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Genotypes by environment interactions and stability of grain yield to high temperature stress in rice (*O. sativa* L.)

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Abstract
Genetic stability is considered one of the most important genetic tests used to as certain the extent of genetic stability reached in plants; consequently, the goal of this research is to detect the degree of genetic stability of a group of a superior rice lines under different environments. Eighty rice genotypes including seven checks were subjected to pooled analysis of variance for four characters *viz*. days to 50% flowering, filled grains per panicle, spikelet fertility per panicle and grain yield per plant. The pooled analysis of variance indicated significant variation among the Environments, Genotypes and Genotype x Environment interaction for all the characters studied. It indicates that there is significant variation among genotypes, which can be further studied for their interaction with different environments to identify for their suitability for cultivation. Analysis of variance of stability parameters revealed that the mean squares due to genotypes were significant for all the characters. The mean sums of squares for Genotype × Environment interactions in pooled analysis were found significant for all the characters studied. This suggested that the genotypes under study had reacted differently to the environments for grain yield per plant and other yield related characters. Stability parameters indicated that the genotypes had high grain yield per plant were Dadhmaini Dhan, Barhasaal, RJR:II, Gangtai, Indira Barani Dhan 1 and Ajam Dhan were below average stable and Ganga Dhan was above average stable genotype, they are suitable for cultivation in poor or unfavourable and rich or favourable environments respectively. For days to 50% flowering, Kakai, Dhanbanko, Nagina 22, IR 42253 were below average stable, Lallu, Jhular and Lallu 14 and NPT 26 were above average stable and Barhi was average stable genotype, For filled grains per panicle IR-64, Bhejari, Gangtai and Bhatamokdo were below average stable, Nagina 22, Samleshwari and Indira Aerobic 1 were above average stable genotypes. For spikelet fertility Jodhari, IR-64 and Safri were below average stable, Nagina 22, Kadam phool, Indira Aerobic 1 and Samleshwari were above average stable and Bankadi was average stable genotype, they are suitable for cultivation in poor, rich and average (rich and poor both) environments respectively.

Keywords: *Oryza sativa*, stability, genotype, environment

Introduction
Rice is the most important and extensively grown staple food crop, accounting for 43% of the total food grain in the country. In 2018 global temperature was 1.06 °C (1.90°F) above that baseline (NOAA National Climatic Data Centre, 2019). Global climate change is likely to increase the current vulnerability of the crop to climate, with a projected global average surface temperature increase of 1.4 – 5.8 ºC by 2100.It has been revealed 7-8% rice yield decline for each 1 °C increase in daytime temperature from 28 °C to 34 °C (Baker *et al.*, 1992). The decline in grain yield and quality of rice grown under heat stress condition has become a trouble for rice cultivation. An average yield loss (about 20%) was recorded among the genotypes with 3.6 ºC increase in temperature at the reproductive stage (Sutradhar, 2013) [13]. Yield is a complex quantitative character and is greatly influenced by environmental fluctuations specially date of sowing, pollen fertility was reduced with increasing temperature, identify the promising cultivars and optimum date of sowing for enhancing higher productivity of heat stress condition in rice.

An information on Genotype x Environment (G x E) interaction leads to successful evaluation of stable genotype, which could be used for general cultivation. Thus, evaluation of genotypes for stability of performance under varying environmental conditions for yield has become an essential part of any breeding programme. An understanding of the causes of genotype x environment interaction can help in identifying traits and environments for better cultivar evaluation. For developing stable varieties, some stability parameters for which Finlay and Wilkinson (1963) [7], Eberhart and Russell (1966) [6] have given some models and have been used in the search for an understanding of the causes of G x E interaction. Development of rice varieties with high yield and desirable grain quality for different environments is one of the

exciting research leads to successful evaluation of stable genotype, which could be used for general cultivation in summer rice cropping. Therefore, the present investigation was carried out, identifying stable genotypes with high yield using Eberhart and Russell model.

