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Correlation of Quantitative and Qualitative Characters with Yield in Rice Mutant Lines

Key words : Correlation, Mutants, Rice, Variation

In the crop improvement programme the knowledge on the nature and magnitude of genetic variation in respect of quantitative and qualitative characters is essential. Hence, in the present investigation, attempts have been made to estimate variability, heritability, genetic advance and correlation for quantitative and qualitative characters in 18 mutant lines of rice.

The experimental material comprised 18 mutant lines of M_4 generation in rice, derived from local land race, treated with different concentrations of EMS (Ethyl methyl sulphonate). The material was planted in randomized complete block design with three replications at Department of Genetics and Plant Breeding, Allahabad Agricultural Institute – Deemed University, Allahabad during *Kharif* 2006. Seedlings of each mutant line were transplanted in a single row of 3 m length, adopting inter- and intra-row spacing of 20x15 cm. The recommended packages of practices were adopted. The data on quantitative traits *viz.,*50% flowering, days to maturity, plant height, number of tillers plant^{-1}, flag leaf length, flag leaf width, panicle length, number of spikelets panicle^{-1}, test weight and grain weight plant^{-1} were recorded plotwise or from 10 randomly selected plants from each replication and mutant. In case of qualitative characters kernel elongation was measured with the help of graph paper. The alkali spreading value, water uptake and volume expansion were measured by using standard method of Little *et al.,* (1958) and Onate and Del Mundo (1966). The mean values were statistically analysed as per Panse and Sukhatme, 1967. Genotypic and phenotypic coefficient of variation and heritability were calculated as per Burton and Devane, 1953. Genetic advance and correlation coefficients were calculated as per Johnson *et al.,* (1955) and Al-Jibouri *et al.,* (1958), respectively.

Analysis of variance revealed significant differences among 18 mutant lines for all 19 characters except panicle length and test weight, indicating the presence of substantial genetic variation. Considerable range of variation is exhibited by the genotypes for all the traits. Maximum variation was observed for number of spikelets panicle^{-1} followed by water uptake, grain yield plant^{-1}, flag leaf length, plant height, milling percentage and hulling percentage Table 1. Hence, there is scope for further improvement of these characters. Singh and Singh (2005) also recorded wide range of variation for milling percentage, grains panicle^{-1} and days to 50% flowering during their study.

The extent of coefficient of variation (Table 1) indicated that grain yield plant^{-1} had maximum genotypic coefficient of variation followed by number of spikelets panicle^{-1} , alkali spreading value, number of tillers plant^{-1} and flag leaf length, offering scope for selection. Phenotypic coefficient of variation was higher than the genotypic coefficient of variation, indicating greater influence of environment on the expression of characters, in consonance with Verma *et al.,* (2000), Suman *et al.,* (2005), Chikkalingaiah *et al.,* (1999) and Patil *et al.,* (2003).

Highest heritability was recorded for alkali spreading value followed by water uptake, number of spikelets panicle^{-1} , grain yield plant^{-1} , days to 50% flowering , kernel elongation and volume expansion, while the lowest heritability was recorded for panicle length and test weight (Table 1). Inspite of high heritability values for most of traits, estimates of genetic gain varied considerably. Number of spikelets panicle^{-1} recorded the highest genetic advance followed by water uptake and grain yield plant^{-1} while the lowest genetic advance was recorded for kernel breadth. The genetic advance as percent of mean was highest for grain yield plant^{-1} followed by number of spikelets panicle^{-1}, alkali spreading value, flag leaf length and number of tillers plant^{-1} while the lowest value was observed for test weight. Similar results of high heritability for alkali spreading value and genetic advance for number of spikelets panicle^{-1} were recorded by Ganeshan *et al.,* (1997), Nayak *et al.,* (2001), Singh and Singh (2005). High heritability with high genetic advance was registered for number of spikelets panicle^{-1} suggesting predominance of additive gene action in

Table 1. Estimates of various genetic parameters for 19 characters in 18 mutant lines of rice

