Genetic Divergence for Yield Contributing Traits in Winged Bean [*Psophocarpus tetragonolobus* L. (DC)]

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Genetic divergence in 30 indigenous and exotic collections of winged bean was studied by Mahalanobis D^2 statistic for days to flowering, days to maturity, plant height, pods per plant, pod length and number of seeds per pod. Significant variations were recorded among the genotypes for all the characters. The genotypes were grouped into nine different clusters. The clustering pattern of the genotypes indicated that genetic diversity was uncorrelated with geographic diversity. IC95234 was the best genotype for early maturity, plant height and more number of pods per plant. Days to maturity and plant height contributed maximum towards the genetic divergence. Hybridization of IC95234 with either of IC112416, IC27885-1, EC142654-4 and EC142667 for early maturity and inter crossing among EC038955, EC178331, EC178288 and IC95234 to get dwarf types have been suggested.

Key Words : Winged bean, Genotypes, Genetic divergence, Earliness, Non- staking types

Introduction

Winged bean [*Psophocarpus tetragonolobus* (L.) DC], also known as Goa bean, four angled bean, asparagus pea and princess pea, is a perennial but usually grown as an annual vine. It has climbing habit, attains height of about 2-3 m and requires staking for proper growth and development. It is primarily cultivated for its immature edible pods which are cooked and eaten as a vegetable. It grows abundantly in hot, humid equatorial countries, from Philippines to Indonesia to India, Burma and Sri Lanka. This bean has been referred as "one species supermarket" because practically the whole plant is edible. While the beans are used as a vegetable, the other parts (leaves, flowers, and tuberous roots) are also edible. Dried seeds are generally eaten as roasted or sprouted, can be used as flour and also to make a coffee-like drink. Being a leguminous crop, all parts are rich in protein, vitamin A and other vitamins. Being an under utilized legume very little work has been done on its genetic improvement.

Only one variety AKWB 1 has been released from germplsam selections. For its wider adoption and easy cultivation selection and development of non staking, non shattering varieties with determinate habit and uniform maturity are required. For that matter it is essential to screen the existing material and efforts be made to undertake hybridization programme among the diverse parents. In this direction an effort has been made to evaluate and classify the available indigenous and exotic material with respect to their divergence for various traits.

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Indian J. Plant Genet. Resour. 22(3): 239-242 (2009)

Materials and Methods

The material comprised of 30 strains of indigenous and exotic collections and were grown in complete Randomized Block Design with three replications at main research farm at Birsa Agricultural University, Ranchi during *Kharif*, 2005. The plot for individual genotype comprised single row of 5 m length with intra and inter row spacing of 30 cm and 60 cm respectively. Observations were recorded for six yield attributing traits namely days to flowering, days to maturity, plant height (cm), pods per plant, pod length (cm) and number of seeds per pod from 5 randomly selected competitive plants. The replicated data were subjected to analysis of variance followed by multivariate analysis of D^2 statistic according to Mahalanobis (1936). The genotypes were grouped on the basis of minimum generalized distance using Toucher's method as described by Rao (1952).

Results and Discussion

The analysis of variance revealed significant differences among genotypes for all the six characters (Table 1). The mean values in respect of all the genotypes for all the characters along with SE and CD (5%) have been given in Table 2. As per diversity analysis, 30 genotypes were grouped into nine clusters (Table 3). Cluster III was the largest with 12 genotypes followed by cluster II with 8 genotypes. Cluster V and cluster I had 3 and 2 genotypes respectively, while clusters IV, VI, VII, VIII and IX had only one genotype each. Seven indigenous collections were grouped in three different clusters along with other exotic accessions. These were IC95236, IC95248 and

IC95248 in cluster II, IC95222, IC45229-1 and IC 112416 in cluster III and IC 95234 in cluster VI. This indicated that the geographic diversity is not an indication of genetic diversity. Such information that genetic diversity is not necessarily correlated with eco-geographical distribution has been indicated in other crops as well (De and Rao. 1987; Mishra and Dash,1997; Katiyar, *et al.,* 1998; Appalaswamy and Reddy, 2002; Reddy, *et al.,* 2004; Katiyar, et.al., 2005). Arunachalam and Bandyopadhayay (1984) indicated that the genetic drift and selection in different environments could cause greater diversity than geographic distances. This emphasizes the significance and importance of studying genetic diversity in germplasm irrespective of their geographic diversity in indigenous as well as exotic material.

