

## Genetic Studies in Early Rice and Choice of Parents in Early Rice

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### Abstract

The experiment comprised 22 rice genotypes including the check Prabhat and were sown in three replications in *kharif* of 1999. Nine characters were included in the study to estimate extent of genetic variability and character association to evaluate direct and indirect effects including selection indices and effect of different season on the genotypes. ANOVA revealed the existence of variability amongst the experimental materials for all the nine characters. For most of the characters low to moderate GCV was observed. Grain yield exhibited high degree of positive correlation and high positive direct effect with number of fertile grain per panicle, leaf area and thousand grain weight in *kharif* season. Selection indices can be constructed on the basis of all the characters under study for grain yield and entries viz. ES-18-11-2-17-1-1-2-1, RAU 1345-1-2-1-1, IR 56383-77-1-1, Turanta and Prabhat were found to be high yielder. **Key words :** Genetic study, Early rice, Parents.

Rice is most important cereal crop of Bihar. More than 70% of the total rice area comes under rainfed low land condition, which remains flooded for 2—3 months. Farmers are unable to have the good harvest of rice even though they are dependent for their 90% calories requirements only from rice. Therefore, there is a great need to have a good and assured harvest of rice only from upland and midland ; which comprises about 30% of the area. For obtaining higher productivity from any ecosystem, genetic improvement is required. The knowledge on the nature and magnitude of genetic variation governing the quantitative characters like yield and its components is essential for formulating effecting genetic improvement program. Keeping these in view the present experiment was conducted during *kharif* of 1999 with 22 early rice genotypes including the check Prabhat.

### Methods

The experiment was carried out at the Research Farm of Rajendra Agricultural University, Bihar, Pusa, during *kharif* of 1999. The experimental material comprised 22 genotypes of rice including the check Prabhat. The experiments material comprised 22 genotypes of rice including the check Prabhat. The experiments were conducted in randomized complete block design with three replication. Data of the five ran-

domly selected plants were recorded for the characters viz. number of tillers per hill, days to 50% flowering, plant height, panicle length, number of fertile grain per panicle, number of sterile grain per panicle, flag leaf area, 1,000-grain weight and the data were analyzed the following the methods given by Panse and Sukhatme (1) for ANOVA and correlation path were analyzed following the methods given by Wright (2), Dewey and Lu (3).

### Results and Discussion

All the genotypes showed significant differences for all the characters (Tables 1—12). Number of tiller per hill varied from 5.25 (Boro 3-II-B-8-1) to 9.78 (ES 29-3-3-1) with the general mean of  $7.83 \pm 0.47$ . None of the genotypes was found to be significantly superior to the check Prabhat (9.72) in *kharif*. Days to 50% flowering varied from 49.66 (Heera) to 93.66 days (Boro 5-IB-6-3-3-4-1-1-1) along with general mean of  $64.85 \pm 0.28$  in *kharif*. The trait plant height (cm) ranged from 62.66 (RAU 1345-2) to 113.00 cm (Boro 5-IB-6-3-3-4-1-1-1) with the general mean of  $83.04 \pm 5.75$ . Only one genotype RAU 1345-2 (62.66 cm) was found to be dwarfier than the dwarf check Heera (73.86 cm) in *kharif*.

Pannicle length varied from 13.93 (RAU 1344-3-2) to 29.63 cm (Boro 5-1B-6-3-3-4-1-1-1) with the

**Table 1.** Analysis of variance for nine characters in *kharif* and *boro* season and pooled.

Sources of variation/characters		Mean sum of square		
		Replication (df = 2)	Treatment (df = 21)	Error (df = 42)
<b><i>Kharif</i> Season</b>				
1.	No. of tiller per hill	2.57	4.80**	0.67
2.	Days to 50% flowering	2.17	279.77**	0.25
3.	Plant height (cm)	90.16	325.71**	99.45
4.	Panicle length (cm)	3.44	25.89**	4.97
5.	No. of fertile grains per panicle	24.45	427.53**	19.55
6.	No. of sterile grains per panicle	14.90	922.09**	9.06
7.	Leaf area (cm <sup>2</sup> )	3.79	52.04**	2.34
8.	Thousand grain weight (g)	0.47	38.02**	0.21
9.	Grain yield (q/ha)	73.14	77.09**	13.92
<b><i>Boro</i> Season</b>				
1.	No. of tillers per hill	0.51	18.04**	2.25
2.	Days to 50% flowering	2.81	339.54**	1.63
3.	Plant height (cm)	1.25	343.88**	12.47
4.	Panicle length (cm)	5.41	31.43**	4.10
5.	No. of fertile grains per panicle	121.31	744.98**	44.09
6.	No. of sterile grains per panicle	64.47	908.47**	46.94
7.	Leaf area (cm <sup>2</sup> )	10.05	143.92**	4.80
8.	Thousand grain weight (g)	0.37	16.50**	0.10
9.	Cold tolerance	3.81	6.97**	0.64
10.	Grain yield (q/ha)	34.50	781.86**	5.23
<b>Pooled Mean Sum of Square</b>				
<i>Kharif</i> season				
1.	No. of tiller per hill	152.07	11.06**	0.20
2.	Days to 50% flowering	0.48	260.13**	83.33
3.	Plant height (cm)	50.11	320.21**	68.23
4.	Panicle length (cm)	4.11	27.61**	4.52
5.	No. of fertile grains per panicle	67.81	546.52**	21.82
6.	No. of sterile grains per panicle	9.33	790.43**	38.06
7.	Leaf area (cm <sup>2</sup> )	14.30	75.71**	3.36
8.	Thousand grain weight (g)	3.42	21.69**	2.88
9.	Grain yield (q/ha)	100.18	273.17**	45.25