Materials and Methods

Field study were conducted with a set of eighty seven rice genotypes in randomized block design with two replications of three different dates of sowing at 10 days interval *viz*., 27 December (E1), 7 January (E2) and 17 January (E3) during Rabi 2017 at Research cum Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G). All the recommended agronomic cultural practices were followed. The study was based on four quantitative characters *viz* days to 50% flowering, filled grains per panicle, spikelet fertility per panicle and grain yield per plant. Data from the three environments and the pooled data are subjected to analysis of variance (Panes and Sukhatme, 1967) [10]. The traits which showed the significant G×E interactions were subjected to stability analysis using the Eberhart and Russell (1966) [6] model. As per the model, three parameters *viz*.**,** overall mean performance of each genotype across the environments, the regression of each genotype on the environmental index (bi) and squared deviation from the regression (S^2di) were estimated. The significance of stability parameters and deviations from unity were tested by student't' test.

Results

Eighty rice genotypes including seven checks were subjected to pooled analysis of variance for four characters *viz*., days to 50% flowering, filled grains per panicle, spikelet fertility per panicle and grain yield per plant. The pooled analysis of variance (Table 1) indicated significant variation among the Environments, Genotypes and G x E interaction for all the characters studied. It indicates that there is significant variation among genotypes, which can be further studied for their interaction with different environments to identify for their suitability for cultivation. The significance of G x E interaction suggests that genotypes behaved differently in different environment. Similar kind of results earlier reported by similar finding were reported by Biswas *et al.* (2011) [3], Lal and Singh (2012) [8], Tariku *et al.* (2013) [14] and Ajmera *et al.* (2017) [1].

Genotype and environment components showed significant and highly significant differences for all the characters, when tested against pooled error and pooled deviation. The Env. + (Varieties X Env.) interaction showed significantly differences for all the characters, when tested against pooled error and pooled deviation, except for the characters filled grains per panicles and spikelet fertility when tested against pooled deviation (Table 2). Environment (linear) component for all the characters found significant when tested against pooled error and pooled deviation**.** It indicates difference between the environments and their influence on genotypes for expression of these characters. Similar finding were reported by Das *et al*. (2010) [4]. The Genotype x Environment (linear) interaction was significant for all characters when tested against pooled error and pooled deviation. This indicated significant differences among the genotypes for linear response to environments behaviour of the genotypes could be predicted over environments more precisely and G X E interaction was outcome of the linear function of environmental components. Hence, prediction of performance of genotypes based on stability parameters would be feasible and reliable. The similar results confirmed the findings of Das *et al*. (2010) [4] and Dushyantha Kumar *et al*. (2010) [5] and Ajmera *et al.* (2017) [1]. In the present study, three parameters viz., mean (x), regression coefficient (bi) and deviation from regression (S^2di) using the model proposed by Eberhart and Russell (1966) [6] has been presented in Table 3.

Days to 50% flowering

Days to 50% flowering ranged from 52 (Kakai) to 89 days (P:357 III) with population mean of 66 days.

Stability parameters indicated that the genotypes had early flowering were Kakai (52 days), Dhanbanko (55 days), Nagina 22 (57 days), IR 42253 (58 days) with below average stability (bi>1) and non-significant deviation from regression line, therefore, this genotype was found to be suitable for rich or favourable environment through its performance was predictable.

Genotypes had early flowering were Lallu (52 days), Jhular (58 days) and Lallu 14 (59 days) and NPT 26 (60 days), with above average stability (bi<1) and non-significant deviation from regression line, therefore, its performance was predictable and it could perform better under poor or unfavorable environment.

Stability parameters indicated that the genotypes had early flowering were Barhi (62 days) with it showed average stability near to unit regression and non-significant deviation from regression line, thus found to be best desirable and stable genotype over the environment (rich and poor) and indicating predictable performance.

Filled grains per panicle

The filled grains per panicle ranged from 51.08 (Aarmoti) to 184.93 (Digambar dhan) with population mean of 99.95.

Stability parameters indicated that the genotypes had high filled grains per panicle were IR-64 (156.4), Bhejari (143.11), Gangtai (134.7) and Bhatamokdo (132.3) with below average stability (bi>1) and non-significant deviation from regression line, therefore, this genotype was found to be suitable for favourable environment through its performance was predictable.