Characters	Phenotypic variance	Genotypic variance	Phenotypic coefficient of variation	Genotypic coefficient of variation	Environmental coefficient of variation	Heritability broad sense	Genetic advance	GA as % of mean
Plant height	19.94	14.26	3.79	3.20	2.02	71.50	6.58	5.58
No. of tillers plant^{-1}	3.22	2.00	17.90	14.11	11.02	62.10	2.30	22.91
Days to 50% flowering	8.75	3.80	2.61	1.72	1.96	43.50	2.65	2.33
Flag leaf length	29.44	26.44	13.82	13.10	4.41	89.80	10.04	25.58
Flag leaf width	0.05	0.01	11.56	6.14	9.80	28.20	0.13	6.73
Panicle length	5.61	0.49	11.55	3.39	11.04	8.60	0.42	2.06
No. of spikelets panicle^{-1}	1346.14	1319.15	22.90	22.67	3.24	98.00	74.07	46.24
Days to maturity	8.88	4.76	2.04	1.49	1.39	53.70	3.29	2.25
Grain yield plant^{-1}	65.73	64.16	30.77	30.40	4.76	97.60	16.30	61.86
Test weight	1.30	0.05	5.68	1.06	5.58	3.50	0.08	0.41
Hulling %	18.28	14.01	5.57	4.87	2.69	76.70	6.75	8.79
Milling %	21.58	17.08	7.31	6.51	3.34	79.20	7.58	11.92
Kernel length	0.001	0.00	5.91	5.02	3.13	71.90	0.04	8.77
Kernel breadth	0.00	0.00	9.16	4.45	8.01	23.60	0.01	4.44
L/B ratio	0.03	0.013	8.12	5.22	6.22	41.40	0.15	6.92
Kernel elongation	0.02	0.013	7.22	6.80	2.41	88.80	0.22	13.21
Volume expansion	0.16	0.14	7.94	7.41	2.87	87.00	0.73	14.23
Water uptake	250.07	245.06	8.42	8.33	1.19	98.00	31.92	16.99
Alkali spreading value	0.29	0.29	17.64	17.64	0.19	100.00	1.11	36.33

GA = Genetic advance

Table 2. Estimates of Phenotypic (rp) (abovediegonal) (rg) (below diagonal) correlations for 19 characters in 18 mutant lines of rice.

Characters	Plant height	No. of tillers plant^{-1}	Days to 50% flowering	Flag leaf length	Flag leaf width	Panicle length	No. of spikelets panicle^{-1}	Days to maturity	Test weight
Plant height	-	-0.17	0.05	0.19	-0.001	0.08	0.36**	-0.06	0.03
No. of tillers plant^{-1}	(-0.13)	-	-0.01	0.20	-0.26	-0.02	0.12	0.02	-0.09
Days to 50% flowering	(0.13)	(-0.24)	-	-0.09	0.02	-0.08	-0.20	0.18	-0.05
Flag leaf length	(0.22)	(0.28*)	(-0.13)	-	-0.31*	0.23	0.46**	-0.19	0.22
Flag leaf width	(-0.21)	(-0.74**)	(-0.56**)	(-0.55**)	-	-0.07	0.10	-0.25	-0.10
Panicle length	(0.28*)	(-0.33*)	(0.08)	(0.43**)	(-1.00**)	-	-0.04	-0.07	0.04
No. of spikelets panicle^{-1}	(0.41**)	(0.14)	(-0.35**)	(0.49**)	(0.13)	(-0.20)	-	-0.06	0.19
Days to maturity	(0.01)	(0.45**)	(0.80**)	(-0.30*)	(-0.41**)	(-0.29*)	(-0.04)	-	0.27
Test weight	(-0.66**)	(1.00**)	(0.77**)	(0.80**)	(1.00**)	(-3.28**)	(1.00**)	(0.55**)	-
Hulling %	(0.35*)	(-0.81**)	(0.17)	(0.06)	(0.62**)	(0.45**)	(0.24)	(-0.47**)	(0.04)
Milling %	(0.38**)	(-0.75**)	(0.19)	(0.08)	(0.61**)	(0.80**)	(0.26)	(-0.48**)	(0.20)
Kernel length	(0.33*)	(0.05)	(-0.16)	(-0.26)	(0.04)	(0.57**)	(-0.46**)	(-0.17)	(-1.00**)
Kernel breadth	(-0.28*)	(1.00**)	(0.02)	(0.12)	(-0.76**)	(-0.13)	(-0.30*)	(0.56**)	(-1.00**)
L/B ratio	(0.47**)	(-0.24)	(-0.22)	(-0.06)	(0.26)	(0.60**)	(-0.10)	(-0.40**)	(0.09)
Kernel elongation	(-0.21)	(0.03)	(-0.23)	(0.42**)	(0.07)	(-0.36**)	(0.48**)	(0.01)	(1.00**)
Volume expansion	(0.30*)	(-0.07)	(0.15)	(0.36**)	(0.20)	(-0.38**)	(0.66**)	(0.01)	(1.00**)
Water uptake	(0.14)	(-0.07)	(0.40**)	(0.20)	(0.02)	(-0.29*)	(0.29*)	(0.16)	(0.54**)
Alkali spreading value	(-0.04)	(-0.06)	(-0.25)	(-0.47**)	(0.26)	(-0.87**)	(0.14)	(0.32)	(-0.44**)
Grain yield plant^{-1}	(0.24)	(0.72**)	(-0.31*)	(0.57**)	(-0.31*)	(-0.36*)	(0.82**)	(0.10)	(1.00**)

