	0.001	0.000	0.002

TABLE – 3: ESTIMATES OF VARIABILITY PARAMETERS FOR FLORAL AND YIELD TRAITS.

S.No.	Characters	Range		mean	GCV (%)	PCV (%)	h^2 (bs)(%)	Genetic Advancement 5%	GA as 5 % of mean
		Min	max						
1	Flag leaf length (cm)	30.900	49.240	37.339	9.309	11.823	62	5.638	15.098
2	Flag leaf breadth(cm)	1.206	2.480	1.733	15.341	16.444	87	0.511	29.483
3	Duration of spikelet opening	31.000	62.333	43.007	21.730	22.624	92.30	18.492	42.997
4	Angle of flower opening	20.000	32.666	28.286	12.036	12.066	99.50	6.996	24.732
5	Stigma length (mm)	1.470	2.520	1.885	10.196	13.117	60.40	0.308	16.325
6	Stigma breadth (mm)	0.246	0.500	0.383	17.331	19.393	79.90	0.122	31.904
7	Stigma exertion rate (%)	42.600	88.166	72.118	16.328	16.642	96.30	23.799	33.000
8	Style length (mm)	0.246	0.443	0.309	10.937	14.428	57.50	0.053	17.080
9	Anther length (mm)	1.803	2.916	2.299	8.948	15.333	34.10	0.247	10.757
10	Anther breadth (mm)	0.340	0.456	0.392	5.243	10.383	25.50	0.021	5.454
11	Panicle exertion rate	32.970	52.813	41.508	9.485	11.426	68.90	6.733	16.221
12	Days to 50 percent flowering	84.333	117.666	96.363	7.404	7.736	91.60	14.065	14.595
13	Plant height (cm)	89.313	173.133	110.937	11.639	12.354	88.80	25.058	22.587
14	Number of productive tillers per plant	5.333	12.200	7.933	15.912	18.116	77.10	2.284	28.792
15	Panicle length (cm)	22.500	30.706	25.143	5.042	6.968	52.40	1.890	7.516
16	Number of grains per panicle	78.066	344.466	195.390	37.240	37.460	98.80	149.011	76.263
17	Grain yield per plant (g)	6.666	22.800	13.533	27.622	29.816	85.80	7.134	52.714
18	1000- grain weight (g)	12.200	30.633	20.318	24.044	26.960	79.50	8.975	44.174
19	Kernel length (mm)	4.080	6.846	5.173	11.883	11.905	99.60	1.264	24.434
20	Kernel breadth (mm)	1.233	2.466	1.644	15.891	15.916	99.70	0.538	32.683
21	Kernal L/B ratio	2.203	4.020	3.181	11.733	11.813	98.60	0.764	24.003

GCV = Genotypic coefficient of variation, PCV=Phenotypic coefficient of variation, h2 (bs) = Heritability (broad sense), GA = Genetic advance, GA (%) = Genetic advance as percent of mean.

TABLE 4: Genotypic (r) correlation coefficient among floral and yield traits of different maintainer and restorer lines of rice