general mean of 21.42. Only two genotypes Boro 5-1B-6-3-3-4-1-1-1 (29.63 cm), and Boro 3-II-B-8-1 (25.76 cm), were found to be significantly superior to the check Prabhat (20.66 cm) in *kharif*. The character number of fertile grain per panicle varied from 47.33 (Heera) to 96.83 (ES 18-11-2-17-1-1-2-1) with the general mean of  $75.00 \pm 2.55$ . None of the entries was found to be significantly superior to the check Turanta (95.66). The number of sterile grain per panicle varied from 10.63 (NDR 1025-3) to 79.06 (Boro 3-II-B-8-1) with the general mean of  $25.00 \pm 3.95$ . Only one entry NDR

1025-3 (10.63) produced significantly less sterile grains per panicle compared to the check Heera (22.76) in *kharif*. The character leaf area (cm<sup>2</sup>) was minimum in Heera (12.34 cm<sup>2</sup>) and maximum in Boro 5-1B-6-3-3-4-1-1-1 (27.87 cm<sup>2</sup>) with the general mean of  $17.00 \pm 0.88$ . The entries viz. ES 21-2-1 (18.76 cm<sup>2</sup>), RAU 1345-5-5-1 (21.66 cm<sup>2</sup>), RAU 1344-4-1 (20.19 cm<sup>2</sup>), RAU 1345-4-1 (18.73 cm<sup>2</sup>), ES 10-11-2-17-1-1-1 (21.58 cm<sup>2</sup>) were found to be significantly superior to the check Prabhat (15.87 cm<sup>2</sup>) in *kharif*. Thousand grain weight (g) varied from 16.32 (RAU 1345-2) to 26.79 g (ES 21-2-1)

**Table 2.** Mean performance of 22 genotypes of rice in *kharif* season.

Genotypes	No. of tiller per hill	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of fertile grain per panicle	No. of sterile grain per panicle	Leaf area (cm <sup>2</sup> )	1000 grain weight (g)	Yield (q/ha)
1. ES 21-2-1	8.63	64.66	97.93	21.70	71.50	14.00	18.76	26.79	41.73
2. ES 29-3-3-1	9.78	62.66	90.73	21.20	64.26	20.73	17.52	26.70	37.56
3. RAU 1344-3-2	7.87	70.33	92.93	13.93	60.86	17.33	17.03	26.30	40.56
4. RAU 1345-5-5-1	9.23	64.33	91.33	21.33	81.86	20.13	21.66	26.76	42.23
5. RAU 1344-4-1	7.90	69.33	96.73	21.50	74.40	18.20	20.19	24.40	35.90
6. RAU 1345-2	6.95	63.66	62.66	20.83	67.90	13.60	17.77	16.32	38.16
7. RAU 1346-4-1	6.87	64.66	89.30	22.10	67.00	15.86	18.73	17.80	40.00
8. RR 151-3	5.88	51.66	107.13	21.26	61.93	36.13	13.79	18.30	31.50
9. RAU 1344-7	7.37	70.66	85.66	20.53	82.40	18.93	17.18	17.50	35.80
10. Boro 3-II-B-8-1	5.25	81.00	105.13	25.76	65.43	66.00	16.01	18.81	30.16
11. ES-18-11-2-17-1-1-2-1	8.58	76.66	96.06	19.46	96.83	51.66	13.89	18.34	37.20
12. RAU 1346-4-2-1	7.16	63.33	88.43	21.06	72.40	20.53	14.33	18.99	31.20
13. RAU 1345-1-7	7.46	62.66	88.43	21.33	74.46	12.76	15.14	17.54	33.00
14. RAU 1345-2-1-3	9.56	65.00	92.23	23.16	81.93	24.33	15.38	20.48	29.23
15. RAU 1345-1-2-1-1	8.30	65.00	88.66	19.93	80.86	14.93	14.22	19.10	34.40
16. IR 56383-77-1-1	7.85	76.00	90.26	22.40	92.40	25.60	18.05	18.11	39.24
17. ES-18-11-2-17-1-1	9.64	72.33	94.00	20.93	80.40	23.73	21.58	18.24	31.23
18. NDR 1025-3	7.49	76.00	83.46	24.00	72.30	20.30	27.63	22.48	32.73
19. Boro 5-IB-6-3-3-4-1-1-1	7.39	93.66	113.00	29.63	83.66	76.66	27.87	24.82	44.23
20. Heera	7.56	49.66	73.86	18.03	47.33	7.70	12.34	18.28	24.70
21. Turanta	6.02	56.00	91.16	18.56	95.66	15.43	12.99	20.10	36.83
22. Prabhat (c)	9.72	67.66	87.50	20.66	78.80	15.60	15.87	22.82	42.93
GM	7.83	64.85	83.04	21.42	75.00	25.00	17.00	20.06	35.95
SE	0.47	0.28	5.75	1.28	2.55	1.73	0.88	0.26	2.15
CV%	10.45	0.73	10.93	10.45	5.88	12.03	8.67	2.21	10.38
CD%	1.36	0.82	16.61	3.71	7.36	5.01	2.54	0.76	6.21

