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Short Communication

Combining ability analysis of quantitative traits in Rice Bean (*Vigna umbellata* (Thunb).)

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Abstract: Combining ability analysis on of quantitative traits in rice bean *Vigna umbellata* [(Thunb.) Ohwi. & Ohashi] was studied using 6 x 6 parents half diallel cross in the F_1 generation. The variances due to gca (except for clusters/plant) and sca were highly significant, indicating the prevalence of additive and non-additive gene action for all the traits studied. The estimates of gca components were higher than sca components for all the traits, except clusters/plant indicating the predominance of the additive gene action for the traits. Parents RBL-50/PRR-2, RBL-6/RBL-1, were good general combinations for pods/plant and clusters/plant respectively. RBL-17/KHRP-2, RBL-6/KHRP-2 and RBL-6/PRR-2 were good specific combinations for grain yield.

Keywords: Combining ability, quantitative traits and rice bean.

مقدرة الائتلاف على الصفات الكمية في نبات فول المانج

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الملخص: تمت دراسة قابلية التزاوج على الصفات الكمية في نبات فول المانج باستخدام تزاوج ستة اباء وهجنها نصف التبادلية في الجيل الأول. كانت الفروق بسبب مقدرة التآلف العامة (باستثناء مجاميع الازهار/نبات) و الخاصة حيث كانت مرتفعة، مما يدل على انتشار الجينات المضافة وغير المضافة لجميع الصفات التي شملتها الدراسة. تقديرات مقدرة التآلف العامة أعلى من عناصر مقدرة التآلف الخاص لجميع الصفات ما عدا مجاميع الازهار/نبات مما يشير إلى قوة فعل الجين المضاف. الآباء RBL-50/PRR-2 وRBL-6/RBL-1 كانت جيدة التآلف العام من حيث عدد القرون/نبات ومجاميع الازهار/نبات على التوالي. وكانت الاباء RBL-6/PRR-2 ,RBL-6/KHRP-2 RBL-17/KHRP-2 جيدة التآلف الخاص من حيث إنتاج الحبوب.

الكلمات المفتاحية: مقدرة الائتلاف، الصفات الكمية وفول المانج.

Introduction

Rice bean *Vigna umbellata* [(Thunb.) Ohwi. & Ohashi] is a non-traditional under utilized grain legume with great growth potential in the North-eastern region, but it is grown on a limited scale due to non-availability of suitable genotypes for good plant type with erect and compact growth habit, early and synchronous maturity. Improvement of the strain through breeding has been limited to the examination of varietal differences and selection from local variability with very few genetic investigations. The major breeding approach for bringing about improvement in an autogamous crop like the rice bean is hybridization, followed by selection in the segregating populations. This primarily depends on the combining ability of the parents used in the hybridization programme and also the nature of the gene action involved in the inheritance of the components of productivity. As information on those aspects is very limited in rice bean (Das and Dana, 1978), the present study was undertaken to identify good general and specific combiners for grain yield and its components.

Materials and Methods

Six elite strains of rice bean, *viz*. RBL-1, RBL-6, RBL-50,RBL-17, PRR-2 and KHRP-2 were selected on the basis of different quantitative in order to incorporate maximum variability in segregating generations through a 6% half diallal rating design. All the parents and these 15 crosses were grown in a randomized block design with three replications during *kharif*, 2006 at Central Research Station (EB-II), Department of Plant Breeding and Genetics, CA, Bhubaneswar. Each sample was grown in a 3 m long single row with a spacing of 45 x 15 cm. Data was recorded on five random plants in each replication for the characters, *viz*. plant height, number of branches, cluster number/plant, pod number/plant, pod length, seed number/pod, 100-seed weight and grain yield/plant, while days to 50% flowering and days to maturity were taken on a plant basis. Statistical analysis for the combining ability based on mean values was done as per Method II and Model I of Griffing (1956).