	Stigma length (mm)	Stigma breadth (mm)	Style length (mm)	Anther length (mm)	Anther Breadth (mm)	Angle of Flower opening (0)	Flag leaf Length (cm)	Flag leaf Breadth (cm)	Stigma exertion rate (%)	Duration spikelet opening (min)	Panicle Exertion rate (%)	Days To 50 percent flowering	Plant Height (cm)	Number of productive tillers per plant	Panicle Length (cm)	Number of grains per panicle	1000 grain weight (gm)	kernel length (mm)	kernel breadth (mm)	L/ B	grain yield p e r plant (gm)
Stigma length(mm)	1.00000	0.41022 **	0.35873 *	0.43283 **	0.00860	0.22422	-0.13958	-0.06704	0.03811	-0.06200	0.00444	-0.07500	-0.36406 *	0.00407	0.11018	-0.14811	0.23548	0.33392 *	-0.02596	0.33251 *	-0.25485
Stigma breadth(mm)		1.00000	0.14148	0.25693	0.22340	0.23703	0.11434	-0.16893	0.02365	0.17480	0.24255	-0.20040	-0.11414	0.16140	0.12229	-0.31615 *	0.40940 **	0.29806 *	0.37867 *	-0.21887	0.03963
Style length (mm)			1.00000	0.25932	0.00517	0.00610	0.05026	-0.28465	0.30009 *	0.20199	0.38130 *	-0.34948 *	-0.17002	0.09031	0.23969	-0.17818	0.05608	0.26431	-0.15979	0.48477 ***	-0.20580
Anther length(mm)				1.00000	0.09258	-0.03325	-0.15302	-0.27744	0.00778	-0.06650	0.20218	-0.31145 *	-0.14781	0.18296	0.02075	-0.35464 *	0.31755 *	0.43200 **	0.25113	0.09030	-0.03698
Anther breadth(mm)					1.00000	0.33708 *	-0.04744	-0.14385	-0.17293	-0.10254	-0.13231	-0.13064	-0.16497	-0.14902	0.03128	-0.14022	0.07691	0.21600	0.23230	-0.13202	-0.11640
Angle of flower opening (0)						1.00000	-0.14637	0.03027	-0.08872	-0.21053	-0.05079	0.10896	-0.30091 *	-0.24611	-0.18445	-0.16210	0.03281	-0.02549	0.03187	-0.12170	-0.09186
Flag leaf length(cm)							1.00000	0.13580	-0.03876	0.07483	0.13922	-0.03402	0.67357***	-0.07310	0.51451***	-0.14102	0.29821 *	0.21734	0.32184 *	-0.10611	0.26937
Flag leaf breadth(cm)								1.00000	-0.02927	0.04085	-0.09344	0.54049 ***	0.31583*	-51821***	-0.13415	0.46286**	-0.05848	-0.34390 *	-0.19274	-0.07755	0.20510
Stigma exertion rate (%)									1.00000	0.27252	0.12952	-0.21046	0.05607	0.35511*	0.12370	0.07735	-0.06939	0.00697	-0.16156	0.24602	0.15898
Duration spikelet opening(min)										1.00000	0.35616 *	-0.12503	0.05543	0.36061*	0.12881	0.01442	0.09775	0.10545	0.07222	-0.01653	0.38307 *
Panicle exertion rate (%)											1.00000	-0.36607 *	-0.10244	0.19776	0.19507	-0.12269	0.08091	0.12959	-0.05788	0.19773	0.29523
Days to 5 0 % percent flowering												1.00000	0.20361	-0.38855**	-0.15980	0.48931 ***	-0.30673 *	-0.41410 **	-0.19857	-0.13312	-0.11201
plant height(cm)													1.00000	-0.03708	0.47059 **	0.15667	0.06222	-0.01820	0.25331	-0.21689	0.29931 *
Number of productive tillers per plant														1.00000	0.16981	-0.15469	0.07278	0.29167	0.08260	0.17116	0.43385 **
Panicle length															1.00000	0.01372	0.06604	0.36128 *	0.14792	0.21933	0.24872
Number of grains per panicle																1.00000	-0.69625 ***	-0.53764 ***	-0.49414 ***	0.13448	0.14199
1000 grain weight(gm)																	1.00000	0.60879 ***	0.67083 ***	-0.26571	0.11848
kernel length(mm)																		1.00000	0.63125 ***	0.14867	0.24282
kernel breadth (mm)																			1.00000	-0.65646 ***	0.24822
L/ B																				1.00000	-0.09377
grain yield p e r plant(gm)																					1.00000
Significance Levels	*0.05*	*0.01*	*0.005*	*0.001*																	
If correlation r =>	*0.29730*	*0.38434*	*0.41577*	*0.47913*																	