Hulling %	Milling %	Kernel length	Kernel breadth	L/B ratio	Kernel elongation	Volume expansion	Water uptake	Alkali spreading value	Grain yield plant^{-1}
0.23	0.27*	0.25	-0.145	0.23	-0.21	0.16	0.13	-0.03	0.20
-0.53**	-0.60**	-0.04	0.513**	-0.24	0.08	0.02	-0.06	-0.05	0.55**
0.08	-0.03	-0.05	0.09	-0.09	-0.10	0.10	0.28*	-0.17	-0.18
0.09	0.03	-0.20	0.048	-0.07	0.37**	0.28*	0.18	-0.45**	0.52**
0.20	0.23	-0.06	-0.225	0.03	0.06	0.08	0.02	0.14	-0.15
0.12	0.05	0.07	0.092	-0.17	-0.13	-0.14	-0.12	-0.25	-0.09
0.21	0.23	-0.36**	-0.156	-0.05	0.45**	0.61**	0.28*	0.14	0.81**
-0.22	-0.21	-0.07	0.074	-0.09	0.01	0.05	0.13	0.23	0.07
-0.05	-0.09	-0.08	0.133	-0.14	0.29*	0.15	0.13	-0.08	0.26
-	0.79**	0.06	-0.464**	0.29*	-0.08	0.29*	0.36**	-0.21	-0.20
(1.00**)	-	0.07	-0.567**	0.37**	-0.11	0.24	0.33*	-0.22	-0.17
(0.09)	(0.13)	-	0.091	0.71**	-0.72**	-0.19	-0.06	-0.15	-0.26
(-0.89**)	(-0.88**)	(0.13)	-	-0.35**	-0.11	-0.16	-0.15	0.08	0.16
(0.55**)	(0.46**)	(0.85**)	(-0.42**)	-	-0.45**	0.15	0.17	-0.14	-0.13
(-0.11)	(-0.12)	(-0.80**)	(-0.30**)	(-0.62**)	-	0.37**	-0.04	-0.007	0.36**
(0.39**)	(0.26)	(-0.29*)	(-0.37**)	(0.15)	(0.41**)	-	0.47**	-0.10	0.42**
(0.42**)	(0.38**)	(-0.07)	(-0.32*)	(0.29*)	(-0.06)	(0.51**)	-	-0.12	0.19
(-0.24)	(-0.24)	(-0.18)	(0.15)	(-0.21)	(-0.01)	(-0.11)	(-0.12)	-	0.05
(-0.23)	(-0.19)	(0.34*)	(0.37**)	(0.25)	(0.40**)	(0.45**)	(0.20)	(0.05)	-

* = Significant at 5% level of significance ** = Significant at 1% level of significance

the expression of this trait. This character could be improved by mass selection and other breeding methods based on progeny testing as also reported by Gupta *et al.,* (1998) and Patil *et al.,* (2003).

The characters *viz.,* number of tillers plant^{-1}, flag leaf length, number of spikelets plant^{-1}, kernel elongation and volume expansion showed positive significant correlation with grain yield at both genotypic and phenotypic levels, (Table 2). Similar findings were reported by Rajamani *et al.,* (2004), Lalitha and Sreedhar (1999) and Shivani and Reddy (2000). Days to maturity, water uptake and alkali spreading value exhibited positive correlation with grain yield as also reported by Rajamani *et al.,* (2004) and Gupta *et al.,* (1998). Seven characters *viz.,* flag leaf width (-0.148), panicle length (-0.091), hulling percentage (-0.195), milling percentage (-0.171), kernel length (-0.262) and L/B ratio (-0.134) exhibited negative and non-significant association with seed yield at phenotypic level. While hulling percentage (-0.226) and milling percentage (-0.193) exhibited negative non-significant association at genotypic level. These results are in agreement with the findings of Chauhan and Chauhan (1993), Lalitha and Sreedhar (1999) and Reddy and Kumar (1997). Negative and non-significant association indicates that independent selection should be done for these characters.

From the present study it is concluded that considerable variation is there among the mutant lines and if we exercise selection pressure on number of tillers plant^{-1}, flag leaf length, number of spikelets plant^{-1} during breeding programmes, there is chance to improve the yield potential of the mutant lines indirectly.

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