Collection and Characterisation of Field Bean [*Lablab purpureus* (L.) Sweet var. *pupureus*]

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Field bean is an ancient domesticate widely cultivated in many tropical and subtropical countries. Despite its wide distribution, adaptability and diversity, it is still considered a neglected crop and underutilised. To understand the available genetic variability and its agronomic potential for future crop improvement, an effort was made to study the variability present in field bean by collecting landraces from farmers. Two exploration and collection missions were conducted resulting in collection of 66 accessions. Among them, 47 accessions were characterised and extensive variability was observed in length, width, thickness and colour of seeds, pod colour, pod curvature, seed shape, pod length and number of pods per plant. The estimation of genotypic co-efficient of variation, phenotypic co-efficient of variation, heritability and genetic advance as % of mean revealed that leaf length, pedicel length, number of primary branches, internode length, pod length, pod width, pod yield/plant, number of pods/plant and 100 seed weight are governed by additive gene action and can be of help in direct selection from phenotypic performance. Ten lines were found potential which need to be evaluated further under multi-locations.

Key Words: Collection, Characterisation, Field bean, *Lablab purpureus* var. *purpureus*, Variability, Landraces, Heritability and Genetic advance

Introduction

Field bean or *Lablab purpureus* (L.) Sweet previously known as *Dolichos lablab* (L.), is cultivated in different parts of the world. It is an ancient domesticate widely distributed in many tropical and subtropical countries where it has become naturalised (Purseglove 1968). In South and Central America, East and West Indies, Asia, China and India, field bean is grown as an annual or as a short-lived perennial (Whyte *et al*., 1953). In these areas, the seed and immature pods are used for human food while the herbage is used as green manure, for erosion control, and as a feed supplement for cattle grazing mature pasture in the dry season (Hendricksen and Minson, 1985). It is used as vegetable (green pods and seeds) and grain legume (Hanelt, 2001). The vegetable type is known as *Lablab purpureus* var. *pupureus* Verdc. and the pulse type as *L. purpureus* var. *lignosus* (Prain) Kumari. The pulse type is called motcha in Tamil Nadu (Nair and Henry, 1983). The field bean is undoubtedly wild in India and also in Java (Hooker, 1879; Candolle, 1959) and was introduced into Africa from South-East Asia during the eighth century (Kay, 1979). It still remains as an important, but minor, crop in many of these regions. In general, tropical legumes tend to be higher in crude lignin and protein and lower in cell wall than tropical grasses (Van Soest, 1994). With an average crude protein of 17% in the dry matter, field bean is slightly above average when compared to other tropical legumes and has considerably more protein than tropical grasses (Norton, 1982). The average of 28% crude fibre in dry matter of field bean ranks less than the majority of tropical legumes and grasses (Norton, 1982). In terms of dry matter digestibility, field bean ranks well compared to both tropical grasses and legumes (Minson and Wilson, 1980). Despite its wide distribution in the tropics, adaptability and diversity, field bean is still considered a neglected and underutilised crop. However, its use as a vegetable, pulse and/or forage crop in the tropical regions with humid to semi-arid climates has resulted in reassessing the potentiality for cultivation in tropical farming systems. For this, an understanding of available genetic variability and its agronomic potential for future crop improvement is essential. Hence an effort was made to collect and study the variability present in field bean.

Materials and Methods

Two exploration and collection missions were conducted to the central and the northern region of Tamil Nadu in April and May 2004 respectively. The physiographic condition of the area surveyed was plains, consisting of red, black or brown loamy soil. The sampling strategy followed was selection of an individual plant from among a population for collection of mature pods. Among the 66 collections, characterisation for five seed characters namely seed length, seed width, seed thickness, 100 seed weight and

seed colour was done in *in situ* condition at the time of collection in 47 accessions. The data was recorded on five seeds/accession. Field evaluation was also done in these 47 accessions in an augmented block design along with 4 check varieties namely RND-1, CO-12, CO-13, DL-40 and DL/6-1 in 5 blocks at Department of Olericulture, College of Horticulture, Kerala Agricultural University. The experiment was conducted in *rabi* 2004-05 and three plants per accession were planted and all plants were taken into consideration for scoring. A total of 22 characters (11 quantitative and 11 qualitative) was recorded. The minimal descriptor of field bean developed by National Bureau Plant Genetic Resources was used. Data were averaged and analysed for standard statistical procedure for calculating range, mean and standard deviation followed for estimating the genotypic and phenotypic co-efficient of variation (Burton, 1952), heritability (Hanson *et al.*, 1956) and genetic advance (Johnson *et al.*, 1955). Frequency distribution of each qualitative character was computed.