Table 5: Path coefficient analysis

	Stigma length (mm)	Stigma breadth (mm)	Style length (mm)	Anther length (mm)	Anther breadth (mm)	Angle of flower opening (^{0})	Flag leaf length (cm)	Flag leaf breadth (cm)	Stigma exertion rate (%)	Duration spikelet opening (min)	Panicle exertion rate (%)	Days to 5 0 % Percent flowering	plant height (cm)	Number of productive tillers per plant	Panicle length	Number of grains per panicle	1000 grain weight (gm)	kernel length (mm)	kernel breadth (mm)	L/ B
Stigma length(mm)	**0.1585**	0.0669	0.0732	0.0981	0.0024	0.0385	-0.0277	-0.0106	0.0080	-0.0122	-0.0011	-0.0124	-0.0638	0.0026	0.0206	-0.0270	0.0452	0.0590	-0.0048	0.0583
Stigma breadth(mm)	-0.0493	**-0.1167**	-0.0194	-0.0362	-0.0338	-0.0280	-0.0152	0.0214	-0.0020	-0.0219	-0.0307	0.0267	0.0148	-0.0210	-0.0201	0.0399	-0.0529	-0.0369	-0.0465	0.0267
Style length(mm)	0.0499	0.0179	**0.1080**	0.0401	0.0051	0.0017	0.0019	-0.0361	0.0365	0.0250	0.0464	-0.0408	-0.0244	0.0150	0.0368	-0.0206	0.0039	0.0339	-0.0190	0.0597
Anther length(mm)	-0.4356	-0.2185	-0.2613	**-0.7038**	0.0331	0.0290	0.1531	0.2607	-0.0067	0.0637	-0.1935	0.2708	0.1371	-0.1767	-0.0055	0.3259	-0.3184	-0.3893	-0.2160	-0.0857
Anther breadth(mm)	-0.0060	-0.1121	-0.0184	0.0182	**-0.3868**	-0.1772	0.0057	0.0719	0.1008	0.0581	0.0289	0.0815	0.0804	0.0785	-0.0525	0.0042	-0.0535	-0.1370	-0.1401	0.0741
Angle of flower opening (^{0})	0.0675	0.0667	0.0045	-0.0114	0.1274	**0.2782**	-0.0454	0.0089	-0.0244	-0.0593	-0.0149	0.0308	-0.0857	-0.0719	-0.0579	0.0453	0.0101	-0.0068	0.0095	-0.0339
Flag leaf length(cm)	0.0383	-0.0285	-0.0039	0.0477	0.0032	0.0358	**-0.2193**	-0.0266	0.0083	-0.0199	-0.0295	0.0075	-0.1636	0.0189	-0.1382	0.0331	-0.0759	-0.0516	-0.0781	0.0281
Flag leaf breadth(cm)	-0.0219	-0.0600	-0.1096	-0.1215	-0.0609	0.0105	0.0397	**0.3280**	-0.0095	0.0157	-0.0325	0.1863	0.1053	-0.1845	-0.0514	0.1561	-0.0239	-0.1149	-0.0640	-0.0264
Stigma exertion rate (%)	-0.0080	-0.0029	-0.0590	-0.0017	0.0455	0.0153	0.0066	0.0051	**-0.1746**	-0.0485	-0.0245	0.0376	-0.0101	-0.0657	-0.0249	-0.0136	0.0124	-0.0014	0.0291	-0.0434
Duration of spikelet opening(min)	0.0228	0.0557	-0.0689	0.0269	0.0446	0.0633	-0.0270	-0.0142	-0.0824	**-0.2970**	-0.1123	0.0410	-0.0157	-0.1119	-0.0471	-0.0041	0.0284	-0.0319	-0.0214	0.0044
Panicle exertion rate (%)	-0.0041	0.1508	0.2460	0.1575	-0.0428	-0.0307	0.0772	-0.0567	0.0803	0.2167	**0.5729**	-0.2287	-0.0625	0.1175	0.1295	-0.0762	0.0337	0.0781	-0.0355	0.1179
