Plant Archives Volume 20 No. 2, 2020 pp. 3657-3660 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

AGRONOMIC PERFORMANCE OF SOME F_5 FAMILIES OF RICE (*ORYZA SATIVA* L.)

Abinash Mishra* and P.C. Kole

Department of Genetics and Plant Breeding, Institute of Agriculture, Visva-Bharati, Sriniketan, Birbhum-731235 (West Bengal) India.

Abstract

Twenty-one different F_5 families were evaluated for 12 characters. Short plant height was observed in the cross SNT × SS and SNT × IE2. Early flowering was found in the crosses SNT × IE2 and IE2 × SS. Little panicle exertion was found in the crosses SNT × SS and KS × IE2. Some crosses having high panicle length were IE2 × SS, KS × IE3 and IE2 × DS. SNT × KS (5) showed greatest value for the traits like primary branches panicle^{-1}, secondary branches panicle^{-1} and grain number. In the cross SNT × IE3 large values were also obtained for the traits primary branches panicle^{-1}, secondary branches panicle^{-1} and grain number there by the grain number was affected by branching pattern of the panicle in some crosses. High plant height with high straw yield was found in the crosses like SNT × KS, IE2 × SS and KS × IE3. The families having the highest and lowest grain yield plant^{-1} were SNT × KS (5) and SNT × SS (2), respectively. From the values of coefficient of variation (CV), the variability was highest in panicle exertion (35.3), followed by straw yield (23.59), grain yield plant^{-1} (22.54), grain number panicle^{-1} (18.67), secondary branches panicle^{-1} (16.23), panicle number (15.62), flag leaf area (12.87), 100-grain weight (6.78), primary branches panicle^{-1} (5.73), panicle length (5.69), plant height (4.63) and days to flowering (1.35).

Key words: Coefficient of variation (CV), Variability and Trait.

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops belonging to the tribe oryzae of the family Gramineae (Poaceae). The cultivated rice is diploid having 24 chromosomes (2n = 2x = 24). It ranks first among the three major cereals, followed by wheat and maize. *O. sativa* and *O. glaberrima* are believed to have evolved independently from a common ancestor *O. perennis*. The genus Oryza contains 25 recognized species. Of which 23 are wild species and two, *O. sativa* and *O. glaberrima* are cultivated (Morishima, 1984; Vaughan, 1994; Brar and Khush, 2003). Grain yield is a complex polygenic quantitative trait which is greatly affected by environment and determined by the magnitude and nature of their genetic variability (Singh *et al*., 2000). Hence, selection of superior genotypes based on yield particularly in early segregating generation is not effective. Therefore, selection has to be made for the component traits. The association of plant characters and yield thus play a significant role in formulation of selection criteria for yield (Hari and Ramakrishnan, 2006).

***Author for correspondence :** E-mail: abinash.siram83@gmail.com

Materials and methods

The field experiments were conducted at the Agricultural Farm, Institute of Agriculture, Visva-Bharati, Sriniketan, which is located at sub-humid lateritic belt. The present investigation was carried out with 21 different F_5 families derived from eight different cross combinations during warm wet (*kharif*) season (July-December) in 2018. The seven parents involved in the 21 different families were Dudheswar (DS), Shantibhog (SNT), Shitabhog (STB), Kerala sundari (KS), IET14142 (IE2), IET14143 (IE3) and Subhasita (SS). Each parental genotype is having some peculiar characteristics (Table 1). Thirty-day old single seedling per hill was transplanted in randomized complete block design (RCBD) with three replications. Each plot consists of 5 rows each with 20 plants with a spacing of 20 cm × 15 cm spacing. Observations were recorded on following twelve different quantitative characters *viz.* plant height, days to flowering, flag leaf area, panicle exertion, panicle length, panicle number, primary branches panicle^{-1}, secondary branches panicle^{-1}, grain number panicle^{-1}, 100-grain weight, straw yield and grain yield plant^{-1}.

Results and Discussion

The mean performance of 21 F_5 families derived from eight crosses for twelve characters is given in (Table 2). The details are as follows:

Plant height (cm)

The average plant height was 130.69cm and it ranged from 96.73cm to 156.54cm. The family having the tallest height was SNT × KS (5) and the shortest was from SNT × SS (2). Short plant height was observed in the cross SNT × SS and SNT × IE2. In the cross KS × IE2, two families were having tall plant height and other two were having considerably shorter plant height indicating presence of greater variability for the plant height.

Days to flowering

The average number of days to flowering was 121.46 and it ranged from 111 to 128. The family having the latest days to flowering was IE2 × DS and earliest was from IE2 × SS (3). Early flowering was found in the crosses SNT × IE2 and IE2 × SS.

