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Research Article

Analysis of genetic variability and correlation for yield and its attributing traits in F_2 population of rice (*Oryza sativa* L.)

M. R. Prajapati[1]*, Madhu Bala[1], V. P. Patel[2], R. K. Patel[1], U. S. Sushmitha[1], A. D. Kyada[1], D. P. Patel[1], Jwala Pranati[1] and B. Sriram kumar[1]

[1]Department of Genetics and Plant Breeding, NMCA, NAU, Navsari, Gujarat
[2]Regional Rice Research Station, NAU, Vyara, Gujarat
***E-Mail:** maulikprajapati3997@gmail.com

Abstract
For designing of the breeding programme, analysis of genetic variability and character correlation is crucial in crop improvement. The aim of this experiment was to estimate genetic variability parameters and trait association for 13 quantitative traits which were measured in F_2 segregating populations of six crosses containing nine parents. All the F_2 populations showed significant GCV and PCV values for productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant, indicating that these traits may be improved through selection. Plant height, productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant showed high heritability coupled with high genetic advance, indicating that these traits were controlled by additive gene action and have a good chance of improvement through pure line selection. Grain yield per plant exhibited a strong positive correlation with plant height, panicle length, grains per panicle, straw yield per plant, productive tillers per plant and harvest index in all the six F_2 segregating populations. The F_2 population of the cross GR 17 × NVSR 2740 demonstrated that more GCV and PCV, high heritability with high genetic advance for the majority of the traits which can be improved by selection.

Keywords: Rice, F_2 population, Variability, heritability, genetic advance and correlation

INTRODUCTION

Rice, *Oryza sativa* (L.) belongs to the family *Poaceae* and the subfamily *Oryzoidae*, is a self-pollinated and short day plant that originated in Southeast Asia. It is grown as a staple food for more than half of the world's population (Khush, 2005). It contains carbohydrates, proteins, minerals and dietary fiber (Verma *et al*., 2006). It is also rich in vitamins such as thiamine, riboflavin and niacin (Verma *et al*., 2006). Understanding the genetic nature of the trait of interest, as well as the selection of parents for the creation and prediction of genetic variability in subsequent generations are important components for achieving success in a breeding programme. Measurements of genetic variability, such as genotypic and phenotypic coefficients of variation (GCV, PCV), heritability (h^2), and genetic advance (GA), are precisely measured in order to correctly determine the degree of genetic variation present in a population. Johnson *et al.* (1955) found that heritability influences the selection programme and shows the relative effectiveness of selection based on the phenotypic variation of a trait. Heritability accompanied with genetic advance is more beneficial for anticipating the real worth of selection. Yield is a dependent character and has complex inheritance because of its polygenic nature. Understanding the strength of correlation between yield and its correlated traits plays an important role in the isolation of potential cultivars. Plant breeders want to achieve a higher gain in yield through an indirect selection of independent traits which may show correlated responses with other linked traits

MATERIALS AND METHODS

The experiment was carried out in a non-replicated fashion utilizing F_2 as segregating material during *Kharif* 2020 at Regional Rice Research Station (RRRS), Navsari Agricultural University, Vyara. There are 20 plants in each row, spaced 20 x 15 cm^2 apart from one another. Each F_2 population contained at least 200 plants, individual plant observations were taken from 100 randomly selected plants. Each parent contained 20 plants and observations were taken from 10 randomly chosen plants. The pedigree and morphological characteristics of parental lines are displayed in **Table 1**. The traits *viz.,* days to flowering, days to maturity, plant height (cm), panicle length (cm), productive tillers per plant, grains per panicle, 100 grain weight (g), kernel length (mm), kernel width (mm), kernel L/B ratio, grain yield per plant, straw yield per plant and harvest index were studied during the experiment.

Mean and variances were calculated using Singh and Chaudhary's formula (1977). Because all individuals in non-segregating generations (P_1 and P_2) have identical genotype, the phenotypic differences are totally environmental. The F_2 population consists of segregating individuals, making it genetically variable with both genetic as well as non-genetic (environmental) components of total (phenotypic) variation. The mean phenotypic variance of the P_1 and P_2 populations was used to determine environmental variance (Tomar, 1998). Quantification of GCV and PCV was done in accordance with Burton and Devana (1953). According to Johnson *et al*. (1955), GCV and PCV are classified in the following categories: 0 to 10 per cent (Low), 11 to 20 per cent (Moderate), >20 per cent (High). Heritability represents the ratio of genetic variance to the total variance of a population. It was calculated according to Allard's formula (1960). Robinson *et al*. (1951) classified heritability as follows: 0 to 30 per cent (Low), 31 to 60 per cent (Moderate), >60 per cent (High). Correlation analysis was carried out by using OPSTAT online software.

