Genotype x environment interactions in hybrid rice

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ABSTRACT

Performance of 12 rice hybrids in respect of grain yield and other characters was evaluated under five environments in Maharashtra during wet season 1999. Variation due to genotype (G), environments (E) and G x E interaction was highly significant in all the traits. Stability parameters $\overline{X}$, b_i and S^2d were estimated for yield and other characters. By regression model, it was revealed that stability in yield of the hybrid appeared to differ in respect of level of stability in the component traits. It was found that stability in grain yield was due to stability in yield components only and plasticity in others. This pattern of stability and plasticity in component traits differ from hybrid to hybrid. Sahyadri hybrid may be rated as most promising hybrid under favorable environment.

Key words: Hybrid rice, stability parameters, regression

The hybrid variety producing stable and high yield over different environments is desirable for wider adaptability. Wide adaptability is mainly comprised of stability and productivity (Matsuo, 1975). The relative value of adaptability is determined by the degree of stability and that of productivity of different hybrids under various environments. The yield and its components being quantitative in nature and more sensitive to environmental fluctuations, exhibit different reaction in their phenotypic expression and also variation in the relationship among them thus possessing problem of direct selection for yield to obtain expected results. The present study was therefore undertaken to assess the yield stability and productivity of a set of hybrid varieties over environments in relation to component traits.

The experimental material comprised of twelve rice hybrids those were released by public sector and two *viz*., PA 6201, PHB 71 released by private sector (Anon., 2001) including national check Jaya and one regional check Sasyasree. The test entries were grown in randomized block design with three replications at five locations of Maharashtra state *i.e.* Karjat, Shirgaon, Radhanagri, Palghar and Vadgaon during wet season 1999.

Twentyone days old seedlings were transplanted at 15 cm x 15 cm spacing with one seedling hill^{-1} in plot size of 4.2 m x 2.1 m.. Recommended package of practices were followed to raise the crop.

Observations on ten randomly selected plants from each plot were recorded for days to 50 per cent flowering, spikelets panicle^{-1} and spikelets fertility (%). The grain yield was recorded on plot basis and converted into hectare basis for comparison. The data were analyzed for stability following Eberhart and Russell (1966) method.

The differences due to hybrids (genotypes) for all the four characters studied were significant .The component E + (G x E) was highly significant for all the four characters. The non-linear component of the interaction was not significant for yield. However, flowering spikelets panicle^{-1} and fertility of spikelets were found to posses significant non-linear component of the interaction of G x E. In general it can be stated that yield, flowering, spikelets panicle^{-1} and fertility are complex characters due to interaction between genotype and environmental factors. Such type of complex interaction for yield and yield determining characters has also been reported by Mahapatra and Das (1989).

Critical perusal of three stability parameters (Table 1) revealed that 'Sahyadri' was ranking first in

Table 1. Stability parameters of yield and yield components in twelve rice hybrids

Genotypes	Yield t ha^{-1}			Days to 50 per cent flowering			Spikelets panicle^{-1}			Spikelets fertility %		
	$\overline{X}$	bi	S2d	$\overline{X}$	bi	S2d	$\overline{X}$	bi	S2d	$\overline{X}$	bi	S2d
ADTRH 1	6.30	0.73**	-7.75	89.46	0.57	11.32**	149.53	0.74	50.66	78.06	0.56	32.22**
APRH 2	5.64	0.61**	-8.18	98.53	1.06	22.67**	135.73	0.21	113.61	78.20	0.67	22.04*
CNRH 3	5.81	0.64**	-8.16	85.26	1.20	36.50**	140.66	0.34	80.04	80.60	-2.30	99.23**
CORH 1	7.00	0.78*	-7.53	88.80	0.74	0.39	140.00	0.68	207.54	86.70	-0.40	27.46**
CORH 2	6.38	0.67**	-7.86	90.86	1.20	6.12	171.40	0.78	90.95	80.33	1.68	-3.12
DRRH 1	7.35	1.09	-8.01	94.68	1.39	8.30**	160.73	2.23	48.06	75.06	2.01	98.81**
KRH 2	8.46	1.06	-8.18	96.00	1.08	25.48**	155.93	0.51	585.91	83.26	1.75	14.01
NSD 2	8.54	1.36**	-7.40	95.26	1.10	18.78**	165.33	1.57	10.67	80.93	0.75	12.01
PSD 1	8.13	1.30**	-7.60	89.93	0.78	22.57**	154.60	1.48	95.30	80.60	1.67	4.38
Sahyadri	9.34	1.23**	-8.17	96.26	1.01	5.22**	166.60	1.59	36.19	86.93	1.01	0.41
PA 6201	8.40	1.40**	-7.80	94.66	0.85	6.09*	183.46	0.35	29.61	80.80	1.37	23.12*
PHB 71	8.96	1.43**	-7.93	94.33	1.06	8.23**	181.00	1.11	82.16	80.26	1.63	-2.31
Jaya(N.C.)	5.61	0.68**	-8.13	96.13	1.97	0.71	143.53	1.11	397.61	81.40	1.42	0.87
Sasyasree (R.C.)	5.95	0.85**	-7.98	95.20	0.95	2.98	130.66	1.22	82.81	82.50	1.47	0.17
Mean	7.27	0.99		93.23	0.99		155.65	0.94		81.11	0.96	

yield (9.34 t ha^{-1}) with 96 days duration of flowering, 167 spikelets panicle^{-1} and maximum spikelet fertility of 86.93 per cent. This was followed by the hybrid PHB 71 which produced 8.96 t ha^{-1} of yield with 94 days duration of flowering, 181 spikelets panicle^{-1} and 80.26 per cent spikelet fertility. The standard national check Jaya had minimum yield performance of 5.61 t ha^{-1}.

The magnitude of 'bi' was significant in almost all the genotypes except DRRH 1 and KRH 2 for yield, whereas for 50 per cent flowering the 'bi' values was non-significant. For spikelet fertility and spikelets panicle^{-1} the 'bi' values were significant only in DRRH 1.This suggested that the yield behaviour in almost all the genotypes except KRH 2 and DRRH 1 was highly predictable. The magnitude of S^{2}d was significant for days to 50 per cent flowering in most of the genotypes under study except Jaya, CORH 1 and Sasyasree. This suggested that flowering behaviour in rice is unpredictable. The fertility of spikelets was found to be unpredictable in ADTRH 1, APRH 2, CNRH 3, CORH 2, DRRH 1 and PA 6201 as the values of S^{2}d were significant. For number of spikelets panicle^{-1} non linear component was significant for KRH 2 and Jaya.

The hybrid KRH 2 was found to be stable for yield as it has average yield performance, regression coefficient near to unity and minimum deviation from regression. Sahyadri hybrid may be recommended for favourable environments as it gave very high mean yield (9.34 t ha^{-1}) with regression coefficient slightly more than unity and minimum deviation from regression as compared to other hybrids. It was also characterised by highest fertility of spikelets and non-significant interaction for number of spikelets and spikelets fertility. The hybrid PHB 71 and NSD 2 can be rated as promising hybrids.

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