



Research Note

Genetic parameters of agro-morpho-physiological traits in rice (*Oryza sativa* L.)

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(Received: 12 ar 2012; Accepted: 16 Mar 2012)

Abstract:

To estimate genetic variability, heritability and genetic advance a study was conducted on 10 diverse parents (3 CMS lines and 7 advance breeding lines) and 21 hybrids of rice. The results obtained from present investigation showed that adequate variability among the parents and crosses for agro-morpho-physiological components. The magnitude of difference between PCV and GCV observed was relatively low for all the characters viz., days to 50 % flowering, flag leaf length, flag leaf width, flag leaf area, plant height, pollen fertility, sterile spikelets per panicle, fertile spikelets per panicle, spikelets per panicle, spikelets fertility, panicle length, grain yield per plant, test weight and head rice recovery, indicating less environmental influence. All the characters exhibited high broad sense heritability. The high heritability along with high genetic advance were registered as per cent of mean for grain yield per plant, pollen fertility (%), sterile spikelets per panicle, fertile spikelets per panicle, spikelets fertility (%), head rice recovery (%), 1000 seed weight, spikelets per panicle. Therefore, the improvement of these traits through selection is the most important way to achieve the genetic gain generation after generation. High heritability coupled with high genetic advance indicates the preponderance of additive gene action and such characters could be improved through selection.

Key words:

Rice, hybrid, variance, PCV, GCV, heritability and genetic advance

Rice is the important stable food grain crop in the world. The basic genetic parameters and their nature help breeder to plan the improvement programme. Heritability values have been variable depending upon the genetic nature of genotype for different agro-morpho-physiological parameters. The knowledge of genetic variability present in a given crop species for the character under improvement is of paramount importance for the success of any plant breeding programme. The genotypic variance and phenotypic variance influences the heritability estimates as well as the environmental factors. Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are normally more helpful in predicting the genetic gain under selection than heritability estimates alone. Therefore, an attempt has been made to study the genetic parameters of rice to develop the selection criteria for improving the traits under study.

Three CMS lines having WA-cytoplasmic background viz., APMS 6 A, CRMS 31 A and IR 79156 A; seven advanced breeding lines viz., NPT 2-2-694-1, NPT 9, NPT 80-1 from tropical japonica/indica background; ET 1-12, ET 1-13 from japonica/indica background; TOX 981-11-2-3 from

WARDA and R 1244-1246-1-605-1 from IGKV, Raipur and their generated twenty one hybrids as per line x tester design were evaluated. The crosses were attempted during wet season 2009 and evaluated during wet season 2009-10 with complete randomized block design in two replications for fifteen agro-morpho-physiological parameters viz., days to 50% flowering, flag leaf length, flag leaf width, flag leaf area, productive tiller per plant, plant height, panicle length, fertile spikelets per panicle, sterile spikelets per panicle, spikelets per panicle, spikelets fertility per cent, pollen fertility per cent, grain yield per plant, 1000-seed weight and head rice recovery per cent. Phenotyping was done as per Virmani *et al.* (1997) and Rani *et al.* (2006). Biometrical analysis was carried out as per Johnson *et al.* (1955); Hanson *et al.* (1956); Sivasubramanian and Madhavamenon (1973) and Singh and Choudary (1985).

Genetic parameters: Analysis of variance for all the characters under study exhibited significant variability (Table 1). The genotypic and phenotypic coefficient of variation, heritability and genetic advance being the important tools to estimate the extent and type of variability for the characters undertaken among the ten parents and their twenty

one F₁s are presented and described under the sub-heads:

Genetic variability: The different parameters for assessment of variability in terms of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was estimated. The PCV obtained was greater than GCV for flag leaf width, plant height, flag leaf area, productive tillers per plant, panicle length and grain yield per plant (Table 2). The high genotypic and phenotypic coefficient of variations were recorded for sterile spikelets per panicle (77.50 and 77.62), grain yield per plant (33.31 and 33.38), pollen fertility (59.78 and 59.89), fertile spikelets per panicle (51.90 and 51.96), productive tillers per plant (46.52 and 47.63), spikelet fertility (44.86 and 44.91), head rice recovery (30.24 and 30.32), spikelets per panicle (27.87 and 27.89 per cent) and flag leaf area (23.52 and 27.24 per cent). Whereas, moderate genotypic and phenotypic coefficients of variation were recorded for 1000 seeds weight (18.93 and 19.74 per cent), flag leaf length (15.66 and 15.96 per cent), plant height (14.59 and 18.40 per cent), flag leaf width (14.67 and 16.72 per cent) and panicle length (11.85 and 13.00). On the other hand days to 50 % flowering was recorded with lowest genotypic and phenotypic coefficient of variation (9.81 per cent and 9.92 per cent), respectively. The results obtained from present investigation showed the existence of adequate variability among the parents and crosses for grain yield and its components. The magnitude of difference between PCV and GCV was observed relatively low for all the characters *viz.*, days to 50 % flowering, flag leaf length, flag leaf width, flag leaf area, plant height, pollen fertility, sterile spikelets per panicle, fertile spikelets per panicle, spikelets per panicle, spikelets fertility, panicle length, grain yield per plant, test weight and head rice recovery, indicating less environmental influence.

Similar result for high PCV and GCV was also reported by Bose *et al.* (2005) for grain yield per plant and days to 50 % flowering; Panwar (2005) for plant height, panicle length, days to 50 % flowering, spikelets fertility % and grain yield; Das *et al.* (2005) productive tillers per plant, grain yield per plant and plant height; Saleem *et al.* (2005) for spikelets fertility per cent; Shukla *et al.* (2005) for high GCV and grain yield; Amudha *et al.* (2006) for productive tillers per plant, spikelets sterility per cent; Kumar *et al.* (2006) for high grain yield per plant; Jayashudha and Sharma (2010) for pollen fertility (%) and spikelets fertility (%).

Heritability: Heritability estimate provide the information regarding the amount of transmissible genetic variation out of total variation and determines response to selection. In the present investigation

heritability in broad sense was estimated for all the characters under study (Table 2). The magnitude of heritability was categorized as high (> 70 %), moderate (31-70 %) and low (< 30 %). All the characters exhibited high broad sense heritability. Heritability was recorded as the highest for pollen fertility per centage (99.83 %) and spikelets per panicle (99.83 %) followed by fertile spikelets per panicle (99.79 %), spikelets fertility per cent (99.77 %), sterile spikelets per panicle (99.70 %), head rice recovery (99.46 %), pollen fertility (99.64 %), grain yield per plant (99.61 %), days to 50 % flowering (97.75 %), flag leaf length (96.27 %), productive tillers per plant (95.38 %), 1000 seed weight (91.93 %), panicle length (83.19 %), flag leaf width (76.97 %) and flag leaf area (74.57 %) whereas, it was found moderate for plant height (62.85%).

Therefore, there is scope of genetic improvement of these characters through selection. Similar results for high broad sense heritability have also been reported by Das *et al.* (2005) for productive tiller and Plant height; Mall *et al.* (2005) for plant height and flag leaf length; Satyanarayana *et al.* (2005) for days to 50% flowering, plant height, productive tiller per plant and panicle length; Patra *et al.* (2006) for plant height, panicle length, productive tiller per plant; Jayashudha and Sharma (2010) for pollen fertility (%), spikelets fertility (%) and days to 50% flowering.

Genetic Advance: The estimates of genetic advance as per cent of mean provide more reliable information regarding the effectiveness of selection in improving the traits. Genetic advance denotes the improvement in the genotypic value of the new population over the original population. The genetic advance as per cent of mean was categorized as high (>20 %), moderate (10-20) and low (< 10%). In the present investigation, genetic advance as per per cent of mean are depicted (Table 2). The high estimates of genetic advance were exhibited as per per cent mean by the characters for sterile spikelets per panicle (159.41) followed by pollen fertility per cent (122.93), fertile spikelets per panicle (106.80), productive tillers per plant (93.58), spikelets fertility per cent (92.31), grain yield per plant (68.49), head rice recovery (62.12), flag leaf area (41.84), 1000 seed weight (37.39), plant height (23.83), panicle length (22.27), flag leaf length (31.66), flag leaf width (26.50) whereas, it was moderate for days to 50% flowering (19.97), respectively.