Flag leaf area (cm^2)

The average flag leaf area was 27.01 cm^2 and it ranged from 20.32cm^2 to 39.09cm^2. The family having the largest flag leaf area was SNT × KS (5) and smallest was from SNT × IE3 (1).

Panicle exertion (cm):

The average panicle exertion was 3.19cm and it ranged from 1.03cm to 7. 65cm. The family having the highest panicle exertion SNT × KS (3) and lowest was IE2 × DS. Little panicle exertion was found in the crosses SNT × SS and KS × IE2. The families under the cross STB × IE3 showed considerable variability for panicle exertion.

Panicle length (cm)

The average panicle length was 23.33cm and it ranged from 19.47cm to 26. 39cm. The families having the highest and lowest panicle length were IE2 × SS (4) and SNT × IE2 (2), respectively. Some crosses having high panicle length were IE2 × SS, KS × IE3 and IE2 × DS. Two families under the cross STB × IE3 showed low panicle length while one family showed considerably greater panicle length indicating considerable variability for panicle length.

Panicle number $plant^{-1}$

The average panicle number was 9.29 and it ranged from 5.33 to 11. They families having the highest and lowest panicle number were SNT × SS (2) and KS × IE2 (3), respectively. High panicle number $plant^{-1}$ was found in the cross SNT × SS, IE2 × DS and SNT × IE2. The families under the crosses SNT × IE2 and SNB × IE3 showed high grain yield as well as high panicle number $plant^{-1}$.

Primary branches $panicle^{-1}$

The average primary branches $panicle^{-1}$ was 10.94 and ranged from 9.58 to 13.55. The families having largest and smallest primary branches $panicle^{-1}$ were SS × KS

Table 1: Characteristics of parental genotypes used in crosses.

S. No.	Genotype	Source/origin/ geographical Distribution	Characters
1	**Subhasita**	Sub Research Rice Station, Chakada (B.C.K.V, West Bengal)	Medium long grain, awn absent, scented, susceptible to false smut, moderately resistance to lodging, acute leaf angle.
2	**Shitabhog**	Sub Research Rice Station, Chakada, (B.C.K.V, West Bengal)	Short grain with higher number of spikelets, awn absent, aromatic, tall stature
3	**Kerala Sundari**	Purulia, Burdwan, North 24 Pargonas, Sagar Island of South 24 Pargonas, Hoogly, Nadia (W.B)	Medium bold grain, awn absent, scented, High yield folk rice, gives grain yield- 4.2-5.4 t/ha: comparable with HYVs. Short duration varieties (seed to seed-130 days)
4	**Shantibhog**	Sub Research Rice Station, Chakada (B.C.K.V, West Bengal)	Long bold grain, awn present with low expressivity, scented rice, sturdy stem.
5	**Dudheswar**	North and South 24 Pargonas	Medium grain fine rice, awn absent, non-aromatic. Boro paddy – partial photo insensitive, tasty fine rice
6	**IET 14142**	Dept. of Genetics and Plant Breeding (Visva-Bharati)	Mutant of "Tulaipanji", awn present with low expressivity, extra primary branch arises from the base of the panicle (neck), mild aromatic.
7	**IET 14143**	Dept. of Genetics and Plant Breeding (Visva-Bharati)	Small grain, reduced height true breeding mutant derived from scented traditional race i.e. Tulaipanji, awn present, unique trait such as semi dwarf with high tillering ability.

Table 2: Mean performance of 21 F_5 families for twelve quantitative characters of rice.