with the general mean of  $20.06 \pm 0.26$ . The entries viz. ES 21-2-1 (26.79 g), ES 29-3-3-1 (26.70 g), RAU 1344-3-2 (26.30 g), RAU 1345-5-5-1 (26.76 g), RAU 1344-4-1 (24.40 g), and Boro 5-IB-6-3-3-4-1-1-1 (24.82 g) were

**Table 3.** Mean performance of 22 genotypes of rice in *boro* season.

Genotypes	No. of tiller per hill	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of fertile grain per panicle	No. of sterile grain per panicle	Leaf area (cm <sup>2</sup> )	1000 grain weight (g)	Cold tolerance	Yield (q/ha)
1. ES 21-2-1	11.36	147.00	74.13	18.50	63.66	16.83	14.94	26.74	4.33	73.70
2. ES 29-3-3-1	16.60	142.33	61.53	16.93	61.53	22.13	8.81	20.22	4.33	70.30
3. RAU 1344-3-2	15.13	156.66	75.26	20.36	83.86	18.03	15.12	19.67	3.67	72.40
4. RAU 1345-5-5-1	10.23	144.33	67.23	20.30	85.83	26.16	12.66	18.20	3.00	90.10
5. RAU 1344-4-1	10.83	164.00	73.20	21.43	78.73	25.66	16.73	25.13	6.33	51.20
6. RAU 1345-2	12.20	152.00	68.03	13.30	73.93	32.16	12.98	19.82	4.33	67.50
7. RAU 1345-4-1	11.06	15.50	64.13	19.20	77.13	22.76	11.23	18.76	5.00	65.90
8. RR 151-3	9.80	140.00	89.30	19.63	64.46	30.63	15.56	20.43	7.00	38.16
9. RAU 1344-7	15.03	165.00	76.10	21.13	77.90	22.80	13.73	20.50	7.00	43.56
10. Boro 3-II-B-8-1	10.80	175.00	101.70	29.36	116.86	79.06	26.76	20.45	1.67	96.60
11. ES-18-11-2-17-1-1-2-1	9.23	144.33	59.86	16.00	47.93	51.63	11.79	17.42	7.00	34.83
12. RAU 1346-4-2-1	14.16	156.33	67.63	19.43	83.66	22.10	12.18	18.47	3.67	71.20

