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Evaluation of exotic rice germplasm for yield and its components

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Abstract
The present investigation consists of 25 genotypes of rice received from Rice Breeding Programme, Directorate of Research, SHUATS, Prayagraj. The study was conducted to evaluate yield and yield contributing traits in randomized block design (RBD) with three replications during *kharif*- 2018, at Field Experimentation Centre, Department of Genetics & Plant Breeding, SHUATS, Prayagraj (U.P.). The data were recorded on 13 characters to study the analysis of variance, Coefficient of variation**,** heritability, Genetic advance and coefficient of correlation. Based on the mean performance among 25 genotypes of rice NDR359 genotype was found to be superior in grain yield. The analysis of variance revealed significant differences for all the characters indicating sufficient variability among the genotypes. Highest genotypic and phenotypic coefficient of variations were recorded for harvest index. The characters *viz.*, number of spikelets per panicle and biological yield per hill exhibited high heritability coupled with high genetic advance indicating that simple selection could be effective for improving these characters. The persual of genotypic and phenotypic correlation coefficients indicated that harvest index, biological yield per hill, tillers per hill, panicles per hill and test weight were significantly and positively associated with grain yield. It is suggested that selection for these traits will be helpful in enhancing the grain yield.

Keywords: Rice, genetic variability, heritability & genetic advance and correlation

Introduction
Rice is the world's most important food. More than half of the world's population depends on rice for food calories and protein, especially in developing countries. The genetic classification of rice plant belongs to the genus Oryza of family Graminae. The genus includes 24 species of which 22 are wild and two viz., *Oryza sativa* L. and *Oryza glaberimma* are cultivated. All species are cultivated in Asia, America, and Europe continents. The cultivated varieties of *Oryza sativa* grouped into three sub species, Indica, Japonica and Javanica. Where Indica are grown throughout the tropical and sub tropical region and Japonica varieties are grown throughout the temperate zone and Javanica are grown mainly in the part of Indonesia.

The nutrient contents of rice are 80% carbohydrates, 7-8% protein (The amino acid profile shows that it is rich in Glutamic acid and Aspartic acid, highest quality cereal protein being rich in lysine (3.8 %), 3% fat and 3% fiber (Juliano *et al.*, 1985) [8]. India is a major rice growing country of the world with an area, production and productivity. During 2017-18 the production of rice has been 112.8 million tones. (NRRI Annual report-2018) [10]. Demand for rice is growing every year and it is estimated that by 2025 AD the requirement would be 140 million tones respectively. To sustain present food self-sufficiency and to meet future food requirements, India has to increase its rice productivity by 3% per annum. (Thiyagarajan and Selvaraju, 2001) [12].

Knowledge of correlation between yield and its contributing characters are basic and foremost endeavor to find out guidelines for plants election. Genetic variability, character association and path-coefficients are pre-requisites for improvement of any crop including rice for selection of superior genotypes and improvement of any trait (Krishnaveni *et al*., 2006).

The quality of rice is considered from viewpoint of milling quality, grain size, shape and appearance and cooking characteristics. Traditionally plant breeders concentrated on breeding for high yielding and pest resistance. Recently the trend has changed to incorporate preferred quality characteristics that increase the total economic value of grain. The grain quality can be improved genetically through the improvement of grain quality components.

Keeping above facts in view the present investigation was carried out with the objectives of evaluation of exotic rice germplasm for yield and its components and for computing genetic variability and correlation of grain yield with yield components among the rice genotypes.

Materials and Methods

The present investigation was conducted during *Kharif* 2018 at field experimentation center of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P.). Experimental materials for the present study consist of 25 rice genotypes received +6from Rice Breeding Program, Directorate of Research, SHUATS, Prayagraj, and one check variety received from the Department of Genetics and Plant Breeding, during *Kharif*-2018. The experiment was laid down in a Randomized Block Design with 25 rice genotypes. The genotypes were replicated thrice, each genotype was grown in a plot of size 2.8m^2 (0.4 m X 7 m) square meter. The data were recorded on five randomly selected plants from each rice hybrids in each replication leaving the first one border rows from all the four sides, in order to avoid the sampling error. Readings from five plants were averaged replication wise and the mean data was used for statistical analysis for 13 characters such as Days to 50% flowering, Plant height, Flag leaf length, Flag leaf width, Panicles length, Number of tillers per hill, Number of panicles per hill, Number of spikelets per panicle, Days to maturity, Biological yield per hill, Harvest index, Test weight and Grain yield per hill. The ANOVA was carried out as per the equation suggested by Panse and Sukhatme (1967), Component of variance by Burton (1952), Heritability in broad sense (h^2) by Lush (1949) [9] and Hanson *et al*., (1956) [7].

