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Short Communication

Combining ability and gene action for yield and quality traits in *Ahu* rices of Assam

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The traditional *Ahu* rice varieties of Assam, which are grown during March/April to June/July, are characterized by early maturity and tolerance to varying levels of moisture stress and known for the presence of unique diversity [1]. Attempt for improvement as well as genetic studies in them, however, are limited. It is, therefore, necessary to study the genetic architecture of this group of rice varieties with respect to various yield and quality attributes. Information on combining ability and gene action, in this regard, would provide guidelines for selection of parents from *Ahu* rice germplasm and also to choose appropriate breeding procedure for their improvement. With this consideration the present investigation was undertaken to study the gene action and combining ability in the *Ahu* group of rice varieties.

Twelve diverse *Ahu* rice cultivars (lines) were crossed with three popular *Ahu* varieties (testers) in a Line × Tester fashion as suggested by Kemthrone [2]. The F_1s and the parents were grown in with 2 replications during *Kharif* 2002 at the experimental farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Each plot consisted of two rows of 2m length with spacing of 20 cm between rows and 15 cm between plants.

Observations were recorded on 14 yield and quality attributes (Table 1) following standard evaluation system for rice [3]. Data were subjected to the analysis of Line × tester mating design as suggested by Kemthorne [2].

Significant variation was recorded for all the 14 traits studied. Except for alkali digestion value (AD) differences among parents, lines and testers for all the traits were found significant. Similarly Lines vs. Testers difference was also significant for all the traits except panicle length (PL). Significant differences were observed amongst the hybrids for all the traits. Significance of variance for parent *vs* hybrids indicated that hybrids were quite different than the parents.

The best general combiner for grain yield was Ikra II (Table 1) which also ranked amongst the best varieties with regard to the *per se* grain yield/plant(GY). It has appeared that the varieties identified as good general combiners for GY were also good for many other component traits. In the present study, high *gca* for effective tillers/plant (ET), panicle length (PL), panicle weight (PW) and spikelets/panicle(SP) was largely seen to contribute to the higher *gca* for grain yield. Basantabahar exhibited high *gca* for grain length (GL), length-breadth ratio (L:B) and water uptake number (WU), while Malbhog I exhibited high *gca* for AD.

A number of parents although poor in *gca* for GY, was observed to exhibit good *gca* for other important traits; these were Guni ahu (earliness and WU), Betguti I (semi-dwarf plant type, elongation ratio and volume expansion), Haripua (SP and WU), Kolagoria (GW), and Aijuri (GL and AD).

Highest *sca* for GY was exhibited by the cross Malbhog I × Nilaji, which also exhibited desirable *sca* effect for ET, PL, PW, SP, GW, GL and VE (Table 1). The first parent in the cross was a good general combiner for GY while the other one exhibited poor *gca* for GY. Crosses identified best for other important traits were: Daokolamaghi × Rongadoria for earliness, Malbhog I × Nilaji for lower plant height, Kolagoria × Rongadoria for SP and PW, Haripua × Nilaji for L:B ratio and Aijuri × Hasakumra for AD. All the crosses with high *sca* effect for grain yield involved one of the parents with good *gca* and the other with poor *gca*. Similar observation of high *sca* obtained from crosses involving high and low *gca* was also made by Reddy [4]. Additive × non-additive type of interaction might be responsible for high *sca* effect for grain yield in these crosses. Peng and Virmani [5] reported about the

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possibility of interaction between positive alleles from good combiner and negative alleles for poor combiners in high × low combiner crosses and suggested for the exploitation of heterosis in F_1 generation as their high yield potential would be unfixable in succeeding generations if no repulsion phase of linkage is involved.

It was observed that if one parent was a good general combiner for some of the yield components the other one desirable for the rest of the important components, the outcome was very promising. Mahapatra and Debjani [6] observed that heterotic effect in the hybrids involving high/low *gca* parents could be attributed to a considerable extent to the divergence with respect of genes having additive effect. In the present investigation both additive and non-additive gene actions were operative for various traits (Table 1). Similar observation was also made by other workers [7-9]. It was, however, observed that additive genetic variance was higher in magnitude for PH, PL and all the quality parameters. Non-additive gene action on the other hand was predominant for GY and its components, *viz.*, ET, PW, SP and GW. Similar observations were also noted by various workers for different yield and quality traits in several sets of rice varieties studied [10-19]. Contrary to the observation of present investigation Roy and Panwar [10] and Mohanty *et al.* [19] reported preponderance of additive gene action for GY.

Thus, simple selection would be effective for improvement of the characters *viz.*, plant height, panicle length and all the grain quality traits under study as they were chiefly governed by additive gene action. For other traits showing preponderance of non-additive gene action, exploitation of heterosis through hybrid varieties would be meaningful. Observations on combining ability effects of various parents and their crosses would be useful in selection of parents for use in hybridization programme.