Genotypes had high filled grains per panicle were Nagina 22 (175.53), Samleshwari (142.52) and Indira Aerobic 1 (123.88), with above average stability (bi<1) and non-significant deviation from regression line, therefore, its performance was predictable and it could perform better under poor environment. None of the genotype was found to be stable over the environment.

Spikelet fertility (%)

The spikelet fertility ranged from 43.85% (Khurabal) to 96.41% (Nagina 22) with population mean of 76.15%.

Stability parameters indicated that the genotypes had high spikelet fertility were Jodhari (89%), IR-64 (86.66%) and Safri (86.55%), with below average stability (bi>1) and non-significant deviation from regression line, therefore, this genotype was found to be suitable for favourable environment through its performance was predictable.

Genotypes had high total grains per panicle were Nagina 22 (96.41%), Kadam phool (90.47%), Indira Aerobic 1 (90%) and Samleshwari (89.91%), with above average stability (bi<1) and non-significant deviation from regression line, therefore, its performance was predictable and it could perform better under poor environment.

Stability parameters indicated that the genotypes had high total grains per panicle was Bankadi (87.19%), with it showed near to unit regression and non-significant deviation from regression line, thus found to be stable over the environment and indicating predictable performance.

Grain yield per plant (g)

The grain yield per plant ranged from 11.03g (Banko) to 36.72g (Dadhmaini Dhan) with population mean of 19.68g.

Stability parameters indicated that the genotypes had high grain yield per plant were Dadhmaini Dhan (36.72 g), Barhasaal (30.59 g), RJR:II (30.15g), Gangtai (28.85g), Indira Barani Dhan 1 (27.45 g) and Ajam Dhan (26.17g), with below average stability (bi>1) and non-significant deviation from regression line, therefore, this genotype was found to be suitable for favourable environment through its performance was predictable.

Genotypes had high grain yield per plant was Ganga Dhan (25.06g), with above average stability (bi<1) and non-significant deviation from regression line, therefore, its performance was predictable and it could perform better under poor environment. Similar results were finding by Rasyad *et al.* (2012) [11], Subudhi *et al.* (2012) [12] Lal and Singh (2012) [8], Tariku *et al.* (2013) [14] and Ajmera *et al.* (2017) [1]. None of the genotype was found to be stable over the environment. It indicates there are no any genotypes that can give stable yield performance in three different environments.

Table 1: Pooled analysis of variance for grain yield and yield contributing traits in rice genotypes

Source of variation	Degree of freedom	Days to 50% flowering (days)	Filled grains per panicle (No.)	Spikelet fertility (%)	Grain yield per plant (g)
Varieties	86	436.07**	4914.48**	639.49**	58.08**
Environments	2	6375.04**	2883.88**	472.81**	101.13**
Varieties X Environment	172	20.63**	532.70**	188.40**	11.38**
Pooled Error	261	1.14	77.98	32.42	4.87

* & ** at 5% and 1% level of significance, respectively.

Table 2: Analysis of variance of Eberhart and Russell model (1966) [6] for stability analysis

Source of variation	Degree of freedom	Days to 50% flowering (days)	Filled grains per panicle (No.)	Spikelet fertility (%)	Grain yield per plant (g)
Varieties	86	218.04**@@	2457.24**@@	319.75**@@	114.55*@@
Environment	2	3187.52**@@	1441.94*@	236.40*@@	103.73**@@
Env. + (Varieties X Env.)	174	46.83**@@	279.86**	95.84**	22.86**@
Environment (linear)	1	6375.04**@@	2883.88**@@	472.81*@@	207.46**@@
Varieties X Env. (linear)	86	14.81**@@	314.89*@	116.99**@@	27.87**@@
Pooled Deviation	87	5.75**	215.31**	70.59**	15.79**
Pooled Error	261	0.57	38.99	16.21	3.78

*, ** Significance at 5 percent and 1 percent level of significance respectively when tested against pooled error

@, @@ Significance at 5 percent and 1 percent level of significance respectively when tested against pooled deviation