Result and discussion

Mean sum of squares for the characters studied revealed that the mean sum of squares due to genotypes were significant for all the characters. This suggests that the genotypes selected were genetically variable and considerable amount of variability existed among them. Thus, indicates ample scope for selection for different quantitative characters for rice improvement. Analysis of variance showed highest significant difference among 25 rice genotypes for all the characters studied, indicating that there is ample scope for selection of promising lines from present gene pool for yield and quality improvement. On the basis of mean performance, the genotypes NDR359 (22.92 g), BP10620F-BB-17-BB8 (22.83 g), HHZ10-DT7-51 (21.70 g), BHS825 (19.83 g), HHZ1-DT3-Y1-Y1 (19.66 g) were regarded as the best genotypes for grain yield per hill.

The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters. The maximum phenotypic coefficient of variation (PCV) was observed for grain yield per plant (31.91) and maximum genotypic coefficient of variation (GCV) was observed for grain yield per plant (29.84).

Heritability estimates showed that character like harvest index (99.00), spikelet's per panicle (99.00), and flag leaf length (99.00) followed by biological yield (97.00), days to 50% flowering (96.00), days to maturity (96.00), test weight (94.00), plant height (91.00), seed yield per plant (87.00), flag leaf width (80.00), panicles per plant (75.00), panicle length (74.00) and tillers per plant (56.00).

Estimates of genetic advance showed that character number of spikelets per panicle (89.51) and lowest genetic advance for flag leaf width (0.24). Grain yield per hill showed positive significant association with harvest index (0.820***), number of spikelet's per panicle (0.607**), tillers per hill (0.316**), panicles per hill (0.224**) and test weight (0.200**) It shows positive non-significant association with panicle length (0.028*) and days to 50% flowering (0.012*) It shows negative significant association with plant height (-0.127*) and days to maturity (-0.211*). It showed negative non-significant association with flag leaf width (-0.097*), biological yield (-0.077*) and flag leaf length (-0.023*) at phenotypic level. Grain yield per hill showed positive significant association with harvest index (-0.879***), spikelet's per panicle (0.653***), tillers per hill (0.359***), test weight (0.227**), and panicles per hill (0.225). It showed positive non-significant association with panicle length (0.028*) and days to 50 % flowering (0.004*). The correlation of grain yield per hill showed negative significant association with days to maturity (-0.246**) and plant height (-0.132**). and It showed negative non-significant association with biological yield (-0.087*), flag leaf width (-0.072*) and flag leaf length (-0.025*) at genotypic level.

In the present study it was concluded that genotype NDR359 (22.92 gm) and BP10620F-BB-17-BB8 (22.83) was recorded highest yield in rice. The difference between PCV and GCV is very less indicating the lesser role of environment on the expression of various quantitative characters. The high heritability observed in all the characters coupled with high genetic advance as percent of mean was recorded under study which indicates there was preponderance of additive gene action for the expression of these characters. Hence, selection these characters can bring enhancement in rice production and productivity. Biological yield, harvest index and Days to maturity showed positive and significant correlation with grain yield per plant, which provide the selection index for selection of parents for the hybridization programme.