Results and Discussions

Exploration and Collection

The two explorations and collection missions executed resulted in the collection of 66 accessions. A total of 37 collection sites in 10 districts of Tamil Nadu was covered (Figure 1). The accessions collected district wise and the landraces collected are given in Table 1. In general, farmers grow this crop in pandals *i.e.*, pole type in the backyard or kitchen garden. The unique landraces of vegetable type collected in Tamil Nadu included *aattukombu avarai* (IC426964) from Villupuram district with twisted pods like a horn of sheep; *kozhiavarai* (IC426951, 426968, 426978, 426983, 426983, 426985, 426989 and 426993) from Dindigul and Tiruchirapalli districts with thin pods that resembled the leg of a chicken; *anaiseviavarai* (IC427443) from Madurai district with broad pods (width of >4.0 cm) that resembled the ear of an elephant. The market attraction goes to *pattaiavarai* (IC427425) with completely purple colored pods and pod length ranging from 23.0-26.0 cm with high yield (60kg/plant).

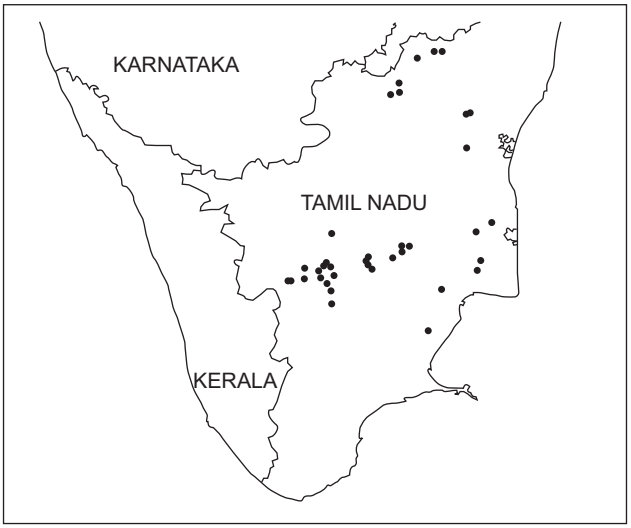

Fig. 1: Collection Sites in Tamil Nadu

Table 1. Cultivars collected from Tamil Nadu

Districts	Accessions (No.)	Cultivar names
Dindigul	27	*belt avarai, koli avarai, pacha avarai, pattai avarai*
Karur	5	*sevavarai, kanu avarai, neela avarai*
Krishnagiri	1	*thotta avarai*
Madurai	2	*anaiseviavarai, pattai Avarai*
Pudukkottai	1	*pachai Avarai*
Thanjavur	1	*avarai*
Thiruvarur	3	*avarai*
Tiruchirappalli	13	*avarai,belt avarai, pachavarai, koli avarai, kanu avarai, patta avaraiyarimai belt avarai*
Vellore	7	*veettu avarai, koli avarai,nattu avarai*
Villupuram	6	*pacha avarai, vella avarai, aattu kombuavarai*

In situ Characterisation of Seed

Extensive variability was found in seed length, seed width, seed thickness, 100 seed weight and color. The range, mean, CV (%) and SD are given in Table 2. The seed color varied from black, black mottled with brown, greenish brown, reddish brown, reddish brown with light brown mottling, brown, shiny reddish brown, cream with dark brown mottling and maroon. The seed length varied from 9.16 to 12.17 mm, width from 7.07 to 10.81 mm, thickness from 4.45 to 7.59 mm and 100 seed weight from 16 to 50 g.

Ex situ Morphological Characterisation

Forty-seven accessions were characterized on the basis of distinguishable phenological and agro-morphological characters. Among the 11 qualitative characters studied, all the accessions were found to be climbing type with stalked inflorescence and were photosensitive. The frequency distribution for rest of the characters is given in Table 3. More variability was found in pod color, pod curvature and seed shape (Fig. 2). The analysis of variance indicated highly significant variation among the

Table 2. *In situ* characterisation of seed characters of field bean

Accessions	Seed length (mm)	Seed width (mm)	Seed thickness (mm)	100 seed weight
Range	9.16-12.97	7.07-10.81	4.45-7.59	16-50
Mean	11.41	8.57	6.07	34.12
SD	0.81	0.73	0.68	8.23
CV (%)	7.07	8.50	11.15	24.13