**Table 3.** Continued.

Genotypes	No. of tiller per hill	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of fertile grain per panicle	No. of sterile grain per panicle	Leaf area (cm <sup>2</sup> )	1000 grain weight (g)	Cold tolerance	Yield (q/ha)
13. RAU 1345-1-7	8.67	167.00	67.93	20.20	111.50	40.56	14.73	20.52	5.00	59.10
14. RAU 1345-2-1-3	13.40	157.00	67.96	20.26	85.90	16.73	13.79	20.43	3.00	78.76
15. RAU 1345-1-2-1-1	12.00	143.66	65.13	19.50	80.40	17.40	10.75	19.29	3.00	78.70
16. IR 56383-77-1-1	16.43	166.33	80.36	23.56	70.90	45.06	15.52	20.82	4.33	55.06
17. ES-18-11-2-17-1-1	14.13	162.00	72.16	19.00	82.13	57.20	16.13	20.60	4.33	67.40
18. NDR 1025-3	16.53	162.00	71.63	23.13	79.03	10.63	18.17	18.82	3.67	64.40
19. Boro 5-IB-6-3-3-4-1-1-1	11.10	168.33	95.66	24.96	94.80	70.63	42.50	24.72	1.67	89.06
20. Heera	13.73	136.33	60.36	18.00	62.10	22.76	13.18	20.36	4.33	51.80
21. Turanta	10.30	151.33	69.53	18.56	82.20	43.86	13.96	23.45	3.00	55.50
22. Prabhat (c)	10.83	163.00	70.80	19.20	64.20	32.30	14.53	19.28	4.33	67.43
GM	11.92	155.45	72.71	20.08	74.84	29.85	15.71	19.73	4.2	65.56
SE	0.86	0.73	2.03	1.16	3.83	3.95	1.26	0.18	0.46	1.31
CV%	12.07	0.82	4.85	10.08	8.45	21.31	13.94	1.52	18.77	3.48
CD%	2.49	2.12	5.88	3.37	11.06	11.41	3.64	0.52	1.32	3.80

found to be significantly superior to the check Prabhat (22.82 g) in *kharif*. The trait yield (q/ha) varied from 24.0 (Heera) to 44.23 q/ha (Boro-5-IB-6-3-3-4-1-1-1) with the general mean of 35.95 ± 2.15. None of the

**Table 4.** Pooled mean performance of 22 genotypes of rice on the basis of *kharif* and *boro* seasons.

Genotypes	No. of tiller per hill	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of fertile grain per panicle	No. of sterile grain per panicle	Leaf area (cm <sup>2</sup> )	1000 grain weight (g)	Yield (q/ha)
1. ES 21-2-1	9.99	105.83	86.03	20.10	67.58	15.41	16.85	26.76	57.71
2. ES 29-3-3-1	13.19	102.50	76.13	19.06	62.90	21.43	13.17	23.46	53.93
3. RAU 1344-3-2	11.50	113.50	84.10	17.15	72.36	17.68	16.07	22.98	51.48
4. RAU 1345-5-5-1	9.73	104.33	79.28	20.81	83.85	23.15	17.16	22.48	66.16
5. RAU 1344-4-1	9.36	116.66	84.96	21.46	76.56	21.93	18.46	24.77	43.55
6. RAU 1345-2	9.57	108.16	65.35	17.06	70.91	22.80	15.38	18.07	52.83
7. RAU 1345-4-1	8.96	109.83	76.71	20.65	72.06	19.31	14.98	18.28	52.95
8. RR 151-3	7.84	95.83	98.21	20.45	63.20	33.38	14.67	19.36	34.83
9. RAU 1344-7	11.20	118.00	80.88	20.83	80.15	20.86	15.45	19.00	39.68
10. Boro 3-II-B-8-1	8.02	128.00	103.41	27.56	91.15	72.53	21.38	19.65	63.38
11. ES-18-11-2-17-1-1-2-1	8.90	110.00	77.96	17.73	72.38	51.65	12.84	17.88	36.01
12. RAU 1346-4-2-1	10.66	109.00	78.03	20.25	78.03	21.31	13.25	18.73	51.20
13. RAU 1345-1-7	8.06	114.83	78.18	20.76	92.98	26.66	14.93	19.03	46.05
14. RAU 1345-2-1-3	11.48	111.00	80.10	21.71	83.91	20.53	14.53	20.46	54.00
15. RAU 1345-1-2-1-1	10.15	104.33	76.90	19.71	80.63	16.16	12.49	19.20	56.55
16. IR 56383-77-1-1	12.14	121.16	85.81	22.98	81.65	35.33	16.78	19.46	47.13
17. ES-18-11-2-17-1-1	11.88	117.16	83.08	19.96	81.26	30.46	18.85	19.42	49.31
18. NDR 1025-3	12.01	119.00	77.55	23.56	75.66	15.46	22.90	20.65	50.06
19. Boro 5-IB-6-3-3-4-1-1-1	9.24	131.00	104.33	27.30	89.03	73.65	35.21	24.77	66.65
20. Heera	10.64	93.00	67.11	18.01	54.71	16.23	12.76	19.32	38.25
21. Turanta	8.16	103.66	80.35	18.56	88.93	29.65	13.48	21.77	46.16
22. Prabhat (c)	10.28	115.33	79.15	19.93	71.50	22.95	15.20	21.05	55.18
GM	10.13	111.45	81.98	20.70	76.88	28.56	16.67	20.75	50.60
SE	0.085	2.048	0.284	0.107	0.2833	0.2659	0.094	0.019	0.155
CV %	6.890	5.030	5.260	6.120	4.140	9.505	6.938	3.101	3.514
CD%	0.798	0.633	4.880	1.390	3.694	3.457	1.234	0.257	2.021

**Table 5.** Genetic parameters of nine characters in different seasons of rice. GCA = Genotypic coefficient of variation ; PCV = Phenotypic coefficient of variation ;  $h^2$  % = Heretability in broad sense ; GA = Genetic advance ; GA% = Genetic advance percentage of mean.