Table 1: Analysis of variance for 13 quantitative characters among 25 genotypes of rice

Sr. NO	Character	Mean Sum of Square		
		Replication (d.f=2)	Treatment (d.f=18)	Error (d.f=36)
1	Days to 50% flowering	2.13	69.92	0.83
2	Plant height	3.79	74.85	2.13
3	Flag leaf length	0.03	40.81	0.09
4	Flag leaf width	0.02	0.03	0.02
5	No. of tillers per hill	0.36	5.49	1.12
6	No. of panicle per hill	0.25	4.74	0.46
7	Panicle length	0.06	8.52	0.89
8	Biological yield	2.26	258.47	2.41
9	Harvest index (%)	0.93	497.74	0.58
10	Days to maturity	0.17	72.69	0.94
11	No. of spikelet's / panicle	19.23	6101.59	20.72
12	Test weight	0.03	22.95	0.47
13	Seed yield per hill	2.49	66.71	3.05

**Significant at 5% level of significance respectively.

Table 2: Mean Performance of 25 Rice Genotypes for 13 Quantitative Characters during *Kharif*- 2018

No	Character	Days to 50% Flowering	Plant Height (cm)	Flag Leaf Length	Flag Leaf Width	Tillers/ Plant	Panicles/ Plant	Panicle Length cm	Spikelet's/ Panicle	Days to Maturity	Biological Yield	harvest Index	Test Weight	Seed Yield/ Plant
1	BHS519	99.33	84.53	26.13	1.65	9.93	8.47	21.80	218.67	130.77	44.43	41.63	21.00	18.80
2	BHS825	94.00	88.20	30.77	1.57	9.80	8.47	26.57	192.33	127.57	49.43	41.97	24.33	19.83
3	BHS826	98.00	86.03	22.53	1.29	11.13	9.57	24.43	187.17	129.00	55.43	35.60	22.17	18.57
4	BP10620F-BB-17-BB8	98.00	94.37	31.63	1.52	10.00	8.73	24.30	250.23	129.13	60.93	37.30	25.17	22.83
5	BP11820-5F-KN-10-2	96.23	85.67	27.53	1.36	10.93	7.07	26.10	190.47	130.93	50.63	32.37	27.17	16.87
6	BP12342-5F-8-KN-2	94.00	84.07	28.33	1.45	9.07	7.70	25.13	129.40	129.67	47.77	31.17	23.17	15.03
7	BP12600F-KN-4-1	89.30	91.10	30.53	1.31	11.27	9.93	24.23	187.47	120.93	63.53	30.80	22.17	18.93
8	BP12816F-KN-7-1	95.00	88.33	27.17	1.38	10.40	10.00	24.77	116.23	135.13	58.47	26.53	30.33	15.13
9	BP16732E-6	88.33	77.77	22.70	1.34	9.20	8.00	25.00	114.83	118.13	40.07	30.87	22.17	12.77
10	HHZ10-DT7-51	92.00	86.00	26.33	1.40	8.17	7.33	23.27	262.67	128.13	41.57	53.33	20.33	21.70
11	HHZ14-SAL10-DT1-DT1	92.00	87.70	29.30	1.35	9.10	8.23	24.07	243.87	130.13	49.73	39.17	18.00	18.40
12	HHZ-14-SAL13-LI2-DT1	88.33	83.87	27.50	1.37	8.73	6.17	25.20	166.23	126.60	33.43	44.57	20.83	14.53
13	HHZ14-SAL19-Y1	96.33	89.10	27.30	1.52	9.13	7.30	23.43	213.63	131.07	48.50	38.37	21.33	17.37
14	HHZ1-DT3-Y1-Y1	92.33	87.13	25.63	1.37	8.17	7.03	21.63	139.10	129.83	43.23	45.93	19.33	19.67
15	HHZ23-DT16-DT1-DT1	97.67	91.37	28.57	1.43	8.13	7.13	22.27	163.90	133.33	47.77	10.80	19.00	7.80
16	HHZ3-SAL13-Y1-SAL1	90.00	89.20	31.60	1.63	9.13	7.30	24.37	122.93	133.87	49.43	13.93	20.50	9.60
17	HHZ3-SAL6-Y1-Y1	91.87	98.30	37.60	1.63	9.20	7.97	22.23	136.30	128.50	71.10	9.67	19.83	10.83
18	HHZ4-SAL12-LI1-LI1	91.00	95.37	31.13	1.57	8.50	6.93	24.57	118.43	125.23	48.97	13.47	23.33	12.43
19	IR10A270	108.0	91.20	31.57	1.39	10.13	9.10	25.77	136.40	140.50	53.27	15.43	20.17	8.63
20	IR10F379	88.77	93.33	28.40	1.23	11.13	9.67	24.83	122.72	122.27	68.33	10.73	18.83	9.27
21	IR10N276	98.33	89.73	30.10	1.44	10.93	9.13	24.07	120.97	135.90	55.87	28.50	20.33	12.17
22	IR11A106	98.33	95.47	32.07	1.39	10.07	9.53	28.27	184.17	131.17	62.63	23.53	22.00	15.53
23	IR11A151	100.2	95.13	26.87	1.48	8.07	7.57	24.73	145.43	135.47	50.40	14.07	24.17	7.57
24	IR11A257	99.93	89.07	37.27	1.38	12.40	11.27	28.43	129.07	134.37	67.33	28.10	23.83	18.73
25	NDR359	100.7	99.40	33.57	1.40	13.24	9.80	24.63	162.67	129.03	50.70	45.40	22.33	22.92
	Mean	95.12	89.66	29.29	1.43	9.84	8.38	24.56	166.21	129.87	52.52	29.73	22.07	15.44
	Range Lowest	88.33	77.77	22.53	1.23	8.07	6.17	21.63	114.83	118.13	33.43	9.67	18.00	7.57
	Range Highest	108.0	99.40	37.60	1.65	13.24	11.27	28.43	262.67	140.50	71.10	53.33	30.33	22.92
	C.D. 5%	1.50	2.40	0.50	0.09	1.74	1.12	1.55	7.47	1.60	2.55	1.26	1.13	2.87
	C.V.	0.96	1.63	1.03	3.69	10.77	8.13	3.85	2.74	0.75	2.96	2.58	3.12	11.32