RESULTS AND DISCUSSION

The results of variability parameters are depicted in **Table 2.** All the populations exhibited the highest GCV and PCV value for grains per panicle, productive tillers per plant, grain yield per plant and straw yield per plant, except for the cross JAYA × NVSR 2115 and NVSR 2310 × NVSR 2115, which had moderate GCV for productive tillers per plant and low GCV in cross GR 17 × MAUDAMANI for grains per panicle and productive tillers per plant. In general, the GCV and PCV values for productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant were greater in the F_2 populations than the other traits. These types of findings were also reported by Ratnakar *et al.* (2012) for productive tillers per plant, grain yield per plant and straw yield per plant; Krishna *et al.* (2014) for grains per panicle and Bhuvaneswari *et al.* (2015) for productive tillers per plant. Many traits including plant height, panicle length, productive tillers per plant, grains per panicle, kernel length, kernel breadth, grain yield per plant, straw yield per plant and harvest index demonstrated high heritability in all of the six F_2 segregating populations. The results are in accordance with the results of Kahani and Hittalmani (2015) for days to flowering, days to maturity, plant height, straw yield per plant; Mallimar *et al.* (2015) for, grains per panicle, kernel length, kernel breadth and grain yield per plant.

Table 1. The parental line's morphological characteristics and parentage/pedigree details

Specifics	JAYA	NVSR 2115	GR17	MAUDAMANI	NVSR 2740	NVSR 2285	NVSR 2098	NVSR 2310	NVSR 3002
Parentage / Pedigree	**TN 1 × T141**	**Gurjari × PAU-201**	**Gurjari × Jaya**	**(Dandi × Naveen)/ Dandi**	**Palwan × Gurjari**	**Jaya × IET 18654**	**Gurjari × PAU 201**	**Gurjari × IET 220557**	**IR 28 × GAR 13**
DF	100-105	95-100	90-100	100-105	80-100	85-95	85-90	90-100	90-95
PH	95-110	130-140	125-135	120-135	95-130	80-100	80-110	75-115	100-115
PL	22-30	120-135	24-28	23-27	23-29	20-25	22-29.30	22-30	20-25
PTP	8-15	8-14	5-10	4-10	4-8	4-7	6-10	3-5	7-10
GP	140-180	130-200	150-250	150-235	140-190	100-180	100-190	85-150	85-160
100 GW	2.70-3.00	2.70-2.80	2.70-3.10	2.65-2.80	2.75-3.40	1.85-2.65	2.85-3.20	2.40-2.95	2.40-2.50
KL	6.50-6.85	7.15-7.50	7.00-7.35	7.15-7.50	6.70-7.40	6.15-6.35	7.10-7.40	6.70-6.90	6.70-7.00
KB	2.45-2.70	2.15-2.45	2.35-2.55	2.15-2.45	2.55-2.90	2.12-2.30	2.30-2.70	2.25-2.65	2.30-2.50
GYP	5000-5500	5500-6000	5200-5600	4500-5000	4000-4400	3600-3800	5000-5500	3800-4000	4200-4400

DF : Days of flowering
PH : Plant height (cm)
PL : Panicle length (cm)
PTP : Productive tillers per plant
GP : Grains per panicle
100 GW : 100 grain weight (g)
KL : Kernel length (mm)
KB : Kernel breadth (mm)
GYP : Grain yield per plant (g)

Table 2. Assessment of genetic variability factors for thirteen quantitative traits in the F_2 segregating populations