The high heritability along with high genetic advance as per cent of mean was registered for grain yield per plant, pollen fertility (%), sterile spikelets per panicle, fertile spikelets per panicle, spikelets fertility (%), head rice recovery (%), 1000 seed



weight, spikelets per panicle therefore, the improvement of these traits through selection is an important way to achieve the genetic gain generation after generation. High heritability coupled with high genetic advance indicates the preponderance of additive gene action and such characters could be improved through selection. Similar finding was also recorded by Das *et al.* (2005) for high heritability coupled with high genetic advance in grain yield per plant, productive tillers per plant, and plant height; Mall *et al.* (2005) for plant height, flag leaf length; Saleem *et al.* (2005) for grain yield per plant; Satyanarayana *et al.* (2005) for spikelets fertility (%), days to 50% flowering, plant height, panicle length; Manna *et al.* (2006) for grain yield per plant, spikelets number per plant; Patra *et al.* (2006) for plant height; Jayashudha and Sharma (2010) for Spikelet fertility (%), spikelet fertility (%), pollen fertility (%) and plant height.

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Table 1. ANOVA for different characters

Source of Variance	Characters														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Replication	3.562	2.382	0.074	0.021	0.980	2.295	0.409	1.715	2.436	0.097	4.941*	0.156	0.001	1.58	2.852
Treatments	87.744**	52.574**	7.683**	6.864**	4.384**	42.309**	555.564**	670.050**	941.149**	1148.665**	875.688**	10.894**	23.795**	508.44**	367.462**
Error	1.635	0.023	0.023	58.181	168.07	0.41	4.824	23.51	23.04	13.43	1.83	2.24	1.58	0.66	0.80

*= Significant P > 0.05, **= Significant P > 0.01

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|-------------------------------|-------------------------------|------------------------------|--------------------------------------|
| 1. Days to 50% flowering, | 2. Flag leaf length (cm), | 3. Flag leaf width (cm), | 4. Flag leaf area(cm ²), |
| 5. Plant height (cm), | 6. Productive tillers/Plant , | 7. Pollen fertility (%), | 8. Sterile spikelets/Panicle, |
| 9. Fertile spikelets/Panicle, | 10. Spikelets /Panicle, | 11. Spikelets fertility (%), | 12. Panicle length(cm), |
| 13. 1000Seed weight (g), | 14. Grain yield/plant (g) | 15. Head rice recovery (%) | |

Table 2 Genetic parameters for rice

Genetic parameters	Characters														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Genotypic variance	70.90	37.07	0.08	170.60	284.38	8.56	1337.60	7863.25	10832.26	7704.04	799.05	11.09	18.01	166.98	147.24
Phenotypic variance	72.54	38.51	0.10	228.78	452.45	8.98	1342.42	7886.75	10855.30	7717.47	800.88	13.33	19.59	167.64	148.04
GCV	9.81	15.66	14.67	23.52	14.59	46.52	59.78	77.50	51.90	27.87	44.86	11.85	18.93	33.31	30.24
PCV	9.92	15.96	16.72	27.24	18.40	47.63	59.89	77.62	51.96	27.89	44.91	13.00	19.74	33.38	30.32
Heritability % (bs)	97.75	96.27	76.97	74.57	62.85	95.38	99.64	99.70	99.79	99.83	99.77	83.19	91.93	99.61	99.46
Genetic advance	17.15	12.31	0.50	23.23	27.54	5.89	75.21	182.40	214.17	180.65	58.16	6.26	8.38	26.57	24.93
Genetic advance as % of mean	19.97	31.66	26.50	41.84	23.83	93.58	122.93	159.41	106.80	57.36	92.31	22.27	37.39	68.49	62.12
Environmental variance	1.635	0.023	0.023	58.181	168.07	0.41	4.824	23.51	23.04	13.43	1.83	2.24	1.58	0.66	0.80

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|-------------------------------|---------------------------|-------------------------------|--------------------------------------|----------------------------|
| 1. Days to 50% flowering, | 2. Flag leaf length (cm), | 3. Flag leaf width (cm), | 4. Flag leaf area(cm ²), | 5. Plant height(cm), |
| 6. Productive tillers/Plant , | 7. Pollen fertility (%), | 8. Sterile spikelets/Panicle, | 9. Fertile spikelets/Panicle, | 10. Spikelets/Panicle, |
| 11. Spikelets fertility(%), | 12. Panicle length(cm), | 13. 1000 Seed weight (g), | 14. Grain yield/plant (g), | 15. Head rice recovery (%) |