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GENETIC DIVERGENCE ANALYSIS IN RICEBEAN

GYANENDRA SINGH*, S. P. SINGH** AND B. S. CHAUDHARY

Department of Agricultural Botany, Janta Vedic College, Baraut, Meerut 250 611

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ABSTRACT

Genetic divergence using D^2 statistic of 100 rice bean (*Vigna umbellata*) cultivars of different ecogeographic origins revealed existence of considerable diversity. The cultivars were grouped into 15 clusters. The cluster I was the largest containing 40 cultivars followed by cluster II with 14 cultivars. Cluster III, IV and VI had nine cultivars each, whereas cluster V had only five cultivars. The diversity among the cultivars measured by intercluster distance, was adequate for improvement of rice bean by hybridization and selection. The cultivars included in the diverse clusters can be used as promising parents for hybridization programme for obtaining high heterotic response and thus better segregants in rice bean.

Key words: Rice bean, *Vigna umbellata*, genetic diversity.

Rice bean [*Vigna umbellata* (Thunb.) Ohwi & Ohashi] an under utilized legume is native of South and South East Asia [1]. In India rice bean is distributed mainly to the tribal regions of North Eastern Hills, Western and Eastern Ghats in Peninsular India [2]. Rice bean possibly has the highest yielding capacity among the Asiatic chickpeas, and if a sizeable consumer demand builds up, it could become a very useful pulse crop [3]. The genetic divergence analysis using D^2 statistic [4] seems to be a powerful tool for quantifying the degree of divergence.

Rice bean being an under-utilized crop information on quantum of genetic divergence is lacking, hence the present investigation was carried out to measure the genetic diversity to identify suitable parents for hybridization for its improvement.

MATERIALS AND METHODS

The experimental material consisting of 100 cultivars of rice bean (*Vigna umbellata*) collected from different parts of the country was grown in a randomized complete block design with three replications at experimental farm of Janta Vedic College,

Present Address: *Directorate of Wheat Research, Karnal 132 001
**Deptt. Agril. Botany, CCS Univ., Meerut 250 005

Baraut, Meerut, U.P. for two consecutive years during 1992-93 and 1993-94. Each plot consisted of two rows of two meter length, and spaced 30 cm apart maintaining plant to plant distance of 10 cm. All the recommended agronomic practices were followed to raise the crop. Data were recorded on 10 randomly selected competitive plants from each plot for the characters (days to 50% flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, 100-seed weight and seed yield per plant. Replication wise data for each character were subjected for analyses of variances and covariances. Multivariate analysis was done utilising Mahalanobis D^2 statistic and cultivars were grouped into different clusters following Tocher's method as described by Rao [5].

RESULTS AND DISCUSSION

The analysis of variance for each individual character in both the years as well as in pooled data showed highly significant differences among the cultivars for all the nine characters (Table 1). Using Tocher's procedure, 100 cultivars were grouped into 15 clusters (Table 2). Among these, cluster I was the largest and consists 40 cultivars followed by cluster II with 14 cultivars. Clusters III, IV and VI, each had nine cultivars, whereas cluster V had 5 cultivars. Clusters VII, VIII, IX, X and XI accounted for two cultivars in each. Clusters XII, XIII, XIV and XV were unique, since each had only one cultivar. The random distribution of cultivars was evident from cluster I having maximum cultivars with wide distribution. The grouping pattern did not show any relationship between genetic divergence and geographic diversity, which has been a point of debate in the past. Murty and Arunachalam [6] reported that genetic drift and selection in different environments could cause greater diversity than geographic distance.

Table 1. Analysis of variance (pooled) for nine metric traits in rice bean

Source	df	Mean squares								
		Days to flowering	Days to maturity	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100-seed weight	Seed yield
Year (Y)	1		8273.25	22046.00	3888.00	84.45	1340.58	0.01	0.75	11.12
Genotype (T)	99	179.41**	240.95**	512.34**	2.75**	114.66**	5.81**	4.96**	17.59**	7011.61**
Y × T	99	14.59*	104.41**	189.75**	1.58*	17.57**	0.19	0.82**	1.40**	559.78**
Error	396	3.43	4.55	10.58	0.08	3.33	0.12	0.09	0.19	87.01

*, **, Significant at 5% and 1% levels, respectively.

Table 2. Distribution of 100 ricebean cultivars in 15 clusters based on D^2 values

Clusters	Cultivars	Number of Cultivars
I	C × N-49-1-12-2, RCRB-8-215, RBS-109, EC-18565-4, TYPE-1, RBS-9, IC-20769, C × M-78-1-1, IC-16770, EC-117044, PD-30, C × N-7-2, IC-1698, BD-1, BDS-895, RBM-13, EC-18230, IC-26964, IC-26963, RCRB-6-222, RCRB-1-15, EC-18791, IC-16754, RBS-119, IC-73520, RBS-8, CxM-33-P2, IC-17656, IC-16799, IC-15655, BD- 136, RBS-102, BD-139, EC-13791, RCRB-1-2-, M-1-6/6, IC-19351, IC-95699, IC-7567 IC-26950	40
II	RCRT-67, RBSK-1, RCRB-1-6, C × N-5/A, EC-95852-2, RCRB-6- 507, RBS-16, EC-18565, IC-1456431, IC-19350, EC-26365, RCRT-64, RCRT-70, RBS-24	14
III	IC-26967, RBS-2, C × N-3/01-1, AAX-34, EC-97882, N- 781, IC-18111 IC-14655, IC-15163	9
IV	C × M 4-P5, AKSS-83, RBS-110, RCRB-6-218, RCRB-6-10, BR- 12, R × S-10, EC-12562, IC-19097	9
V	RCRB-501, RBS-121, NKG-137, IC-16800-2, RBS-17	5
VI	LOCAL HEE, RBL-1, C × M-12-P9, IC-26954, TYPE-12, RCRB-6-221, RCRB-6-220, IC-2068, RCRB-6-215	9
VII	RBS-112, RCRB-6-506	2
VIII	RCRB-1-206, RBS-8A	2
IX	IC-15668, RCRT-69	2
X	RBS-106, C × M-3-P1-1	2
XI	IC-16771, EC-37242-2	2
XII	RCRT-66	1
XIII	RBS-15	1
XIV	EC-18181	1
XV	C × M P12-7	1