Table 3: Estimates of components of variance and Genetic parameters for different characters in rice

Sr. No.	Characters	VG	VP	GCV	PCV	h^2 (bs)%	GA	GA as %of mean
1	Days to 50% Flowering	23.03	23.87	5.05	5.14	0.96	9.71	10.21
2	Plant Height	24.24	26.37	5.49	5.73	0.92	9.72	10.85
3	Flag Leaf Length	13.57	13.66	12.58	12.62	0.99	7.56	25.83
4	Flag Leaf Width	0.01	0.01	7.37	8.24	0.80	0.19	13.57
5	Tillers/ Plant	1.46	2.58	12.27	16.33	0.56	1.87	19.01
6	Panicles/ Plant	1.43	1.89	14.27	16.42	0.75	2.14	25.53
7	Panicle Length	2.54	3.44	6.49	7.55	0.74	2.83	11.51
8	Spikelet's/ Panicle	2026.96	2047.68	27.09	27.23	0.99	92.27	55.52
9	Days to Maturity	23.92	24.86	3.77	3.84	0.96	9.88	7.61
10	Biological Yield	85.35	87.77	17.59	17.84	0.97	18.77	35.74
11	harvest Index	165.72	166.30	43.30	43.38	1.00	26.47	89.04
12	Test Weight	7.49	7.97	12.40	12.79	0.94	5.47	24.77
13	Seed Yield/ Plant	21.22	24.27	29.84	31.92	0.87	8.87	57.48

VG= Genotypic Variance, VP=Phenotypic Variance, GCV=Genotypic Coefficient of Variation,
PCV=Phenotypic Coefficient of Variation, h^2(bs)= Heritability (broad sense), GA= Genetic Advance