Table 3: Mean performance and stability parameters for yield and yield contributing traits of 87 Rice (*Oryza sativa* L.) genotypes

S. No	Genotype	Days to 50% flowering (days)			Filled grains per panicle (No.)			Spikelet fertility (%)		
		Mean	bi	S²di	Mean	bi	S²di	Mean	bi	S²di
1	Aerra Mindo	53.67	1.05*	-0.42	69.87	2.25*	-38.30	68.31	6.00	-15.53
2	Aarmoti	52.17	0.69	7.75**	51.08	-1.67	-37.43	71.42	9.51	95.98**
3	Barhi	61.83	0.90	0.80	73.98	2.43	-14.40	75.71	5.28	-1.43
4	Batri (II)	53.83	0.79	4.39**	63.83	-3.85	667.07**	78.77	-8.10	-12.24
5	Dehura Baya	52.83	0.33*@	-0.54	71.49	-0.94	11.55	70.18	-4.72	-14.34
6	Dokra Mechha	58.00	1.01	25.41**	88.95	7.03	33.81	68.93	10.59	96.20**
7	Mal do kalam	56.33	0.65	6.26**	71.15	-3.78	60.82	76.49	-3.99	86.62*
8	Hirikani	56.50	0.58	20.70**	102.03	1.36	-36.71	76.50	3.66	-12.54
9	Jholar	61.00	0.10	20.18**	87.95	1.75	119.47*	85.94	3.19	-15.95
10	Jhular	58.00	0.35	0.97	88.25	0.31	346.74**	73.83	-1.94	71.93*
11	Kadam Phool	58.00	0.32	5.39**	99.18	-1.79	1056.54**	68.65	1.56	313.54**
12	Kadam Phool	63.17	0.39	0.67	94.83	1.31	136.13	90.47	0.48	-16.21
13	Kakai	51.83	1.06	1.55	110.53	0.61	198.87*	68.93	-2.40	-4.27
14	Kali Muchh	61.83	0.60	-0.21	97.38	-1.47	800.61**	67.01	2.48	507.39**
15	Lallu	52.00	0.62	-0.35	53.60	0.35	2.65	83.82	3.73	51.60*
16	Lallu 14	58.67	0.81	3.09	88.78	2.05	325.06**	79.19	2.28	173.98**
17	Local	54.17	0.29	11.27**	60.71	0.28	-33.38	70.18	0.27	84.55*
18	No.16	53.33	0.55	3.20	47.91	-0.54	11.89	87.47	2.61	17.94
19	RJR:II	65.83	1.15	4.01**	117.48	3.85	156.09*	85.64	3.84	-15.58
20	OSSR: 181 III	59.83	0.14	0.61	65.74	0.55	70.42	67.36	6.72	-5.85
21	Ajawain	63.00	1.36	3.37**	115.88	-0.97	-31.48	87.38	0.37	-11.91
22	VishunBhog	59.83	0.82	0.14	77.95	3.87	-11.99	79.05	5.46	69.09*
23	Anjaniya	64.17	1.40*@	-0.51	87.04	-0.30	152.78*	83.64	-3.31	42.14
24	Baikoni	67.33	1.17	1.59	90.57	1.28	577.88**	76.85	-1.59	96.05**
25	Baikoni	65.50	1.06	2.98	95.48	0.23	-38.23	85.99	-0.62	-14.59
26	Bankal	53.50	1.62	7.59**	70.07	-2.12	96.82	72.62	-0.22	74.73*