Traits	JAYA × NVSR 2115						GR 17 × MAUDAMANI						GR 17 × NVSR 2740					
	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM
DF	101.44	6.74	6.90	95.36	13.76	13.56	89.68	4.86	5.57	75.91	7.82	8.72	93.92	8.40	9.36	80.52	14.57	15.52
DM	130.98	4.83	4.91	96.81	12.83	9.79	119.72	3.80	4.05	88.45	8.82	7.37	123.88	6.61	6.94	90.61	16.06	12.96
PH	127.56	13.20	13.70	92.81	33.41	26.19	105.59	8.74	9.38	86.89	17.72	16.79	111.74	16.96	17.66	92.16	37.47	33.54
PL	25.51	8.30	10.27	65.29	3.52	13.81	24.45	6.30	7.39	72.66	2.71	11.07	24.11	11.35	13.51	70.60	4.74	19.65
PTP	6.69	15.23	34.70	19.26	0.92	13.77	7.88	7.69	22.55	11.64	0.43	5.41	7.19	34.37	39.72	74.87	4.40	61.26
GP	159.49	28.22	30.30	86.75	86.36	54.15	110.71	8.50	25.18	11.40	6.54	5.91	125.74	35.02	36.53	91.90	86.97	69.16
100 GW	2.63	9.92	10.01	98.26	0.53	20.26	2.99	6.35	6.59	93.02	0.38	12.62	3.01	8.53	10.37	67.62	0.44	14.45
KL	7.01	4.23	4.51	87.96	0.57	8.17	7.15	1.78	2.23	63.96	0.21	2.94	7.30	3.30	3.89	71.68	0.42	5.75
KB	2.42	6.90	7.73	79.62	0.31	12.68	2.50	3.33	4.45	56.05	0.13	5.13	2.61	6.55	7.30	80.61	0.32	12.12
L/B	2.92	8.11	8.84	84.22	0.45	15.34	2.86	3.76	5.14	53.59	0.16	5.68	2.81	6.49	7.30	79.27	0.33	11.91
GYP	25.72	43.73	52.78	68.65	19.20	74.64	23.22	30.35	33.54	81.86	13.14	56.57	24.56	56.63	60.42	87.84	26.86	109.34
SYP	28.41	37.27	46.52	64.16	17.47	61.49	26.65	22.17	27.45	65.25	9.83	36.90	26.44	54.46	58.00	88.17	27.86	105.35
HI	46.73	8.35	8.91	87.69	7.52	16.10	46.16	6.28	7.29	74.12	5.14	11.13	47.92	7.22	8.03	80.89	6.41	13.38

Table 2. Continued

Traits	NVSR 2285 × NVSR 2098						NVSR 2310 × NVSR 2115						NVSR 2098 × NVSR 3002					
	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM	Mean	GCV (%)	PCV (%)	h^2 (b)	GA	GAM
DF	88.15	5.03	5.58	81.28	8.24	9.35	95.67	7.77	8.01	94.11	14.85	15.53	90.37	4.27	4.59	86.35	7.38	8.17
DM	118.16	3.64	4.12	78.04	7.82	6.62	125.54	5.79	6.00	93.27	14.46	11.52	120.43	3.19	3.41	87.66	7.41	6.15
PH	103.00	12.53	14.64	73.25	22.75	22.09	99.83	9.27	11.36	66.56	15.55	15.58	104.77	7.36	8.91	68.30	13.13	12.54
PL	24.02	6.76	11.81	32.74	1.91	7.97	23.57	8.21	10.04	66.81	3.26	13.82	23.93	7.65	8.77	76.14	3.29	13.75
PTP	7.87	26.19	30.84	72.10	3.61	45.81	5.73	17.21	25.16	46.79	1.39	24.25	6.47	21.96	29.75	54.49	2.16	33.44
GP	116.44	24.66	32.99	55.87	44.22	37.97	95.19	29.66	32.53	83.18	53.05	55.73	122.49	26.01	29.59	77.23	57.67	47.08
100 GW	2.39	9.08	11.28	64.82	0.36	15.07	2.93	9.66	10.02	92.94	0.56	19.18	2.66	9.71	9.78	98.62	0.53	19.87
KL	6.58	5.46	5.62	94.40	0.72	10.93	7.11	3.53	3.70	90.37	0.49	6.93	6.93	3.61	4.12	76.99	0.45	6.53
KB	2.35	5.91	6.66	78.79	0.25	10.81	2.50	5.06	5.65	80.23	0.23	9.33	2.38	4.08	5.24	60.70	0.16	6.55
L/B	2.81	8.17	8.80	86.17	0.44	15.63	2.85	4.53	5.62	65.03	0.21	7.53	2.92	6.19	6.64	86.96	0.35	11.89
GYP	20.45	58.97	61.10	93.16	23.98	117.25	15.43	50.36	53.80	87.61	14.98	97.10	24.00	23.52	39.29	35.85	6.96	29.01
SYP	24.50	52.81	54.48	93.95	25.84	105.45	18.17	43.37	47.25	84.25	14.90	82.00	26.29	18.27	31.57	33.49	5.73	21.78
HI	44.51	6.83	7.46	83.86	5.73	12.88	45.41	5.08	7.58	44.94	3.19	7.02	47.08	6.49	7.63	72.44	5.36	11.39