Season/characters	<i>kharif</i> season					<i>Boro</i> season				
	GCV%	PCV%	$h^2$ %	GA	GA%	GCV%	PCV%	$h^2$ %	GA	GA %
1. No. of tiller per hill	14.72	16.15	86.25	24.9	318.00	19.24	20.56	87.52	47.24	396.30
2. Day to 50% flowering	14.88	14.89	99.91	198.83	306.59	6.82	6.84	99.52	218.62	140.63
3. Plant height (cm)	10.45	12.54	69.46	178.89	215.42	14.58	14.85	96.44	218.46	300.45
4. Panicle length (cm)	12.33	13.71	80.88	54.42	254.06	15.05	16.11	87.29	62.27	310.10
5. No. of fertile grain per panicle	15.50	15.87	95.43	240.23	319.45	20.42	21.05	94.08	314.86	420.71
6. No. of sterile grain per panicle	54.27	54.54	99.01	359.36	1118.10	13.79	13.97	94.83	349.08	1169.44
7. Leaf area (cm <sup>2</sup> )	23.93	24.49	95.50	83.82	493.05	16.61	44.08	96.66	140.27	892.07
8. 1000 grain weight (g)	17.01	17.06	98.38	73.11	8501.16	11.85	11.88	99.45	48.18	244.19
9. Cold tolerance	-	-	-	-	-	59.90	62.85	95.30	51.82	123.40
10. Yield (q/ha)	12.76	14.09	81.83	94.50	731.18	24.56	24.62	99.32	331.42	505.52

#### Pooled Basis

Character	GCV	PCV	$h^2$ %	GA	GA%
1. No. of tiller per hill	6.4468	7.0338	84.0063	13.4532	132.8055
2. Days to 50% flowering	2.1089	2.1188	99.0681	48.4484	43.4436
3. Plant height (cm)	2.7080	3.1584	73.0950	45.6024	55.6250
4. Panicle length (cm)	3.1733	3.9931	63.1525	13.5381	65.3698
5. No. of fertile grain per panicle	7.2824	7.4849	94.6628	115.3498	150.0192
6. No. of sterile grain per panicle	10.0001	10.9117	83.9947	58.8568	206.0091
7. Leaf area (cm <sup>2</sup> )	9.5512	9.8900	92.7081	32.7008	136.1655
8. 1000 grain weight (g)	4.8031	4.8238	99.1416	20.5308	96.986
9. Yield (q/ha)	8.9340	9.0477	97.4851	93.5212	184.0243

genotypes was found to be significantly superior to the check Prabhat (42.93 q/ha) in *kharif*. Genetic vari-

ability for all nine characters was studied in *kharif* season with the help of different genetic parameters

**Table 6.** Phenotypic (upper value) and genotypic (lower value) correlation coefficients between different character combinations among nine characters in *kharif* season. \*Significant at  $P = 0.05$ , \*\*Significant at  $P = 0.01$ .

Characters		ch-1	ch-2	ch-3	ch-4	ch-5
1. No. of tiller per hill	P	1.000	0.041	0.025	0.006	0.195
	G	1.000	0.047	0.183	0.025	0.205
2. Days to 50% flowering	P		1.000	0.347	0.514*	0.384
	G		1.000	0.522	0.665	0.407
3. Plant height (cm)	P			1.000	0.296	0.171
	G			1.000	0.589	0.263
4. Panicle length (cm)	P				1.000	0.144
	G				1.000	0.205
5. No. of fertile grain per panicle	P					1.000
	G					1.000
6. No. of sterile grain per panicle	P					
	G					
7. Leaf area (cm <sup>2</sup> )	P					
	G					
8. 1000 grain weight (g)	P					
	G					
9. Yield (q/ha)	P					
	G					

**Table 6.** Continued.

Characters		ch-6	ch-7	ch-8	ch-9
1. No. of tiller per hill	P	0.245	0.391	0.083	0.195
	G	0.309	0.470	0.211	0.260
2. Days to 50% flowering	P	0.697**	0.178	0.621**	0.032
	G	0.707	0.179	0.668	0.419
3. Plant height (cm)	P	0.549**	0.254	0.166	0.131
	G	0.834	0.418	0.255	0.244
4. Panicle length (cm)	P	0.142	0.022	0.451*	0.099
	G	0.730	0.039	0.681	0.086
5. No. of fertile grain per panicle	P	0.185	0.068	0.112	0.434*
	G	0.221	0.079	0.103	0.481
6. No. of sterile grain per panicle	P	1.000	0.021	0.266	0.075
	G	1.000	0.019	0.299	0.095
7. Leaf area (cm <sup>2</sup> )	P		1.000	0.419	0.450*
	G		1.000	0.447	0.588
8. 1000 grain weight (g)	P			1.000	0.424*
	G			1.000	0.462
9. Yield (q/ha)	P				
	G				

viz. genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense ( $h^2$ ), genetic advance (GA) and GA as per cent of mean.