27	Bakhiya	53.83	1.17	4.59**	79.27	-2.78	96.25	51.98	-2.79	-14.12
28	Banskupi	71.83	0.98	9.57**	72.91	2.77*@	-38.32	77.14	4.87	-12.78
29	Banspatri	64.00	1.27*	-0.51	98.76	-0.57	-38.22	85.72	0.02	-16.01
30	Bankari	67.83	0.91	6.03**	99.76	-2.54	31.37	71.46	-5.58	153.13**
31	Bankadi	70.67	1.13	1.23	119.08	1.53	102.14	87.19	0.95	-15.13
32	Chingar Bnko	67.33	1.47*@	-0.48	101.67	-0.43	402.22**	82.62	0.48	200.85**
33	Shiv dharohar-4	76.50	0.76	2.61	96.79	1.40	117.15*	82.07	0.27	44.58
34	Safri	72.67	0.56	-0.35	116.07	2.28	181.22*	86.55	4.51	63.41*
35	Ganga kali	69.67	0.80	2.77	115.49	3.33	2278.80**	71.05	5.74	83.51*
36	Bhurkund	74.33	0.74	7.58**	94.37	0.34	-29.00	72.80	-0.18	8.99
37	Gangtai	77.33	0.56	13.96**	134.70	1.83	-35.84	85.04	2.09	-11.67
38	90 Number	72.17	1.05	-0.42	100.98	-0.83	0.28	74.07	-0.58	35.72
39	Dadbako	72.00	1.22	1.98	119.03	-0.28	126.55*	89.33	-1.97	2.67
40	Gangtaidhan	72.17	1.40*@	-0.51	89.05	1.90	-15.90	69.83	1.13	1.33
41	Ganga dhan	65.50	0.57	0.43	108.97	4.16	-35.93	83.85	5.64	-13.66
42	Tendhumoridhan	69.17	1.51	1.11	133.12	0.22	319.08**	79.72	-1.80	110.10**
43	Ajam dhan	63.67	1.37	0.34	110.40	0.31	-32.90	82.33	-0.32	-5.35
44	Bhatamokdo	72.00	1.32	0.61	132.63	3.82	19.03	75.11	2.98	34.16
45	Safed Lalak	87.50	0.70	-0.19	118.97	2.96	-38.70	74.16	4.84	-13.35
46	Tewandhan	67.33	1.20*	0.07	140.05	6.90	985.91**	81.95	7.52	-4.25
47	Hajar Khunta	59.50	0.93	49.99**	90.03	1.36	-26.02	82.24	0.67	-6.08
48	Sindursaal	55.83	0.69*	-0.36	81.03	-3.00	379.13**	66.36	-4.54	257.03**
49	Kolhinkhosa	68.33	0.93**@	-0.57	109.75	1.56	325.63**	77.50	0.00	83.41*
50	Neta Kalani	65.83	0.88	1.31	77.99	-5.81	54.38	60.62	-10.13	-12.11
51	Dadhmainidhan	76.50	0.70	-0.19	113.28	4.96	170.87*	75.87	4.60	-2.61
52	Digamberdhan	70.83	0.85*	-0.54	184.92	-1.74	2035.85**	91.76	-0.64	-1.81
53	Harikhuntadhan	83.67	0.37	10.31**	107.18	2.33	-10.56	79.78	2.05	-0.72
54	Damru Baba-3	85.50	0.33	9.48**	87.07	3.78	145.98*	84.82	5.65	97.21**
55	Jeera Baba	74.17	1.04	4.52**	126.60	7.27	-15.12	74.51	6.65	16.76
56	NPT 6	71.67	2.11	72.12**	150.73	5.36	723.81**	85.22	3.21	167.39**
57	NPT 8	60.67	1.83*	-0.04	88.33	1.18	-11.42	85.86	1.33	-14.42
58	NPT 9	61.33	-0.10@	-0.14	69.77	-3.13	145.82*	60.90	-4.76	351.37**
59	NPT 11	64.33	1.57	8.34**	82.06	2.20	183.19*	80.76	3.63	251.88**
60	NPT 19	69.00	1.03	5.96**	128.00	4.95	-19.19	76.57	2.24	-0.16
61	NPT 26	59.83	1.63	5.46**	112.63	6.40	279.70**	66.95	5.83	37.91
62	IR 42253	58.00	1.38	1.15	54.27	-2.71	-33.58	77.39	-0.94	-11.59
63	NPT 12	69.00	1.11*	-0.28	86.46	-0.02	129.86*	82.77	0.36	23.15
64	NPT 6	69.17	1.26**@	-0.55	106.35	5.77	453.72**	75.09	8.89	45.26
65	SL 14.11	69.50	1.27	2.03	72.86	-4.96	54.01	71.30	-10.88	-1.64
66	SL 14.16	62.00	0.84*	-0.52	72.01	4.55	655.49**	54.75	8.55	144.76**
67	SL 14.19	67.33	1.80	21.90**	75.99	-2.39	-1.71	60.74	-3.83	-14.60
68	Barhasal	66.17	1.32*	-0.42	112.72	3.22*@	-38.95	75.11	3.86	-7.20
69	SitasaalDhan	65.17	1.18	2.93	120.20	2.11*@	-38.75	76.81	1.39	-16.15
70	Dan Banko	55.33	1.47	1.89	68.93	-1.41	172.65*	57.54	-1.75	186.66**
71	Jodhari	68.50	1.08*	-0.14	95.60	2.12	-28.34	89.01	3.68	-8.59
72	Jugsay	60.67	1.05*	-0.42	121.08	5.94	377.06**	72.42	5.73	385.11**
73	Bega hundi	70.50	0.80	26.15**	117.03	0.69	196.29*	83.23	3.75	49.78
74	Anjaniya	84.67	0.29	4.14**	102.85	0.79	-33.38	79.19	0.82	-10.56
75	Banko	63.17	0.81	13.75**	70.22	-5.47	-6.73	50.42	-9.73	-16.19
76	Bhejari	67.00	1.65	2.17	143.11	3.35	23.65	77.41	0.96	92.17*
77	Ganga Puriha	69.50	1.18	10.60**	72.04	-4.89	35.82	56.97	-9.21	213.95**
78	Khurabal	64.50	1.54*	0.14	58.64	-2.84	-19.90	43.85	-6.69	-4.44
79	Nagbel	73.83	1.25*	-0.28	117.57	3.86	194.43*	77.18	3.58	167.11**
80	P:357 III	88.83	0.41@	-0.47	67.04	-4.92*@	-37.21	54.39	-10.38	-16.07
81	NAGINA 22	56.67	1.07	0.09	175.53	0.34	11.91	96.41	0.15	-12.25
82	Swarna	86.33	1.74	1.39	128.37	7.64	9.00	64.32	9.85	67.50*
83	Indira Barani Dhan 1	68.00	0.97	12.28**	140.51	2.23*@	-38.82	84.77	1.98	-15.99
84	MTU 1010	66.33	1.82	1.81	160.52	5.26**@@	-38.80	83.36	1.83	-10.13
85	Samleshwari	67.83	1.31	2.87	142.52	-0.57	-29.87	89.91	-2.64	-10.83
86	IR-64	70.33	1.52*@	-0.52	156.40	2.41	70.79	86.66	2.98	-4.55
87	Indira Aerobic 1	66.83	1.61	3.25	123.88	0.84	-38.91	90.20	-0.07	17.74
Population mean			65.81			99.95			76.15	
CD 5%			4.72			28.89			16.54	
SE mean			1.70			10.38			5.94	