DF : Days of flowering
DM : Days of maturity
PH : Plant height (cm)
PL : Panicle length (cm)
PTP : Productive tillers per plant
GP : Grains per panicle
100 GW : 100 grain weight (g)
KL : Kernel length (mm)
KB : Kernel breadth (mm)
L/B : L/B ratio
GYP : Grain yield per plant (g)
SYP : Straw yield per plant (g)
HI : Harvest index (%)

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All the F_2 segregating populations demonstrated higher genetic advance as a per cent mean in terms of plant height, productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant. These findings are in conformation with those of Kahani and Hittalmani (2015) who reported the higher genetic advance as a per cent mean for plant height; Savitha and Usha (2015) for grain yield per plant; Sala and Santhi (2016) for productive tillers per plant; Balat (2018) for grain yield per plant and straw yield per plant and Kumar *et al.* (2020) for productive tillers per plant. When determining the impact of heritability on selecting the best individuals, heritability estimates in combination with genetic advancement are more useful than heritability alone. Our study found that traits like plant height, the number of productive tillers per plant, the number of grains per panicle, grain yield per plant and straw yield per plant had high heritability with genetic advances. This suggests that these traits are controlled by additive gene action and can be improved by simple phenotypic selection.

The results of correlation analysis are presented in **Table 3.** All the F_2 segregating populations observed that, grain yield per plant was positive and strongly correlated to panicle length, plant height, grains per panicle, straw yield per plant, productive tillers per plant and harvest index, except for the cross GR 17 × MAUDAMANI, where the plant height and panicle length exhibited a positive but non significant correlation with grain yield per plant. Improvement in above mentioned traits may lead to simultaneous improvement in grain yield per plant and thus they may be considered important yield attributing characters. Similar kind of results showing significant correlation for grain yield per plant were reported by Kumar *et al*. (2015) for harvest index, grains per panicle, straw yield per plant and panicle length; Subbulakshmi and Muthuswamy (2018) for grains per panicle and productive tillers per plant; Kumar *et al.* (2017) for plant height and panicle length; Seneega *et al.* (2019) for plant height, panicle length and productive tillers per plant and Kumar *et al*. (2020) for plant height, productive tillers per plant and panicle length.

Days to flowering showed a positive and highly significant correlation with days to maturity in all F_2 populations. It was also observed that positive and highly significant correlation with plant height and grains per panicle in the cross GR 17 × NVSR 2740; with panicle length, plant height, productive tillers per plant, grains per panicle, kernel breadth, grain yield per plant and straw yield per plant in the cross NVSR 2310 × NVSR 2115 and with 100 grain weight in the cross NVSR 2285 × NVSR 2098. Similar kind of results was reported by Akinwale *et al.* (2011) and Nagaraju *et al.* (2013) for days to maturity and grains per plant; Kahani and Hittalmani (2015) for days to maturity and kernel length; Kumar *et al*. (2017) for panicle length; Saha *et al.* (2019) and Tiwari *et al.* (2019) for days to maturity, plant height and grain yield per plant. Days to maturity demonstrated a positive and highly significant correlation with days to flowering in all six F_2 populations; with plant height and grains per panicle in the cross GR 17 × NVSR 2740; with plant height, panicle length, grains per panicle, productive tillers per plant, kernel breadth, grain yield per plant and straw yield per plant in NVSR 2310 × NVSR 2115 and with 100 grain weight in NVSR 2285 × NVSR 2098. Similar findings were reported by Nagaraju *et al*. (2013) for grains per panicle and days to flowering; Kahani and Hittalmani (2015) for days to flowering and 100 grain weight; Kumar *et al.* (2017) for panicle length and grain yield per plant and Tiwari *et al*. (2019) for plant height, grain yield per plant and days to flowering.