For all the characters, PCV was higher than GCV in *kharif* season. The characters having the GCV upto 15% have been grouped in low genetic variation, those having 16.00 to 25.00% in moderate genotypic variability and those having GCV of more than 25.00%

are kept in high genotypic variability class.

Characters with low GCV were number of tiller per hill, days to 50% flowering, plant height, panicle length and yield. Moderate genotypic variability was observed for number of fertile grains per panicle, leaf area and 1000 grain weight, while high genotypic variability was observed for number of fertile grains per panicle in *kharif* season.

All the characters which exhibited high heritabil-

**Table 7.** Phenotypic (upper value) and genotypic (lower value) correlation coefficients between different character combinations among ten characters in *boro* season. \*Significant at  $P = 0.05$ , \*\*Significant at  $P = 0.01$ .

Characters		ch-1	ch-2	ch-3	ch-4	ch-5
1. No. of tiller per hill	P	1.000	0.075	-0.040	0.051	-0.139
	G	1.000	0.073	-0.138	0.067	-0.199
2. Days to 50% flowering	P		1.000	0.537**	0.602**	0.613**
	G		1.000	0.566	0.724	0.679
3. Plant height (cm)	P			1.000	0.655**	0.457*
	G			1.000	0.852	0.501
4. Panicle length (cm)	P				1.000	0.532*
	G				1.000	0.722
5. No. of fertile grain per panicle	P					1.000
	G					1.000
6. No. of sterile grain per panicle	P					
	G					
7. Leaf area (cm <sup>2</sup> )	P					
	G					
8. 1000 grain weight (g)	P					
	G					
9. Cold tolerance	P					
	G					
10. Yield (q/ha)						

**Table 7.** Continued.

Characters		ch-6	ch-7	ch-8	ch-9	ch-10
1. No. of tiller per hill	P	-0.291	-0.141	-0.123	0.087	0.039
	G	-0.474	-0.161	-0.167	0.110	0.052
2. Days to 50% flowering	P	0.435*	0.176	0.526*	0.197	0.265
	G	0.474	0.179	0.553	0.249	0.266
3. Plant height (cm)	P	0.599**	0.348	0.746**	0.255	0.277
	G	0.655	0.378	0.798	0.296	0.310
4. Panicle length (cm)	P	0.406	0.165	0.556**	0.383	0.381
	G	0.536	0.205	0.738	0.459	0.450
5. No. of fertile grain per panicle	P	0.361	0.093	0.437**	0.487**	0.539**
	G	0.431	0.097	0.496	0.594	0.603
6. No. of sterile grain per panicle	P	1.000	0.151	0.617**	0.268	0.161
	G	1.000	0.161	0.713	0.285	0.179
7. Leaf area (cm <sup>2</sup> )	P		1.000	0.423*	0.092	0.059
	G		1.000	0.447	0.101	0.661
8. 1000 grain weight (g)	P			1.000	0.399	0.492*
	G			1.000	0.497	0.515
9. Cold tolerance	P				1.000	0.757**
	G				1.000	0.932
10. Yield (q/ha)						

ity coupled with high genetic advance indicating the preponderance of additive type of gene action, suggest that selection can be made in early generation in segregating generation.

Genotypic and phenotypic correlation coefficient were worked out for all the character combinations. In almost all the trait combination genotypic correlation coefficient was higher in magnitude than the

phenotypic correlation coefficient. The days to 50% flowering exhibited positive and significant correlation with panicle length, number of sterile grains per panicle length, number of sterile grains per panicle and thousand grain weight ; like wise plant height also exhibit positive correlation coefficient with number of sterile grain per panicle and panicle length have significant correlation with thousand grain weight. Number of fertile grain per panicle, leaf area and thou-

**Table 8.** Poled phenotypic (upper value) and genotypic (lower value) correlation coefficient between different character combinations among nine characters in rice. \*Significant at  $P = 0.05$ , \*\*Significant at  $P = 0.01$ .