S. No	Genotype	Grain yield per plant (g)		
		Mean	bi	S²di
1	Aerra Mindo	19.74	-0.54	0.53
2	Aarmoti	13.92	1.36	-0.32
3	Barhi	16.64	-4.73*@	-3.59
4	Batri (II)	17.11	3.69	5.44
5	Dehura Baya	14.22	1.91	20.20*
6	Dokra Mechha	16.8	-0.94	81.78**
7	Mal do kalam	14.6	2.23	5.15
8	Hirikani	16.61	1.62	8.97
9	Jholar	16.08	0.09	-3.51
10	Jhular	14.45	-0.07	53.88**
11	Kadam Phool	17.41	0.49	33.88**
12	Kadam Phool	11.41	-0.52	46.30**
13	Kakai	20.41	-1.07	-2.6
14	Kali Muchh	18.11	2.76	26.00**
15	Lallu	11.94	-0.15	-2.54
16	Lallu 14	13.81	-3.52	25.27**
17	Local	11.76	0.26	-3.53
18	No.16	21.09	1.06	-1.6
19	RJR:II	30.15	-1.65	-3.47
20	OSSR: 181 III	15.8	-0.18	-1.05
21	Ajawain	27.59	3.27	-2.23
22	Vishun Bhog	13.22	-2.75	8.79
23	Anjaniya	16.46	-0.21	22.00**
24	Baikoni	17.78	-1.1	23.86**
25	Baikoni	20.93	-1.16	3.19
26	Bankal	11.84	3.23	1.06
27	Bakhiya	16.27	2.1	16.60*
28	Banskupi	13.78	-0.4	-1.88
29	Banspatri	24.28	-1.15	39.27**
30	Bankari	19.01	1.67**@@	-3.78
31	Bankadi	20.93	1.24	2.83
32	Chingar Bnko	29.38	1.24	20.19*
33	Shiv dharohar-4	21.71	3.80*	-3.67
34	Safri	22.93	1.9	2.38
35	Ganga kali	29.73	-0.97	121.24**
36	Bhurkund	22.43	6.54	69.27**
37	Gangtai	28.85	5.17	7.51
38	90 Number	24.68	6.67	14.67*
39	Dadbako	27.07	6.24*@	-3.52
40	Gangtaidhan	14.08	-0.24	-0.89
41	Ganga dhan	25.06	-0.17	-3.41
42	Tendhumoridhan	23.48	6.58	23.93**
43	Ajam dhan	26.17	2.65	-3.12
44	Bhatamokdo	24.43	-1.30@	-3.68
45	Safed Lalak	24.47	0.07	24.25**
46	Tewandhan	29.23	-7.64	10.79
47	Hajar Khunta	14.33	1.66*@	-3.78
48	Sindursaal	20.45	6.42	18.20*
49	Kolhinkhosa	21.45	-4.68	-2.61
50	Neta Kalani	25.64	9.47	14.69*
51	Dadhmainidhan	36.72	-3.51	10.75
52	Digamberdhan	24.84	4.71	21.14*
53	Harikhuntadhan	12.23	-0.82*@	-3.78
54	Damru Baba-3	11.83	-0.92	4.79
55	Jeera Baba	28.08	-4.53	19.02*
56	NPT 6	29.36	2.09	11.60*
57	NPT 8	19.23	2.15	21.90**
58	NPT 9	18.45	3.79	-3.19
59	NPT 11	14.77	1.96	-2.85
60	NPT 19	23.18	-5.66	-1.52
61	NPT 26	27.99	-5.08	-2.7
62	IR 42253	13.88	4.43	-3.06
63	NPT 12	18.56	1.24	10.84
64	NPT 6	26.43	-6.51	5.87
65	SL 14.11	12.34	4.67**@@	-3.77
66	SL 14.16	13.86	-1.68	16.51*
67	SL 14.19	18.18	1.98	31.33**