Character	Plant height (cm)	Days to flowe-ring	Flag leaf area (cm^2)	Panicle exertion (cm)	Panicle length (cm)	Panicle plant^{-1}	Primary branches panicle^{-1}	Second-ary branches panicle^{-1}	Filled grains panicle^{-1}	Test weight (g)	Straw yield (g)	Grain yield plant^{-1}
IE 2 ×DS	116.19	128.00	23.68	1.03	24.48	10.88	11.00	19.67	79.75	1.93	50.83	12.12
IE 2×SS (1)	145.79	122.67	26.65	2.12	25.18	9.30	11.23	19.00	83.49	1.98	44.31	12.99
(2)	153.61	123.00	24.05	4.07	24.35	9.59	11.07	26.00	116.66	1.96	39.45	13.45
(3)	138.01	111.00	26.13	3.04	24.15	10.09	10.37	28.73	112.09	1.96	47.14	18.64
(4)	150.58	120.00	33.21	2.27	26.39	10.26	11.19	21.33	111.85	1.71	47.54	17.35
SNT×IE2(1)	117.15	118.33	23.38	2.12	22.86	10.81	11.60	23.07	105.88	2.21	33.18	23.07
(2)	105.73	114.67	21.72	4.08	19.47	10.67	10.05	16.60	86.42	2.16	34.32	18.14
(3)	103.67	122.00	21.65	2.59	21.18	10.60	10.47	20.55	109.98	2.01	28.81	21.36
KS × IE2	130.16	123.33	20.76	4.46	24.04	10.74	12.06	25.33	111.43	1.83	45.78	17.65
KS ×IE2 (1)	123.31	112.00	24.84	2.11	22.12	7.48	11.08	24.00	106.70	1.57	25.93	12.34
(2)	144.16	123.67	36.98	1.20	23.95	7.67	11.44	30.00	142.30	2.18	56.91	14.78
(3)	126.42	123.33	31.31	2.31	24.51	5.33	11.00	27.67	98.50	1.44	31.88	10.96
K.S ×IE3 (1)	142.12	124.33	25.26	1.92	24.11	9.78	11.02	27.73	78.81	1.82	42.22	18.80
(2)	128.24	119.00	28.39	3.86	25.40	9.67	9.94	24.21	109.00	1.92	41.09	21.12
STB× IE3(1)	133.02	123.33	20.32	4.20	22.67	9.09	10.60	21.81	105.32	1.87	32.94	17.36
(2)	144.34	121.00	32.25	6.87	20.75	7.47	10.94	27.87	165.45	1.89	30.21	17.95
(3)	144.71	121.33	29.13	2.50	26.03	8.56	11.38	30.41	131.27	1.90	52.91	17.73
SNT×SS (1)	101.06	121.67	23.55	2.27	21.11	10.45	9.68	14.95	81.05	1.70	42.95	11.08
(2)	96.73	126.67	22.68	1.94	21.17	11.00	9.87	19.00	74.45	1.63	42.95	10.95
SNT× KS (3)	143.02	123.67	32.33	7.65	21.63	7.57	10.39	22.87	112.06	2.28	55.70	16.72
SNT× KS (5)	156.54	127.67	39.09	4.53	25.10	8.17	13.55	35.75	161.96	2.41	67.05	29.19
Min	96.73	111.00	20.32	1.03	19.47	5.33	9.68	14.95	74.45	1.44	25.93	10.95
Max	156.54	128.00	39.09	7.65	26.39	11.00	13.55	35.75	165.45	2.41	67.05	29.19
GM	130.69	121.46	27.01	3.19	23.33	9.29	10.94	24.12	108.78	1.92	42.57	16.84
CV	4.63	1.35	12.87	35.3	5.69	15.62	5.73	16.23	18.67	6.78	23.59	22.54
SE	4.94	1.34	2.84	0.92	1.08	1.18	0.51	3.19	16.58	0.10	8.20	3.10
LSD at 5%	9.98	2.70	5.73	1.85	2.18	2.38	1.03	6.44	33.50	0.20	16.57	6.26
LSD at 1%	13.35	3.62	7.67	2.48	2.92	3.19	1.37	8.62	44.83	0.27	22.17	8.38

(5) and SNT × SS (1), respectively. SNT × KS (5) showed greatest value for the traits like primary branches panicle^{-1}, secondary branches panicle^{-1} and grain number. In the cross SNT × IE3 large values were also obtained for the traits primary branches panicle^{-1}, secondary branches panicle^{-1} and grain number indicating that the grain number was affected by branching pattern of the panicle in some crosses.

Secondary branches panicle^{-1}

The average secondary branches panicle^{-1} was 24.12 and ranged from 14.95 to 35.75. The families having the largest and smallest secondary branches panicle^{-1} were SNT × KS (5) and SNT× SS (1). The crosses like STB × IE3 and KS × IE3 showed large value for this trait and in the cross IE2 × SS, families showed a wide variation for secondary branches panicle^{-1}.

Grain number panicle^{-1}

The average grain number panicle^{-1} was 108.78 and ranged between 74.45 and 165.45. The families having the greatest and smallest grain number panicle^{-1} were STB × IE3 (2) and SNT × SS (2) respectively. In the family SNT × KS (5) large values were obtained for grain number panicle^{-1}, 100-grain weight and grain yield. In the cross STB × IE3, one family was having very high grain number while other two were comparatively small showing wide variation for this trait. Wide genetic variability was also recorded in other crosses like SNT × KS and KS × IE2.

100-grain weight(g)

The average 100-grain weight was 1.92g and it ranged from 1.44g to 2.41g. The families having highest and lowest 100-grain weight were STB × KS (5) and KS × IE2 (2), respectively.

Straw yield (g)

The average straw yield was 42.57g and it ranged from 25.93g to 67.05g. The family having the highest

straw yield was SNT × KS (5) and lowest was in KS × IE2 (1). High plant height with high straw yield was found in the crosses like SNT × KS, IE2 × SS and KS × IE3.