Results and Discussion

Analysis of the variance revealed highly significant general combining ability (gca) variances for all the characters except clusters/plant and specific combining ability (sca) variances for: days to 50% flowering, days to maturity, plant height, branches/plant, clusters/plant, pods/plant, pod length, seeds/pod, 100-seed weight and grain yield/plant (Table 1); indicating the presence of additive as well as non-additive gene effects in the parents and hybrids for these characters. Das and Dana (1978) reported the predominance of a non-additive variance in rice bean for green and dry foder yield. Also Singh and Singh (1996) reported the presence of both additive and non-additive gene effects in the parents and hybrids for grain yield and different component traits in rice bean. However, in the present study, the variances due to gca were of a higher magnitude than the corresponding sca variance for all the characters except clusters/plant; suggesting predominance of additive gene action in respect to these traits and non-additive for clusters/plant.

The estimates of gca effects revealed a good general combiner for earliness, short plant height and 100-seed weight (Table 2). Based on simultaneous considerations of the gca effects for yield and its direct components, PRR-2 was a good general combiner for production breeding. The variety RBL-50 was a good general combiner for branches/plant and pod length. The other parents with good general combining ability estimates were RBL-1 for cluster number/plant and number of seeds/pod; RBL-6 for pod number/plant and PRR-2, closely followed by KHRP-2 for grain yield/plant. Singh and Singh (1996) also obtained similar results for the variety RBL-50, which was a good general combiner for branches/plant. Based on simultaneous consideration of gca effects for yield and its component characters, RBL-50 and PRR-2 offered the best possibilities of exploitation for the development of improved lines in rice bean.

The sca estimates indicated that the crosses RBL-17/KHRP-2, RBL-17/PRR-2, RBL-50/RBL-17, RBL-6/KHRP-2 and RBL-6/PRR-2 produced superior hybrids (Table 3). The sca of 15 heterotic crosses for yield and its component traits indicated that most of the good specific cross combinations for different characters involved either one or both good gca parents. The crosses involving high x high gca parents indicates the possibility of complementary epistasis acting in the direction of additive effects of the good combiners. The crosses of high x low gca parents with positive sca effects may be due to dominance x recessive interaction, expected to produce desirable segregates in F_2. However, crosses between low x low gca parents indicated the importance of non-additive genetic variations and they can be exploited by heterosis breeding or multiple crosses, followed by intermating among the desirable segregates. Similar results were reported by Singh and Singh (1996) in rice bean and Shanmugasundaram and Sree Rangaswamy (1994) in black gram.

The present study has identified parents RBL-17, RBL-50 and PRR-2 as superior general combiners for yield and its component traits. The importance of additive as well as non-additive genetic components is highlighted in this study. Improvement in yield and its attributes should be possible by resorting to bi-parental mating, followed by recurrent selection or by a selective diallal mating system.

Table 1. ANOVA of combining ability for 10 characters in F_1 of 6-parent diallel cross of rice bean.

Source	General combining ability	Specific combining ability	Error
d.f.	5	15	40
Days to 50% flowering	61.003**	5.413**	1.071
Days to maturity	56.388**	48.984**	1.217
Plant height (cm)	11.503**	9.835**	1.503
Branches/ plant	0.117**	0.053**	0.014
Clusters/ plant	0.114	0.182**	0.053
Pods/ plant	4.977**	3.159**	0.131
Pod length (cm)	0.231**	0.118**	0.027
Seeds/ pod	0.364**	0.157**	0.028
100- seed weight (g)	0.143**	0.101**	0.024
Single plant yield (g)	0.955**	0.672**	0.031

*Significant at P = 0.05; **Significant at P = 0.01

Table 2. GCA effects of the parental varieties for 10 characters in F_1 of a 6-parental diallel cross of rice bean.