		ch-1	ch-2	ch-3	ch-4	ch-5
1. No. of tiller per hill	P	1.000	0.028	0.064	0.083	-0.192
	G	1.000	0.080	0.398	0.381	-0.444
2. Days to 50% flowering	P		1.000	0.467*	0.629**	0.609**
	G		1.000	0.614	0.802	0.676
3. Plant height (cm)	P			1.000	0.492	0.341
	G			1.000	0.854	0.475
4. Panicle length (cm)	P				1.000	0.361
	G				1.000	0.501
5. No. of fertile grain per panicle	P					1.000
	G					1.000
6. No. of sterile grain per panicle	P					
	G					
7. Leaf area (cm <sup>2</sup> )	P					
	G					
8. 1000 grain weight (g)	P					
	G					
9. Yield (q/ha)	P					
	G					

**Table 8.** Continued.

		ch-6	ch-7	ch-8	ch-9
1. No. of tiller per hill	P	-0.187	-0.084	0.150	0.135
	G	-0.543	-0.078	0.469	-0.025
2. Days to 50% flowering	P	0.567**	0.693**	-0.047	0.287
	G	0.589	0.739	0.057	0.359
3. Plant height (cm)	P	0.618**	0.530*	0.042	0.112
	G	0.833	0.715	0.059	0.103
4. Panicle length (cm)	P	0.565**	0.667**	0.005	0.332
	G	0.745	0.938	0.025	0.524
5. No. of fertile grain per panicle	P	0.392	0.373	-0.043	0.254
	G	0.479	0.434	-0.124	0.393
6. No. of sterile grain per panicle	P	1.000	0.574**	-0.067	0.141
	G	10.00	0.649	-0.115	0.213
7. Leaf area (cm <sup>2</sup> )	P		1.000	0.227	0.340
	G		1.000	0.257	0.512
8. 1000 grain weight (g)	P			1.000	0.381
	G			1.000	0.560
9. Yield (q/ha)	P				
	G				

sand grain weight exhibited significant and positive correlation with grain weight.

It suggests a fairly inherent association between the characters studied. Phenotypic expressions were suppressed more likely under the influence of environment as also suggested by Chauhan (4) and Singh (5). Therefore selections on the basis of these traits may lead to significant increase in the productivity without affecting the other traits (6).

In the present investigation the path coefficient analysis reveals that the thousand grain weight exhibited high positive direct effect on grain yield sug-

gesting that selection of this trait will be rewarding in the yield improvement as also observed earlier (6, 7).

Based on the selection index score the entries namely viz. ES-18-11-2-17-1-1-2-1, RAU 1345-1-2-1-1, IR 56383-77-1-1, Turanta and Prabhat may be used for direct cultivation or may be utilized in breeding program for improvement of yield

*Conclusion*

The genotypes compared sufficient variability for the characters. Most of the characters showed low to moderate genetic coefficient of variation and

**Table 9.** Genotypic direct (diagonal) and indirect effect of eight characters on yield in *kharif* season. Residual effect = 0.360.

Characters	1	2	3	4	5	6	7	8	Correlation with yield
1. No. of tiller per hill	-0.451	-0.348	-1.288	-0.103	-0.038	1.408	-0.048	0.386	0.260
2. Days to 50 % flowering	0.292	-0.181	-2.469	-0.091	0.151	1.661	-0.018	0.900	0.419
3. Plant height (cm)	0.227	-0.231	-1.453	-0.155	0.208	1.454	-0.049	0.085	0.244
4. Panicle length (cm)	0.227	-0.016	0.452	0.039	-0.824	-0.615	-0.015	1.013	0.086
5. No. of fertile grain per panicle	1.109	-0.141	-0.649	-0.032	-0.169	0.442	-0.007	-0.171	0.481
6. No. of sterile grain per panicle	0.246	-0.246	-2.059	-0.113	0.255	1.992	-0.022	0.042	0.095
7. Leaf area (cm <sup>2</sup> )	0.115	-0.232	-0.629	-0.105	-0.174	0.597	0.072	0.964	0.588
8. 1000 grain weight (g)	-0.087	-0.062	-1.031	-0.006	-0.387	0.038	-0.032	2.156	0.462

**Table 10.** Genotypic direct (diagonal) and indirect effect of nine characters on yield in *boro* season. Residual effect = 0.441.