The inter and intra-cluster D^2 values (Table 4) showed that there was very little diversity within a cluster, cluster III with 12 genotypes having D^2 value 3.46, followed by cluster V with 3 genotypes having D^2 value 2.96 and cluster II with 8 genotypes having D^2 value 2.88. The diversity was maximum between clusters IV and VI (D^2 13.23), followed by between clusters VII and VIII (D^2 12.79) and between 1 and VI (D^2 12.03).

The knowledge of the characters contributing to divergence is an important factor. This helps the breeder to choose parents with highly variable traits to seek

Table 1. ANOVA in respect of six characters in winged bean

Source	d.f.	Days to flowering	Days to maturity	Plant height	Pods/plant	Pod length	No. of seeds/pod
Reps	2	4.48	1.21	270.93	0.41	1.30	1.10
Genotypes	29	146.09**	329.52**	4086.10**	45.86**	8.81**	1.53*
Error	58	6.04	2.85	242.59	6.32	2.54	0.85

* Significant at P= 0.05, ** Significant at P= 0.01

Table 2. Mean values of different characters in respect of 30 winged bean genotypes

Acc.	Days to flowering	Days to maturity	Pl.height(cm)	Pods/plant	Pod length (cm)	No. of seeds /pods
IC45229-1	80.00	169.67	189.00	16.00	19.00	5.50
IC95222	75.00	165.00	213.00	18.00	16.33	6.67
IC95234	66.00	**153.00**	**170.00**	**19.67**	17.33	6.17
IC95236	83.00	179.67	210.00	15.00	14.00	5.13
IC95248	86.00	176.33	230.00	14.00	17.00	5.10
IC112416	78.00	**157.00**	250.00	9.67	14.67	5.07
IC112417	88.00	183.00	187.00	8.33	12.67	6.00
EC21904	72.00	160.00	193.00	18.00	15.00	5.13
EC27885-1	69.33	**155.00**	208.00	12.67	16.33	6.73
EC27886	78.00	162.67	**176.00**	11.00	17.00	6.97
EC27886-A2	89.00	169.33	210.00	9.00	16.67	5.60
EC114273-B	85.00	187.33	181.00	12.00	19.00	6.13
EC116887	76.00	168.00	**176.00**	14.67	13.67	5.07
EC116889	73.67	163.00	230.00	8.00	16.33	6.73
EC121918	76.00	166.67	205.00	9.33	17.00	6.63
EC121919-A	82.00	183.00	245.00	11.33	15.33	6.70
EC142654	80.00	175.00	178.00	10.33	13.00	6.40
EC142654-4	75.00	**157.67**	230.00	16.00	14.33	6.60
EC142662	79.00	162.00	208.67	14.00	15.00	5.50
EC142667	72.00	**159.67**	278.67	13.33	18.33	6.57
EC178266	79.00	170.00	282.67	18.00	15.67	7.07
EC178269	86.00	181.67	241.67	12.00	15.00	5.60
EC178287	90.33	184.00	286.00	8.33	14.33	6.80
EC178288	83.67	175.00	**168.33**	14.00	15.00	6.77
EC178296	88.33	179.33	195.00	12.33	12.00	6.93
EC038955	71.00	176.00	**138.33**	**21.00**	17.00	6.83
EC142665	67.00	180.00	195.00	14.00	15.00	7.00
EC178271	68.33	173.00	181.67	15.67	15.00	7.00
EC178313	72.67	188.00	**170.33**	**21.33**	15.33	6.33
EC178331	71.33	187.33	**161.67**	**20.33**	15.67	7.33
SE	1.42	0.98	8.99	1.45	0.92	0.53
CD(5%)	4.02	2.76	25.46	4.11	2.61	1.50