Plant height was positively and significantly correlated with panicle length, productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant in all F_2 populations, except the cross GR 17 × MAUDAMANI, which was only correlated with panicle length. Thus, improvement in this trait may lead to an increase in grain yield per plant. Present results are in accordance with the findings of Ratnakar *et al*. (2012) for panicle length, productive tillers per plant, grain yield per plant and straw yield per plant; Norain *et al.* (2014) for panicle length and grains per panicle; Bhuvaneswari *et al.* (2015) for panicle length and straw yield per plant and Kumar *et al.* (2017) for panicle length and grain yield per plant

Panicle length was positively and highly significantly correlated with productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant in all F_2 populations, except cross GR17 × MAUDAMANI, in which correlation with productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant was non significant. For productive tillers per plant, the cross NVSR 2098 × NVSR 3002 exhibited positive and non significant correlation. Thus, improvement in this trait may result into simultaneous improvement in grain yield. These results are resemblances with the findings of Norain *et al*. (2014) for grain yield per plant, grains per panicle and straw yield per plant and Kumar *et al.* (2020) for straw yield per plant.

In all F_2 populations, productive tillers per plant had a highly significant and positive correlation with grain yield per plant, straw yield per plant and harvest index. In the crosses of JAYA × NVSR 2115 and GR 17 × NVSR 2740, also exhibited a highly significant and positive correlation with grains per panicle. Thus, improvement in this trait may lead to ultimate improvement in grain yield. A similar kind of result was reported by Ratnakar *et al.* (2012) for grain yield per plant and straw yield per plant; Nagaraju *et al.* (2013) for grains per panicle, grain yield per plant and harvest index and Kahani and Hittalmani (2015) for grain yield per plant and straw yield per plant.

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Table 3. Correlation analysis in F_2 segregating populations