Characters	1	2	3	4	5
1. No. of tiller per hill	-0.008	-0.602	-1.039	2.079	-0.646
2. Days to 50% flowering	0.016	-0.341	-1.834	2.447	-0.477
3. Plant height (cm)	-0.008	-0.436	-1.562	2.872	-0.686
4. Panicle length (cm)	0.023	-0.409	-0.921	2.072	-0.951
5. No. of fertile grain per panicle	-0.116	-0.044	0.254	0.194	0.189
6. No. of sterile grain per panicle	0.055	-0.286	-1.202	1.541	-0.410
7. Leaf area (cm <sup>2</sup> )	0.018	-0.108	-0.694	0.591	-0.092
8. 1000 grain weight (g)	0.019	-0.333	-1.464	2.120	-0.472
9. Cold tolerance	0.033	0.150	0.543	-1.319	0.105

**Table 10.** Continued.

Characters	6	7	8	9	Correlation with yield
1. No. of tiller per hill	-0.026	0.128	0.270	0.112	0.052
2. Days to 50% flowering	-0.036	0.270	0.390	0.133	0.266
3. Plant height (cm)	-0.030	0.147	0.361	0.206	0.310
4. Panicle length (cm)	-0.024	0.069	0.243	0.049	0.450
5. No. of fertile grain per panicle	0.026	-0.115	-0.082	0.128	0.603
6. No. of sterile grain per panicle	-0.056	0.115	0.349	0.046	0.179
7. Leaf area (cm <sup>2</sup> )	-0.009	0.313	0.129	0.022	0.061
8. 1000 grain weight (g)	-0.039	0.319	0.489	0.223	0.515
9. Cold tolerance	0.005	0.355	-0.243	0.448	0.932

high heritability coupled with high genetic advance which indicated the presence of additive gene action. During selection number of fertile grain per panicle,

leaf area and thousand grain weight may be considered as prime characters for enhancement of yield in early rice.

**Table 11.** Pooled genotypic direct (diagonal) and indirect effect of eight characters on yield. Residual effect = 0.56.

Characters	1	2	3	4	5
1. No. of tiller per hill	-1.670	-0.121	0.138	0.774	0.263
2. Days to 50% flowering	0.133	1.517	-0.214	-1.631	-0.400
3. Plant height (cm)	0.664	0.931	-0.348	-1.763	-0.281
4. Panicle length (cm)	0.636	1.216	-0.297	-2.033	-0.296
5. No. of fertile grain per panicle	0.741	1.025	-0.165	-1.081	-0.592
6. No. of sterile grain per panicle	0.907	0.893	-0.290	-1.515	-0.283
7. Leaf area (cm <sup>2</sup> )	0.130	1.121	-0.249	-1.907	-0.257
8. 1000 grain weight (g)	-0.783	-0.086	-0.020	-0.051	-0.073
9. Yield (q/ha)					

**Table 11.** Continued.

Characters	6	7	8	Correlation with yield
1. No. of tiller per hill	0.312	-0.142	0.419	-0.025
2. Days to 50% flowering	-0.339	1.343	-0.051	0.359
3. Plant height (cm)	-0.479	1.299	0.052	0.103
4. Panicle length (cm)	-0.428	1.704	0.022	0.524
5. No. of fertile grain per panicle	-0.275	0.788	-0.101	0.393
6. No. of sterile grain per panicle	-0.575	1.179	-0.102	0.213
7. Leaf area (cm <sup>2</sup> )	-0.373	1.817	0.229	0.512
8. 1000 grain weight (g)	-0.066	0.467	0.894	0.560
9. Yield (q/ha)				

**Table 12.** Relative ranking of genotypes on the basis of grain yield and selection score in *kharif* season. Rank correlation coefficient =0.73.

Genotype	Grain yield (q/ha)	Rank as per grain yield	Selection score on the basis of selection index	Rank as per selection index
1. ES 21-2-1	41.73	4	16.19	14
2. ES 29-3-3-1	37.56	9	15.54	18
3. RAU 1344-3-2	40.56	5	15.23	19
4. RAU 1345-5-5-1	42.23	3	16.98	9
5. RAU 1344-4-1	35.90	12	16.34	13
6. RAU 1345-2	38.16	8	15.91	15
7. RAU 1345-4-1	40.00	6	15.70	17
8. RR 151-3	31.50	17	15.73	16
9. RAU 1344-7	35.80	13	17.58	7
10. Boro 3-II-B-8-1	30.16	20	15.73	16
11. ES-18-11-2-17-1-1-2-1	37.20	10	19.56	2
12. RAU 1346-4-2-1	31.20	19	16.82	12
13. RAU 1345-1-7	33.00	15	16.95	10
14. RAU 1345-2-1-3	29.23	21	17.74	6
15. RAU 1345-1-2-1-1	34.40	14	17.76	5
16. IR 56383-77-1-1	39.20	7	18.57	3
17. ES-18-11-2-17-1-1	31.23	18	16.83	11
18. NRD 102-3	32.73	16	15.94	15
19. Boro 5-IB-6-3-3-4-1-1-1	44.23	1	17.27	8
20. Heera	24.70	22	14.77	20
21. Turanta	36.83	11	20.50	1
22. Prabhat (c)	42.93	2	18.13	4

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