Table 3. Cluster composition in winged bean

Cluster group	No. of genotypes	Genotypes
I	2	EC178313, EC178331
II	8	EC121919-A, EC178269, IC95236, IC95248, EC178296, EC142654, EC178288, IC112417
III	12	EC116889, EC121918, EC142662, EC27886, IC95222, EC116887, IC45229-1, EC21904, EC142654-4, EC27885-1, IC 112416, EC 142667
IV	1	EC178287
V	3	EC142665, EC178271, EC038955
VI	1	IC95234
VII	1	EC178266
VIII	1	EC114273-B
IX	1	EC27886-A2

genetic improvement through hybridization. The relative contribution of each character towards divergence has been given in Table 5. A perusal of the data (Table 5) indicated that days to maturity contributed maximum (66.21 %) to the genetic divergence followed by plant height (12.41%). Number of seeds per pod and pod length contributed least towards genetic diversity having values 0.69 and 0.92 % respectively. Since plant height and days to maturity are the two important traits in winged bean for development of early maturing and indeterminate type of varieties, the selection of parents for hybridization from different clusters with respect to these traits will be desirable. The perusal of data in Table 3 showed that parents IC95234, IC112416, EC27885-1, EC142654-4 and EC142667 were earlier in maturity (< 160 days). Amongst them IC95234 belonged to cluster VI, whereas IC112416, IC27885-1, EC142654-4 and EC 142667 belonged to cluster III. Therefore, hybridizing IC95234 with either of IC112416, IC27885-1, EC142654-4 and EC142667 could give better early maturing genotypes in segregating generations. Similarly genotypes EC038955, EC178331, EC178288, IC95234, EC 178313, EC27886, EC116887 and EC142654 were short (< 180 cm height) in height. Among them EC 038955 in cluster V was the shortest (138 cm) followed by EC 178331 (161.67 cm) in cluster II, EC178288 (167.33 cm) in cluster I and IC95234 (170 cm) in cluster VI. Therefore, inter crossing of all these divergent genotypes could give still better segregates in respect of short height for easy handling in cultivation of this crop. Exotic genotypes EC178313, EC038955, EC178331 had maximum no. of pods per plant (> 20). Of these genotypes, EC178313 and EC178331 were in cluster I and EC038955 in cluster V. Therefore, inter crossing EC038955 with either of 178313 and EC178331 may throw good segregates in respect of pods per plant. Among the available genotypes IC95234 was the best in respect of early maturity, lower plant height and more number of pods per plant. Therefore this genotype appeared promising and needs multi-location evaluation before recommending for cultivation.

From this study it became evident that wide variations existed among genotypes in respect of plant height, days to maturity and pods per plant. Apart from IC95234 being a promising genotype, hybridizing IC95234 with either of IC112416, IC27885-1, EC142654-4 and EC142667 for early maturity, intercrossing amongst EC038955, EC178331, EC178288 and IC95234 for dwarfing and hybridizing EC038955 with either of EC178313 and EC178331 for more no. of pods per plant can be useful

Table 4. Average intra (in bold) and inter cluster distance (D^2)values in winged bean

Cluster	I	II	III	IV	V	VI	VII	VIII	IX
I	0.85	6.03	9.69	7.69	4.40	12.03	7.78	4.81	9.21
II		2.88	7.00	4.16	5.40	10.65	5.43	3.96	4.43
III			3.46	9.06	6.35	5.18	4.49	9.37	5.24
IV				0.00	7.84	13.23	6.41	4.86	5.97
V					2.96	8.32	5.28	6.16	7.07
VI						0.00	7.56	12.79	8.93
VII							0.00	7.71	5.34
VIII								0.00	6.59
IX									0.00

Table 5. Contribution of different characters towards genetic divergence in winged bean

SI. No.	Characters	Contribution (%)
1	Days to flowering	10.57
2	Days to maturity	66.21
3	Plant height (cm)	12.41
4	Pods per Plant	9.20
5	Pod length (cm)	0.92
6	No. of seed per pod	0.69

in selecting desirable non staking plants with in winged bean for higher productivity and early maturity.

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