Source	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches/ plant	Clusters/ plant	Pods/ plant	Pod length (cm)	Seeds/ pod	100- seed weight (g)	Single plant yield (g)
RBL-1	-0.014	-0.097	-0.379	-0.136*	0.219*	-0.167	-0.190*	0.181*	-0.169*	-0.297*
RBL-6	1.403*	0.153	-0.037	-0.019	0.053	1.026*	-0.224*	-0.162*	0.093	0.052
RBL-50	2.694*	0.819*	-0.108	0.189*	-0.076	-1.263*	0.170*	0.223*	0.124*	-0.425*
RBL-17	-4.431*	-4.931*	-1.938*	-0.086*	-0.089	-0.284*	0.041	0.146*	0.135*	-0.117*
PR-2	-1.972*	3.028*	1.583*	-0.044	-0.035	0.586*	0.160*	-0.300*	-0.063	0.425*
KIRP-2	2.319*	1.028*	0.879*	0.097*	-0.072	0.100	0.043	-0.088	-0.121*	0.362
SE (g_i)	0.334	0.356	0.395	0.037	0.074	0.116	0.053	0.054	0.050	0.057
SE ($g_i - g_l$)	0.517	0.551	0.613	0.058	0.115	0.180	0.082	0.084	0.077	0.088

*Significant at P = 0.05

Table 3. SCA effects of the parental varieties for 10 characters in F_1 of crosses among 6 varieties of rice bean.

Source	Days to 50% flowering	Days to maturity	Plant height(cm)	Branches/ plant	Clusters/ plant	Pods/ plant	Pod length(cm)	Seeds/ pod	100- seed weight (g)	Single plant yield (g)
RBL-1/RBL-6	0.643	1.357	-0.322	-0.190	-0.126	-0.343	0.382*	-0.536*	-0.045	0.213
RBL-1/RBL-50	1.018	1.024	1.383	0.068	0.470*	1.047*	-0.152	-0.595*	-0.011	0.264
RBL-1/RBL-17	-0.524	-0.893	2.812*	0.076	-0.118	0.467	-0.170	0.615*	0.146	0.341*
RBL-1/PRR-2	-0.982	-4.518*	-2.709*	-0.099	-0.105	1.797*	-0.406*	-0.086	-0.250	0.167
RBL-1/KHRP-2	2.393*	1.149	-0.738	0.159	-0.334	-1.217*	-0.362	0.670*	0.175	-0.481*
RBL-6/RBL-50	1.268	4.107*	-3.159*	0.018	0.237	-0.147	-0.715*	0.162	0.402*	-0.464*
RBL-6/RBL-17	2.776*	5.190*	3.670*	-0.107	-0.218	0.374	-0.176	0.011	-0.469*	-0.407*
RBL-6/PRR-2	3.935*	1.232	0.950	0.318*	-0.072	1.804*	0.027	0.204	-0.031	0.908*
RBL-6/KHRP-2	-1.024	-1.434	0.120	0.309*	0.565*	1.690*	-0.068	0.106	0.028	1.154*
RBL-50/RBL-17	3.102*	2.524*	3.674*	0.217*	0.178	0.663*	0.097	-0.440	0.646*	0.357*
RBL-50/PRR-2	-2.691*	-18,435*	3.554*	-0.157	0.157	0.293	0.327*	-0.020	0.104	0.379*
RBL-50/KHRP-2	0.018	0.565	-2.209*	-0.166	-0.038	1.379*	-0.205	0.114	-0.028	0.728*
RBL-17/PRR-2	-1.232	-4.685*	0.916	0.318*	0.603*	1.814*	-0.303*	0.249	0-.150	0.774*
RBL-17/KHRP-2	-1.191	-2.685*	3.654*	0.243*	0.774*	2.100*	0.038	-0.576*	0.238	0.912*
PRR-2/KHRP-2	2.351*	-2.976*	0.366	-0.132	-0.347	-0.170	0.021	-0.097	-0.194	0.128
SE (s_{ij})	0.917	0.977	1.086	0.103	0.204	0.320	0.145	0.149	0.138	0.156
SE (s_{ij}-s_{ik})	1.369	1.459	1.621	0.154	0.305	0.478	0.217	0.222	0.206	0.234
SE (s_{ij}-s_{ik}-s_{kl})	1.267	1.351	1.501	0.142	0.282	0.442	0.201	0.206	0.190	0.216

*Significant at P = 0.05

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