Cross	Traits	DF	DM	PH	PL	PTP	GP	100 GW	KL	KB	L/B	GYP	SYP	HI
JAYA × NVSR 2115	DF	1.000												
	DM	0.994**	1.000											
	PH	0.148	0.161	1.000										
	PL	0.162	0.166	0.678**	1.000									
	PTP	0.183	0.180	0.404**	0.369**	1.000								
	GP	0.219*	0.215*	0.430**	0.438**	0.337**	1.000							
	100 GW	-0.055	-0.054	-0.031	-0.026	-0.001	-0.091	1.000						
	KL	-0.046	-0.043	-0.353**	-0.345**	-0.054	-0.230*	0.350**	1.000					
	KB	0.148	0.149	-0.083	-0.061	0.050	-0.033	0.253*	-0.059	1.000				
	L/B	-0.142	-0.142	-0.130	-0.149	-0.077	-0.092	-0.034	0.577**	-0.840**	1.000			
	GYP	0.204*	0.200*	0.539**	0.514**	0.811**	0.719**	0.162	-0.124	0.035	-0.099	1.000		
	SYP	0.172	0.177	0.592**	0.533**	0.778**	0.652**	0.134	-0.118	0.004	-0.067	0.956**	1.000	
	HI	0.237*	0.209*	0.060	0.165	0.447**	0.509**	0.121	-0.053	0.104	-0.128	0.515**	0.267**	1.000
GR 17 × MAUDAMANI	DF	1.000												
	DM	0.992**	1.000											
	PH	0.130	0.128	1.000										
	PL	0.013	0.018	0.210*	1.000									
	PTP	0.156	0.151	0.263**	0.083	1.000								
	GP	0.138	0.133	0.027	0.160	0.023	1.000							
	100 GW	-0.098	-0.108	-0.066	0.098	-0.134	-0.104	1.000						
	KL	0.013	0.031	-0.100	0.251*	-0.014	-0.049	0.042	1.000					
	KB	0.120	0.132	0.056	0.118	-0.013	-0.064	0.132	0.218*	1.000				
	L/B	-0.102	-0.105	-0.097	0.006	0.016	0.040	-0.123	0.276**	-0.876**	1.000			
	GYP	0.136	0.122	0.195	0.190	0.653**	0.676**	0.039	-0.041	0.004	-0.021	1.000		
	SYP	0.123	0.108	0.184	0.142	0.677**	0.508**	0.044	-0.066	0.008	-0.036	0.921**	1.000	
	HI	0.062	0.058	0.116	0.214*	0.267**	0.567**	-0.002	0.108	0.016	0.037	0.563**	0.217*	1.000
GR 17 × NVSR 2740	DF	1.000												
	DM	0.995**	1.000											
	PH	0.356**	0.356**	1.000										
	PL	0.151	0.145	0.642**	1.000									
	PTP	0.025	0.024	0.314**	0.290**	1.000								
	GP	0.272**	0.269**	0.463**	0.584**	0.311**	1.000							
	100 GW	-0.055	-0.055	-0.053	-0.022	-0.194	-0.016	1.000						
	KL	0.024	0.020	0.157	0.180	-0.131	0.160	0.244*	1.000					
	KB	0.147	0.146	-0.031	-0.031	-0.237*	0.060	0.465**	0.306**	1.000				
	L/B	-0.133	-0.134	0.117	0.123	0.192	0.063	-0.349**	0.231*	-0.848**	1.000			
	GYP	0.215*	0.216*	0.390**	0.365**	0.758**	0.664**	0.024	0.063	-0.040	0.122	1.000		
	SYP	0.209*	0.207*	0.403**	0.378**	0.736**	0.653**	0.012	0.081	-0.039	0.125	0.974**	1.000	
	HI	0.114	0.124	0.100	0.064	0.142	0.131	0.164	-0.105	0.147	-0.194	0.229*	0.037	1.000
NVSR 2285 × NVSR 2098	DF	1.000												
	DM	0.998**	1.000											
	PH	0.123	0.129	1.000										
	PL	0.129	0.131	0.424**	1.000									
	PTP	-0.068	-0.064	0.294**	0.357**	1.000								
	GP	0.070	0.075	0.291**	0.332**	0.229*	1.000							
	100 GW	0.357**	0.359**	0.106	0.072	0.002	0.284**	1.000						
	KL	0.180	0.180	0.099	0.007	0.089	0.188	0.531**	1.000					
	KB	0.177	0.187	0.109	0.121	0.097	0.127	0.350**	-0.036	1.000				
	L/B	-0.012	-0.019	-0.016	-0.083	-0.008	0.026	0.076	0.671**	-0.761**	1.000			
	GYP	0.135	0.141	0.281**	0.272**	0.626**	0.718**	0.449**	0.366**	0.212*	0.083	1.000		
	SYP	0.143	0.149	0.293**	0.282**	0.619**	0.709**	0.439**	0.346**	0.206*	0.075	0.989**	1.000	
	HI	0.028	0.033	0.241*	0.143	0.474**	0.403**	0.263**	0.291**	0.108	0.111	0.577**	0.478**	1.000

Table 3. Continued

Cross	Traits	DF	DM	PH	PL	PTP	GP	100 GW	KL	KB	L/B	GYP	SYP	HI
NVSR 2310 × NVSR 2115	DF	1.000												
	DM	0.996**	1.000											
	PH	0.376**	0.364**	1.000										
	PL	0.328**	0.329**	0.600**	1.000									
	PTP	0.306**	0.312**	0.543**	0.317**	1.000								
	GP	0.398**	0.398**	0.375**	0.495**	0.097	1.000							
	100 GW	0.249*	0.240*	0.234*	-0.094	0.156	0.038	1.000						
	KL	0.220*	0.215*	0.250*	0.200*	0.003	0.199*	0.228*	1.000					
	KB	0.287**	0.277**	0.126	0.170	0.099	-0.018	-0.001	0.324**	1.000				
	L/B	-0.148	-0.141	0.038	-0.031	-0.096	0.155	0.140	0.345**	-0.773**	1.000			
	GYP	0.458**	0.460**	0.531**	0.425**	0.554**	0.749**	0.300**	0.177	0.026	0.096	1.000		
	SYP	0.460**	0.459**	0.558**	0.458**	0.532**	0.730**	0.306**	0.167	0.072	0.043	0.961**	1.000	
	HI	0.126	0.132	0.144	0.051	0.240*	0.307**	0.086	0.140	-0.063	0.160	0.426**	0.182	1.000
NVSR 2098 × NVSR 3002	DF	1.000												
	DM	0.995**	1.000											
	PH	0.071	0.068	1.000										
	PL	0.231*	0.226*	0.564**	1.000									
	PTP	-0.126	-0.126	0.293**	0.120	1.000								
	GP	0.179	0.179	0.263**	0.328**	-0.060	1.000							
	100 GW	0.167	0.188	0.058	0.213*	-0.144	-0.091	1.000						
	KL	0.166	0.172	-0.109	0.153	-0.203*	-0.120	0.372**	1.000					
	KB	0.026	0.027	0.174	0.183	0.085	-0.202*	0.491**	0.047	1.000				
	L/B	0.084	0.087	-0.216*	-0.049	-0.196	0.071	-0.154	0.600**	-0.768**	1.000			
	GYP	-0.005	-0.005	0.406**	0.328**	0.651**	0.683**	-0.196	-0.229*	-0.094	-0.079	1.000		
	SYP	-0.037	-0.034	0.363**	0.300**	0.608**	0.644**	-0.198*	-0.177	-0.154	0.001	0.947**	1.000	
	HI	0.073	0.071	0.305**	0.197*	0.447**	0.469**	-0.128	-0.249*	0.040	-0.193	0.638**	0.376**	1.000