Average intra and intercluster D^2 values among 100 cultivars presented in Table 3 revealed that cluster VII showed minimum intracluster value (35.01) indicating that the cultivars within this cluster were similar. While cluster XI showed maximum intra cluster D^2 value (103.76) followed by cluster X (100.57) and IX (97.09) revealing thereby the existence of diverse cultivars in these clusters. The intercluster D^2 values ranged from 104.02 to 763.36. Minimum intercluster D^2 values was observed between cluster I and III (104.02) indicating the close relationship among the cultivars included

Table 3. Average intra and intercluster D^2 values in 15 clusters of rice bean

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
I	64.78	141.35	104.02	112.93	118.41	150.33	284.98	208.86	192.22	199.17	114.78	535.39	192.76	201.88	380.74
II		79.82	175.26	260.64	238.05	145.01	163.80	190.44	159.00	261.93	168.36	262.68	212.66	279.84	221.77
III			69.48	140.73	163.76	241.93	379.88	127.30	270.45	281.24	203.91	505.39	118.95	170.92	508.66
IV				74.68	130.88	240.33	419.37	296.65	335.18	179.63	162.26	763.36	201.54	317.40	581.15
V					61.51	214.24	287.60	326.45	376.90	117.16	153.75	737.22	272.56	404.80	458.71
VI						78.07	209.51	384.33	153.58	186.88	120.80	434.93	292.44	409.62	186.41
VII							35.01	440.88	279.51	275.18	218.66	439.10	421.83	550.86	166.99
VIII								55.36	376.99	459.57	378.91	328.45	163.46	178.07	549.33
IX									97.09	410.19	183.67	400.82	359.33	249.94	265.00
X										100.57	168.11	694.35	301.76	635.50	374.96
XI											103.76	617.79	282.89	366.49	349.18
XII												-	429.69	591.87	282.06
XIII													-	341.14	558.13
XIV														-	662.75
XV															-

Table 4. Cluster mean values for nine characters in rice bean.

Clusters	Days to flowe-ring	Days to maturity	Plant height (cm)	Branches /plant	Pods /plant	Pod length (cm)	Seeds /pod	100-seed weight (g)	Seed yield (g)
Cluster I	72.95	135.19	82.06	3.15	18.91	8.50	6.80	9.74	94.81
Cluster II	72.05	134.36	81.16	3.65	23.58	9.88	7.69	12.04	130.07
Cluster III	74.70	138.31	85.09	2.92	16.26	7.93	6.71	11.54	69.30
Cluster IV	71.13	133.59	66.59	3.36	15.74	8.16	6.05	9.25	65.04
Cluster V	62.43	124.87	84.60	3.66	16.77	7.72	6.39	9.14	80.20
Cluster VI	69.80	129.39	71.86	3.00	23.96	8.78	8.30	9.37	148.57
Cluster VII	63.33	125.58	84.83	5.64	26.50	10.49	8.90	10.84	134.25
Cluster VIII	79.08	140.33	88.00	3.53	19.71	8.53	5.96	14.77	86.25
Cluster IX	78.25	145.92	80.47	2.88	25.42	10.39	8.58	9.35	146.25
Cluster X	56.00	120.17	64.50	3.38	19.54	8.46	6.84	9.50	103.67
Cluster XI	71.25	127.42	75.25	3.18	20.55	9.83	7.73	8.40	98.42
CLuster XII	77.67	154.00	80.00	2.73	34.57	10.25	8.80	18.70	193.33
Cluster XIII	77.67	147.33	69.67	2.60	14.87	7.88	8.23	15.03	66.67
Cluster XIV	96.00	157.67	114.00	4.57	20.80	8.44	6.60	10.75	112.00
Cluster XV	64.00	135.33	82.67	5.30	47.87	9.11	8.77	10.81	208.33

in these clusters. Maximum intercluster value was observed between cluster IV and cluster XII (763.36) which indicated that the cultivars included in these clusters had maximum divergence. Hence, intermating between the cultivars included in these different clusters may give high heterotic response and thus better segregants.

The average cluster means for nine characters (Table 4) indicates that cultivars included in cluster X were of early flowering and maturity types with average height. These cultivars took minimum days to 50% flowering (56), days to maturity (120.17) and had lowest plant height (64.5cm). Cluster XV gave maximum number pods per plant (47.8) and seed yield (208.33g). Cluster VII showed maximum pod length (10.49), whereas cluster XII showed maximum 100-seed weight. Cultivars in cluster V had the highest mean seed yield, early maturity and medium in height. The cluster XII having the cultivars with high seed yield, bolder seeds, more number of seeds per pod and medium in maturity was the second best cluster.

It can be concluded from the present analysis that the cultivars included in the diverse clusters (cluster IV, V, XII and XV) hold good promise as parents for obtaining potential hybrids and thereby creating large variability for these characters in rice bean.

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