68	Barhasal	30.59	-1.49	-2.01
69	Sitasaal Dhan	17.96	-2.3	-2.61
70	Dan Banko	17.32	1.96	14.97*
71	Jodhari	13.65	-1.56	7.21
72	Jugsay	22.38	-4.42	100.87**
73	Bega hundi	21.69	-1.54	5.54
74	Anjaniya	11.67	0.43	-3.52
75	Banko	11.03	3.34	-2.05
76	Bhejari	12.02	-0.87	-3.16
77	Ganga Puriha	14.72	4.73	-3.41
78	Khurabal	13.53	2.01	-3.01
79	Nagbel	17.92	-1.35	37.66**
80	P:357 III	11.56	2.6	0.29
81	NAGINA 22	28.05	4.34*@	1.23
82	Swarna	20.77	1.35	-2.48
83	Indira Barani Dhan 1	27.45	5.49	6.32
84	MTU 1010	25.81	7.42	10.92*
85	Samleshwari	25.67	6.08	10.84
86	IR-64	23.06	6.92	14.86*
87	Indira Aerobic 1	25.99	5.29	25.64**
Population mean		19.68		
CD 5%		7.82		
SE mean		2.81		

* & ** at 5% and 1% level of significance, respectively.
@&@@ for b=1 at 5% and 1% level of significance, respectively