Grain yield plant^{-1}(g)

The average grain yield plant^{-1} was 16.84 g and it ranged from 10.95g to 29.19g. The families having the highest and lowest grain yield plant^{-1} were SNT × KS (5) and SNT × SS (2), respectively. From the values of coefficient of variation (CV), the variability was highest in panicle exertion (35.3), followed by straw yield (23.59), grain yield plant^{-1} (22.54), grain number panicle^{-1} (18.67), secondary branches panicle^{-1} (16.23), panicle number (15.62), flag leaf area (12.87), 100-grain weight (6.78), primary branches panicle^{-1} (5.73), panicle length (5.69), plant height (4.63) and days to flowering (1.35). Considerable amount of variability has been reported earlier for grain yield plant^{-1} (Kumar, 2007; Thrirungana *et al*., 2007; Anbanandan *et al*., 2009 and Krishna *et al*., 2014), grain number (Thirungana *et al*., 2007; Koli and Punia 2012; Aditya and Bhatia 2013; Rai *et al*., 2013 and Krishna *et al*., 2014) and secondary branches panicle^{-1} (Sanghera and Kashyap, 2012)

Conclusion

The families of the cross KS × IE2 exhibited moderate values for panicle length, primary branches panicle^{-1}, filled grains panicle^{-1} and 100-rain weight and semi-dwarf plant height which was contributed by the parental genotype IE2. The families in the cross IE2 × SS were uniform with respect to plant height, panicle length, number of primary branches, number of secondary branches and 100-grain weight. Recombinants within the families registered very high number of filled grains and good grain yield which were inherited from the parent Subhasita. Individual family in the cross SNT × IE2 recombined long bold grains with high percentage of filled grains of the parent Shantibhog with short plant height of the true breeding mutant parent IE2. STB × IE3 (2) exhibited semi-dwarf plant height, large values for the primary branches of panicle, secondary branches of panicle and number of filled grains and the high spikelet number contributed by Shitabhog recombined with short plant height of the mutant parent IE3. SNT × KS (5) exhibited highest mean values for number of primary branches and secondary branches and grain yield which were contributed by the parent KS, which is high yielding. Therefore, there is scope of further selection in this generation.

References

Aditya, J.P. and A. Bhartiya (2013). Genetic variability, correlation analysis for quantitative characters in rainfed upland rice of Uttarakhand hills. *J. Rice Res*., **6(2)**.

Anbanandan, V., K. Saravanan and T. Sabesan (2009). Variability, heritability and genetic advance in rice (*Oryza sativa* L.). *Int. J. Plant Sci*., **4(1):** 61-63.

Brar, D.S. and G.S. Khush (2003). Utilization of wild species of genus Oryza in rice improvement. *Monograph Genus Oryza*., 283-309.

Hari Ramakrishnan, S., C.R. Anandakumar, S. Saravanan and N. Malini (2006). Association analysis of some yield traits in rice (*Oryza sativa* L.). *J. App. Sci. Res*., **2(7):** 402-404.

Koli, N.R. and S.S. Punia (2012). Effect of intermating on genetic variability and character association in aromatic rice. *Elect. J. Plant Breed*., **3(2):** 830-834.

Krishna, L., C.S. Raju, S. Kumar, N. Reddy and M.H.V. Bhave (2014). Genetic variability studies for qualitative and quantitative traits in F_2 generation of aromatic rice (*Oryza Sativa* L.). *The J. Res., P.J.T.S.A.U.*, **42(3):** 26-30.

Kumar, S.T., R. Narasimman, R. Eswaran, C.P.S. Kumar and A. Anandan (2007). Studies on genetic variability, heritability and genetic advance in segregating generations of rice (*Oryza sativa* L.). *Int. J. Plant Sci*., **2(1):** 48-51.

Morishima, H. (1984). Wild plants and domestication. In: Tsunoda, S. and Takahashi, N.(ed) Biology of Rice. Elsevier, Amsterdam. 3-30.

Rai, P.K., U.K. Sarker, P.C. Roy and A.K.M.S. Islam (2013). Character association in F_4 generation of rice (*Oryza Sativa* L.). Bangladesh. *J. Plant Breed. Genet.*, **26(2):** 39-44.

Sanghera, G.S. and S.C. Kashyap (2012). Genetic parameters and selection indices in F_3 progenies of hill rice genotypes. *Notulae Scientia Biologicae.*, **4(4):** 110-114.

Thirungnanakumar, S., R. Narshiman, A. Anandan and N.S. Kumar (2011). Studies of genetics of yield and yield component characters in F_2 and F_3 generation of rice. *African J. Biotech*., **10(41):** 7987-7997.

Vaughan, D.A., B.R. Lu and N. Tomooka (2008). The evolving story of rice. *Plant science*., **174(4):** 394-40.