DF : Days of flowering; DM : Days of maturity; PH : Plant height (cm); PL : Panicle length (cm); PTP : Productive tillers per plant; GP : Grains per panicle; 100 GW : 100 grain weight; KL : Kernel length; KB : Kernel breadth; L/B : L/B ratio; GYP : Grain yield per plant; SYP : Straw yield per plant; HI : Harvest index

Significant at 5% and 1% levels of probability, respectively, are * and **.

In all F_2 populations, grains per panicle were significantly and positively correlated with grain yield per plant, straw yield per plant and harvest index. Nagaraju *et al.* (2013) obtained similar kind of results for grain yield per plant and harvest index and Naseem *et al.* (2014) for grain yield per plant. In the cross JAYA × NVSR 2115, 100 grain weight was positively & highly correlated with kernel length. With kernel breadth in the cross GR17 × NVSR 2740, with grain yield per plant and straw yield per plant in the cross NVSR 2310 × NVSR 2115, with harvest index in the cross NVSR 2285 × NVSR 2098 and with kernel length and kernel breadth in the cross NVSR 2098 × NVSR 3002. Ratnakar *et al.* (2012) manifested similar kind of results for grain yield per plant and straw yield per plant.

Kernel length had a strong positive and highly significant correlation with L/B ratio in all F_2 populations except the cross GR 17 × NVSR 2740 which exhibited a highly significant but negative correlation with L/B ratio, with kernel breadth positive & highly significant in the crosses GR 17 × NVSR 2740 and NVSR 2310 × NVSR 2115, with grain yield per plant, straw yield per plant and harvest index exhibited positive and highly significant correlation in the cross NVSR 2285 × NVSR 2098. Similar result is in conformation with the findings of Venkanna *et al.* (2014) for L/B ratio. In all the F_2 populations, kernel breadth had a highly significant but negative correlation with L/B ratio. Similar results were observed by Venkanna *et al.* (2014).

For all of the F_2 segregating populations, straw yield per plant was positive and highly significant correlation with grain yield per plant. The same results are in accordance with Ratnakar *et al.,* (2012) and Kahani and Hittalmani (2015).

In essence, almost all the F_2 populations had high GCV and PCV values for productive tillers per plant, grains per panicle, grain yield per plant and straw yield per plant so, greater emphasis should be given to these traits for progress through selection in the desired direction. Productive tillers per plant, plant height, grains per panicle, grain yield per plant and straw yield per plant demonstrated high genetic advance as a per cent of mean (indicating additive gene action) coupled with high heritability so, the selection is effective for these traits. Grain yield per plant was found to have a high and positive correlation with plant height, panicle length, grains per panicle, straw yield per plant, productive tillers per plant and harvest index. So, improvement in these traits simultaneously improves grain yield. To generate further variability, inter-mating within and between populations as well as some sort of biparental mating involving the segregating populations such as JAYA × NVSR 2115, GR 17 × MAUDAMANI, NVSR 2285 × NVSR 2098, NVSR 2310 × NVSR 2115 and NVSR 2098 × NVSR 3002 is required.

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