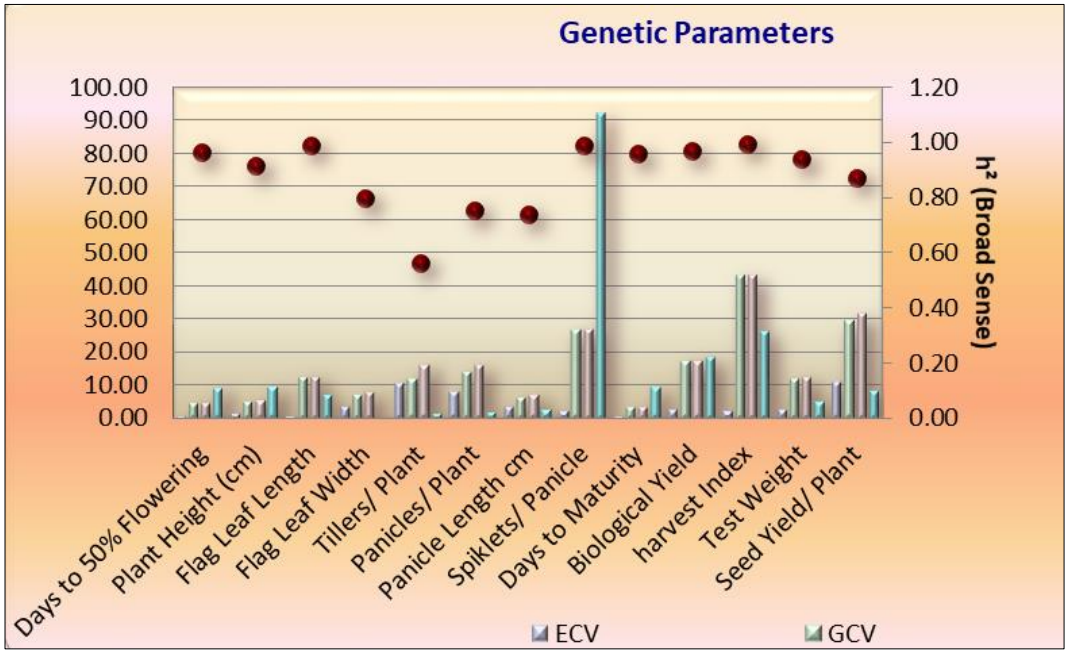

Fig 1: Histogram depicting GCV, PCV, Heritability and genetic advance for 13 quantitative characters in rice.

Table 4: Estimates of Genotypic correlation coefficient between yield and its related traits in 25 rice genotypes

Sr. No	Character	Days to 50% Flowering	Plant Height	Flag Leaf Length	Flag Leaf Width	Tillers/ Hill	Panicle/ Hill	Panicles Length	Spikelet's/ Panicle	Days to Maturity	Biological Yield	harvest Index	Test Weight	Seed Yield/ Hill
1	Days to 50% Flowering	1.00	0.29*	0.20*	0.08	0.35**	0.37**	0.22	0.07	0.75***	0.16	-0.06	0.16	0.04
2	Plant Height		1.00	0.68***	0.23*	0.27**	0.27**	0.02	-0.07	0.2	0.6	-0.44**	-0.03	-0.13
3	Flag Leaf Length			1.00	0.34**	0.39**	0.36**	0.32**	-0.14	0.24*	0.6	-0.33**	-0.02	-0.02
4	Flag Leaf Width				1.00	-0.42**	-0.39**	-0.31	0.05	0.25*	-0.08	-0.14	0.03	-0.07
5	Tillers/ Hill					1.00	0.91***	0.5	-0.1	-0.03	0.59***	0.09	0.29*	0.35
6	Panicle/ Hill						1.00	0.49**	-0.12	0.1	0.75***	-0.07	0.24*	0.22
7	Panicles Length							1.00	-0.17	0.09	0.27*	-0.09	0.45**	0.02
8	Spikelet's/ Panicle								1.00	-0.08	0.16	0.6	-0.08	0.65**
9	Days to Maturity									1.00	0.07	-0.19	0.11	-0.24*
10	Biological Yield										1.00	-0.19	0.13	-0.08
11	harvest Index											1.00	0.05	0.87
12	Test Weight												1.00	0.22
13	Seed Yield/ Hill													1.00

(*) & (**) represent significant levels at 5% and 1% respectively.