Summary
Genotype × environment interaction was observed to be significant for all characters under study. Highly significant G × E interaction for most of the characters indicated its significant portion due to linear component. Significant pooled deviation (non-linear) indicated considerable genetic diversity for the concerned traits. Among 87 genotypes for days to 50% flowering, Kakai, Dhanbanko, Nagina 22, IR 42253 were below average stable, Lallu, Jhular and Lallu 14 and NPT 26 were above average stable and Barhi was average stable genotype, they are suitable for cultivation in poor, rich and average (rich and poor both) environments respectively. For filled grains per panicle IR-64, Bhejari, Gangtai and Bhatamokdo were below average stable, Nagina 22, Samleshwari and Indira Aerobic 1 were above average stable genotypes. For spikelet fertility Jodhari, IR-64 and Safri were below average stable, Nagina 22, Kadam phool, Indira Aerobic 1 and Samleshwari were above average stable and Bankadi was average stable genotype. For grain yield per plant Dadhmaini Dhan, Barhasaal, RJR:II, Gangtai, Indira Barani Dhan 1 and Ajam Dhan were below average stable and Ganga Dhan was above average stable genotype.

References
1. Ajmera S, Kumar SS, Ravindrababu V. Studies on Stability Analysis for Grain Yield and its Attributes in Rice (*Oryza sativa* L.) Genotypes. Int. J Pure App. Biosci. 2017; 5(4):892-908.
2. Baker JT, Allen Jr LH, Boote KJ. Temperature effects on rice at elevated CO2 concentration. J Exp Bot, 43:959-964. Bangladesh. Int. J of Innovation and Applied Studies, 1992; 8(3):1329-1338.
3. Biswas PL, Barman HN, Ghosal S, Tohiduzzaan S, Hazrat Ali M. Stability study for growth duration and grain yield of exotic hybrid rice genotypes in Bangladesh. Bangladesh Journal of Agriculture Resource. 2011; 36(1):97-102.
4. Das S, Misra RC, Patnaik MC, Das SR. G x E Interaction, adaptability and yield stability of mid-early rice genotypes. Indian Journal of Agriculture Research. 2010; 44(2):104-111.
5. Dushyanthakumar BM, Shadadshari YG, Krishnamurthy SL. Genotype X Environment interaction and stability analysis for grain yield and its components in halugidda local rice mutants. Electronic Journal of Plant Breeding. 2010; 1(5):1286-1289.
6. Eberhart SA, Russell WA. Stability parameters for comparing varieties. Crop Science. 1966; 6:36-40.
7. Finlay KW, Wilkinson GN. The analysis of adaptation in a plant-breeding programme. PN, AAS, 1963, 169.
8. Lal M, Pal Singh D. Genotype X Environment interaction in rice. (*Oryza sativa.* L). Annals of Biology. 2012; 28(1):53-55.
9. Lal M, Pal Singh D. Genotype X Environment interaction in rice. (*Oryza sativa.* L). Annals of Biology. 2012; 28(1):53-55.
10. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR New Delhi. 2nd Edn. 1967, 381.
11. Rasyad A, Manurung GME, Van Sanford DA. Genotype x environment interction and stability of yield components among rice genotypes in Riau Province Indonesia, Journal of Breeding and Genetics. 2012; 44(1):102-111.
12. Subudhi HN, Bose LK, Singh ON, Rao GJN. Genotype x Environment interaction for grain yield and its component traits in irrigated rice. Madras Agriculture Journal. 2012; 99(4-6):178-180.
13. Sutradhar H. Effect of High Temperature on Floral Characteristics, Seed Set and Seed Quality in Parental Lines of Rice Hybrids. M.Sc. Thesis. Indian Agricultural Research Institute, New Delhi, 2013.
14. Tariku S, Lakew T, Bitew M, Asfaw M. Genotype by environment interaction and grain yield stability analysis of rice (*Oryza sativa* L.) genotypes evaluated in north western Ethiopia. Net Journal of Agricultural Science. 2013; 1(1):10-16.