Table 1. Combining ability variances along with *gca* and *sca* effects in selected parents and crosses in *Ahu* rices

Parameters/parents/crosses	Days to 50% flowering	Plant height (cm)	Effective tillers/plant	Panicle length (cm)	Panicle weight (g)	Spikelets/panicle	100-grain weight (g)	Grain length (cm)	Grain length-breadth ratio (cm)	Kernel elongation on cooking	Volume expansion on cooking	Water uptake number	Alkali digestion value	Grain yield/plant (g)
δ^2 *gca*	7.93	63.49	0.49	1.20	0.14	194.6	0.005	0.107	0.07	0.004	0.21	1040.06	0.59	5.38
δ^2 *sca*	15.20	52.84	1.74	1.86	0.64	809.24	0.02	0.04	0.02	0.002	0.18	1102.18	0.14	21.74
δ^2 *gca* (var A)/δ^2 *sca* (var D)	1.04	2.40	0.56	1.29	0.38	0.48	0.50	5.35	7.00	4.00	2.33	1.89	8.43	0.49
Aijuri	7.99**	2.93**	0.85**	0.37	0.22**	–3.94	0.09**	0.78**	0.52**	–0.04**	–0.65**	–74.09**	3.68**	–3.14**
Basantabahar	–0.58*	–3.90**	0.56**	0.88**	0.45**	15.75**	0.01	0.77**	0.71**	–0.07**	0.10**	34.07**	–0.74**	2.77**
Ikra II	–1.18**	–0.84	4.00**	3.28**	0.91**	33.33**	–0.01	–0.29**	–0.40**	–0.02*	–0.07**	–53.81**	–0.74**	11.02**
Malbhog I	–2.18**	6.33**	1.28**	0.72**	0.31**	13.61**	–0.08**	–0.38**	–0.03	0.01	–0.02*	–9.02	3.68**	4.77**
Betguti I	1.15**	–7.55**	0.08	–1.41**	–0.02	–9.22*	0.11**	–0.23**	–0.14**	0.41**	0.81**	34.35**	–0.74**	–0.20
Guniahu I	–6.85**	2.03**	–0.72**	1.18**	0.48**	5.60	0.11**	–0.16**	–0.32**	0.10**	0.77**	41.36**	–0.74**	–0.18
Haripua	–0.45	5.05**	–1.30**	–0.55*	0.61**	47.40**	–0.25**	–0.38**	–0.27**	–0.06**	0.57**	38.77**	–0.74**	–0.92
Kolagoria	–0.51	4.11**	–1.12**	–0.69*	–0.71**	–39.74**	0.19**	0.58**	0.02	–0.07**	–0.22**	–0.86	–0.74**	–5.25**
Daokolamaghi	–1.01**	7.93**	–0.44**	–2.56**	–0.89**	–42.10**	0.17**	0.21**	0.09**	0.01	–0.07**	21.75**	–0.74**	–0.25
Hasakumra	–0.93**	–7.92**	–0.18**	–0.88**	–0.32**	–12.01**	0.02*	–0.12**	–0.08**	–0.01	0.53**	33.80**	–0.03	–1.79**
Nilaji	3.19**	8.59**	–0.30**	1.17**	0.02	4.38**	–0.06**	0.32**	0.28**	–0.02**	–0.20**	–2.95	–0.05	–0.18
Rongadoria	–2.26**	0.67*	0.48**	–0.29*	0.30**	7.63**	0.04**	–0.20**	–0.20**	0.03**	–0.33**	–30.85**	0.08**	1.97**
Malbhog I × Nilaji	–1.86**	–7.14**	0.87**	0.96**	0.54**	13.07*	0.07	0.14**	0.02	0.02	0.20**	–16.83	–0.74**	5.97**
Daokolamaghi × Rongadoria	–5.57**	0.87	–0.31	0.26	–0.52**	–15.59*	–0.05	–0.04	0.04	0.04	–0.21**	38.21**	–0.08	–2.74*
Kolagoria × Rongadoria	0.26	–4.76**	1.27**	0.30	1.25**	43.81**	0.09*	0.04	–0.01	0.05*	–0.14**	6.33	–0.08	5.49**
Haripua × Nilaji	1.31**	–4.51**	–0.04	–0.12	0.22	10.67	0.01	0.20**	0.17**	0.02	–0.06*	10.01	0.05	0.13
Aijuri × Hasakumra	–3.90**	–0.68	0.06	0.92*	–0.23	–9.94	0.06	0.08**	0.02	–0.04*	0.09**	11.29	0.64**	–0.34
SE± (Line)	0.28	0.61	0.16	0.26	0.08	3.94	0.02	0.012	0.02	0.013	0.02	5.51	0.05	0.72
SE± (Tester)	0.14	0.30	0.08	0.13	0.04	1.97	0.09	0.014	0.013	0.012	0.014	2.76	0.02	0.36
SE± (*sca*)	0.48	1.05	0.28	0.46	0.13	6.83	0.04	0.02	0.04	0.02	0.02	9.57	0.08	1.24

*,**Significants at P = 0.05 and P = 0.01, respectively.

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