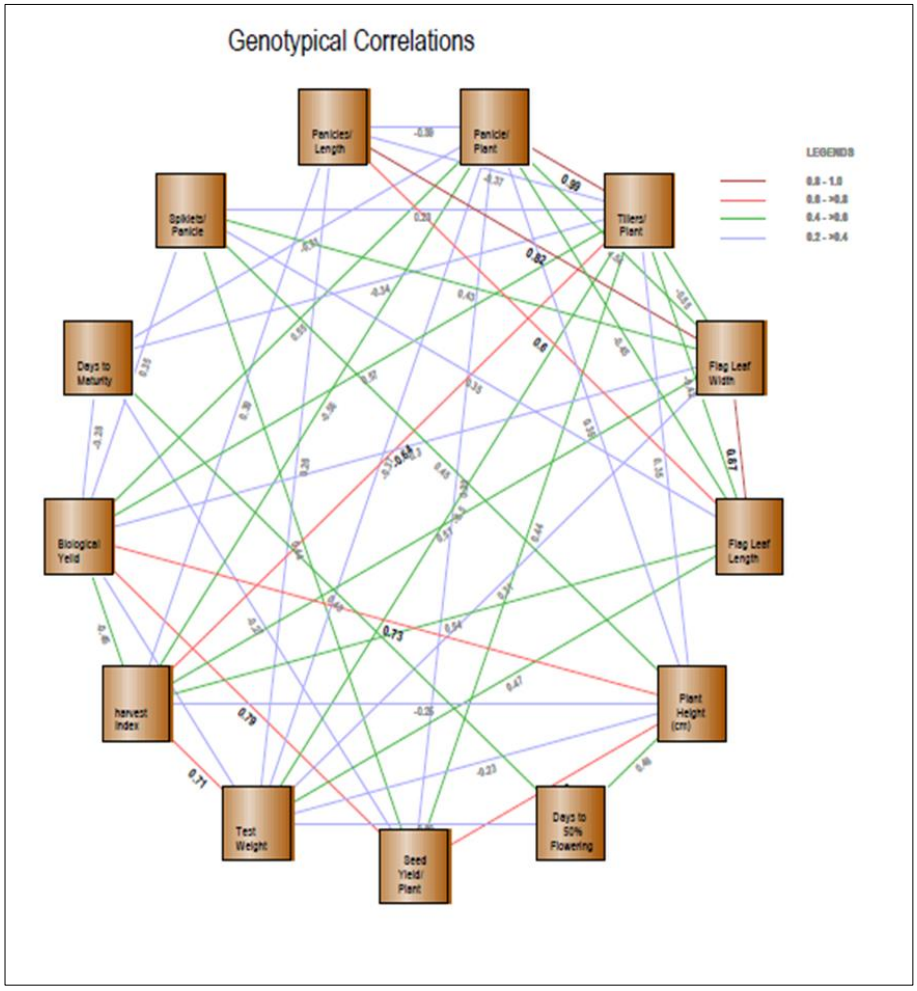

Fig 2: Genotypic Correlation diagram for yield and yield attributing characters

Table 5: Estimates of phenotypic correlation coefficient between yield and its related traits in 25 rice genotypes

Sr. No.	Characters	Days to 50% flowering	Plant height	Flag Leaf length	Flag Leaf width	Tillers/ hill	Panicles/ hill	Panicle length	Spikelet's / panicle	Days to maturity	Biological yield	Harvest index (%)	Test wt.	Grain yield/ hill
1	Days to 50% flowering	1.00	0.28*	0.20	0.07	0.27*	0.34**	0.17	0.07	0.73***	0.16	-0.06	0.15	0.01
2	Plant height		1.00	0.65***	0.19	0.15	0.22	0.03	-0.07	0.19	0.57***	-0.42***	-0.03	-0.12
3	Flag leaf length			1.00	0.30**	0.28**	0.31**	0.27*	-0.15	0.23*	0.60***	-0.33**	-0.02	-0.02
4	Flag leaf width				1.00	-0.23*	-0.25*	-0.22*	0.05	0.2	-0.08	-0.12	0.03	-0.09
5	Tillers/ hill					1.00	0.68***	0.35**	-0.06	0.01	0.42***	0.07	0.2	0.31**
6	Panicles/ hill						1.00	0.36**	-0.1	0.07	0.62***	-0.06	0.17	0.22
7	Panicle length							1.00	-0.14	0.08	0.26*	-0.09	0.35**	0.02
8	Spikelet's / panicle								1.00	-0.08	-0.16	0.60***	-0.08	0.60***
9	Days to maturity									1.00	0.07	-0.19	0.1	-0.21
10	Biological yield										1.00	-0.48***	0.12	-0.07
11	Harvest index											1.00	0.05	0.82***
12	Test weight												1.00	0.20
13	Grain Yield/ Hill													1.00

(*) & (**) represent significant levels at 5% and 1% respectively.