Days to 5 0 % percent flowering	0.0239	0.0697	0.1151	0.1172	0.0642	-0.0337	0.0104	-0.1731	0.0657	0.0421	0.1216	**-0.3047**	-0.0648	0.1238	0.0522	-0.1522	0.0981	0.1283	0.0617	0.0406
plant height(cm)	-0.3043	-0.0957	-0.1711	-0.1473	-0.1572	-0.2331	0.5645	0.2430	0.0436	0.0401	-0.0825	0.1609	**0.7566**	-0.0389	0.4182	0.1229	0.0460	-0.0131	0.1947	-0.1677
Number of productive tillers per plant	0.0111	0.1237	0.0953	0.1727	-0.1396	-0.1779	-0.0593	-0.3869	0.2588	0.2591	0.1410	-0.2793	-0.0354	**0.6877**	0.1275	-0.1112	0.0635	0.2101	0.0605	0.1214
Panicle length	-0.0316	-0.0420	-0.0830	-0.0019	-0.0331	0.0507	-0.1535	0.0382	-0.0347	-0.0387	-0.0551	0.0418	-0.1346	-0.0452	**-0.2436**	-0.0029	-0.0208	-0.0999	-0.0417	-0.0598
Number of grains per panicle	0.0798	-0.1605	-0.0896	-0.2173	-0.0900	-0.0764	-0.0709	0.2234	0.0366	0.0066	-0.0624	0.2343	0.0762	-0.0759	0.0056	**0.4692**	-0.3427	-0.2530	-0.2329	0.0648
1000 grain weight(gm)	0.0366	0.0581	0.0046	0.0580	0.0177	0.0046	0.0444	-0.0093	-0.0091	0.0123	0.0075	-0.0413	0.0078	0.0118	0.0109	-0.0937	**0.1282**	0.0813	0.0897	-0.0361
kernel length(mm)	1.0523	0.8927	0.8868	1.5629	1.0004	-0.0694	0.6641	-0.9899	0.0231	0.3039	0.3852	-1.1901	-0.0489	0.8632	1.1587	-1.5235	1.7918	**2.8255**	1.7806	0.4097
kernel breadth(mm)	0.0810	-1.0624	0.4697	-0.8190	-0.9663	-0.0916	-0.9497	0.5210	0.4442	-0.1924	0.1655	0.5400	-0.6868	-0.2346	-0.4569	1.3248	-1.8663	-1.6817	**-2.6686**	1.7653
L/ B	-0.8884	0.5529	-1.3353	-0.2941	0.4628	0.2941	0.3088	0.1943	-0.6002	0.0360	-0.4969	0.3214	0.5352	-0.4262	-0.5925	-0.3336	0.6804	-0.3501	1.5972	**-2.4145**
grain yield p e r plant(gm)	-0.2879	0.0442	-0.2163	-0.0550	-0.1040	-0.0963	0.3083	0.2123	0.1621	0.3894	0.3331	-0.1169	0.3169	0.4664	0.2693	0.1424	0.1304	0.2486	0.2542	-0.0966
Partial R^2	-0.0456	-0.0052	-0.0234	0.0387	0.0402	-0.0268	-0.0676	0.0696	-0.0283	-0.1156	0.1908	0.0356	0.2398	0.3207	-0.0656	0.0668	0.0167	0.7025	-0.6785	0.2331

4. CONCLUSION

Genetic analysis on floral and yield traits revealed that all the genotypes in these study were significantly different for all the characters and sufficient variability was available in these germplasm lines. Correlation and path analysis revealed that the characters viz; plant height, Number of productive tillers had positive significant correlation along with direct effect on grain yield. So that, these characters could be used in selection programme.

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