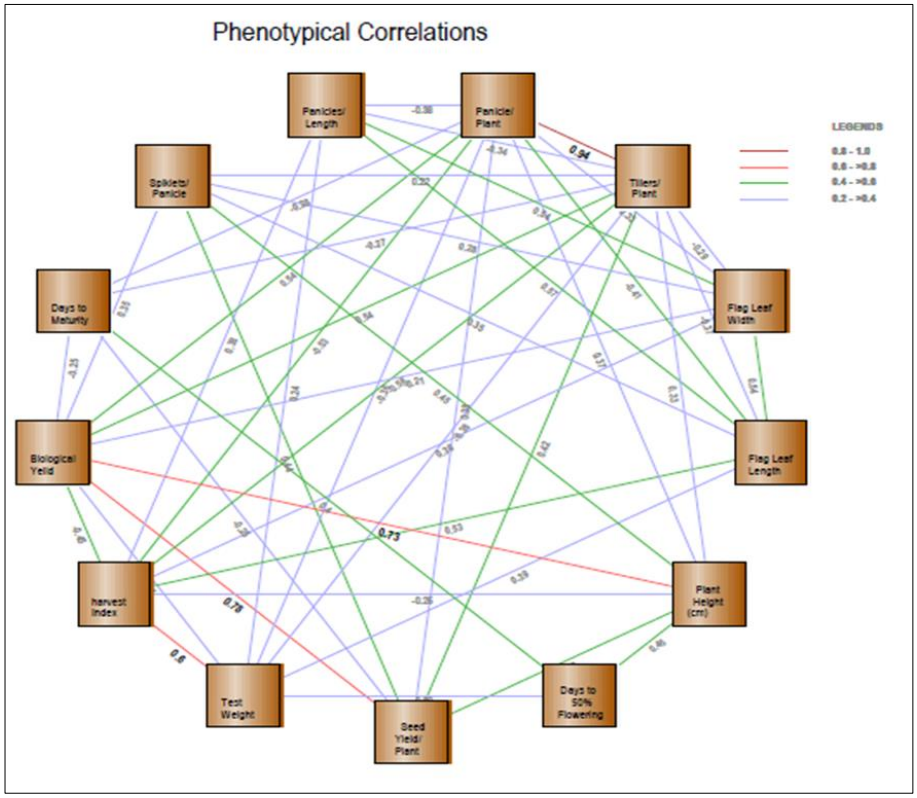

Fig 3: Phenotypic Correlation diagram for yield and yield attributing characters

References

1. Akinwale MG, Gregorio G, Nwilene F, Akinyele BO, Ogunbayo SA, Odiyi AC. Heritability and correlation coefficient analysis for yield and its components in rice (*Oryza sativa* L.). African Journal of Plant Science. 2011; 5(3):207-212.
2. Anjaneyulu M, Reddy DR, Reddy KHP. Genetic variability, heritability and genetic advance in rice (*Oryza sativa* L.). Research on Crops. 2010; 11(2):415-416.
3. Bhandru D, Reddy DL, Ramesha MS. Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines. Electronic Journal. of Plant. Breeding. 2010; 2:1, 112-116.
4. Burton GS, Devance EW. Estimating heritability in tall fescue from replicated clonal material. Agronomy Journal. 1953; 45:474-481.
5. Fisher RA. The correlation between relative on supposition of mendelian inheritance. Royal Society of Edinburgah. 1918; 52:399-433.
6. Jayasudha S, Deepak Sharma. Genetic parameter of variability for yield and physiological traits in rice (*Oryza sativa* L.). Electronic Journal of Plant Breeding. 2010; 1(5):1332-1338.
7. Johanson HW, Robinson HF, Comstock RE. Estimates of genetic variability in soybean. Agronomy Journal. 1955; 47:314-318.
8. Juliano BO. Criteria and tests for rice grain qualities. Rice chemistry and technology, 2nd edition, American association of cereal chemists, 1985, 443-524.
9. Lush JL. Heritability of quantitative characters in farm animals. Proc. 8th International P. P. Congress Genetic Heriditus (Supply Volume), 1949, 356-375.
10. NRRI. Annual report of national rice research institute, 2018, 08-09.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers (2nd Ed.), ICAR Publication, New Delhi, 1957.
12. Thiyagarajan TM, Selvaraju R. Water saving in rice cultivation in India. In: proceedings of an international workshop on water saving rice production systems. Nanjing University, China, 2001, 15-45.