Table 3. Frequency distribution of qualitative traits

Qualitative Characters	Descriptor states	Accessions (no.)	Frequency %
Stem color	3	37	78.72
	5	10	21.28
Pod color	3	3	6.38
	4	35	74.47
	5	3	6.38
	99	6	12.77
Pod suture color	2	8	17.02
	99	39	82.98
Pod shape	4	37	78.72
	5	10	21.28
Pod curvature	1	26	55.32
	2	6	12.77
	99	15	31.91
Pod surface	1	34	72.34
	2	13	27.66
Seed shape	1	12	25.53
	2	14	29.79
	3	21	44.68
Leaf vein color	2	37	78.72
	3	10	21.28

genotypes for all the quantitative characters except pod width and pod weight/plant (Table 4). The variability may be due to genetic constitution of the materials as well as environmental influence. The development of an effective plant breeding programme is dependent on the existence of genetic variability. The efficiency of selection depends upon the magnitude of genetic variability present in the plant population. The estimates of mean, range, phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV), heritability (h^2) and genetic advance (GA) as % of mean are presented in Table 5. Maximum range was found for pod yield per plant (kg) (0.049-6.05) and minimum range for number of primary branches per plant (2-6). High magnitude of PCV than GCV for all the characters indicated considerable influence of environment on the expression of the characters. Maximum PCV and GCV was observed for number of pods/plant and pod yield/plant. Moderate PCV and GCV for leaf length, pedicel length, pod length and pod width. All the other characters exhibited low GCV and PCV.

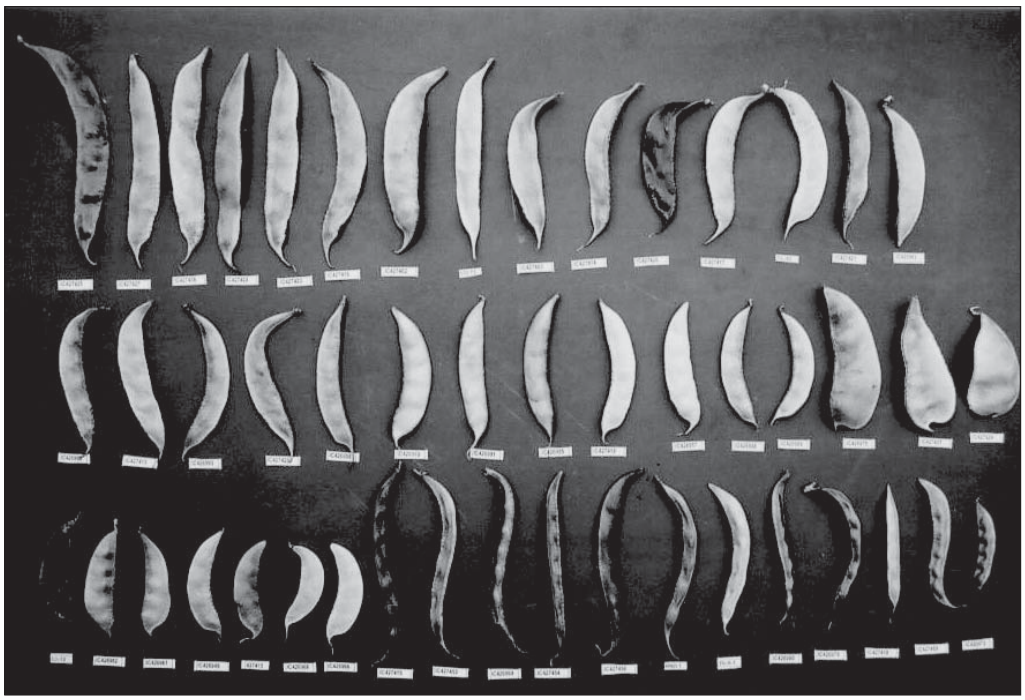

Fig. 2: Variability in pod characters

Table 4. Analysis of variance of quantitative traits

Characters	Mean sum of squares			
	Rows	Columns	Error	CD (0.05%)
Leaf length (cm)	10.42**	0.36	0.75	2.31
Leaf breadth (cm)	7.66**	0.47	1.03	2.71
Pedicel length (cm)	62.00**	5.09	3.22	4.79
No. of primary branches	2.11**	0.05	0.05	0.57
Internode length (cm)	20.74**	1.83	1.74	3.52
Pod length (cm)	30.35**	0.48	0.63	2.12
Pod width (cm)	1.21	0.01	0.03	0.47
Pod yield per plant (g)	2253422.08**	25233.87	26632.41	435.72
No. of pods per plant	335558.55**	3265.65	4665.98	182.38
Pod weight (g)	0.35	0.08	0.11	0.88
100 seed weight (g)	167.39**	4.31	3.60	5.07

Heritability values ranged from 30.38 to 94.36 % for the characters studied. The highest heritability was noted for pod yield/plant, number of pods/plant, pod length, pod width, 100-seed weight and number of primary branches. These characters have more reliable phenotypic performance and there could be more relationship between phenotypic and breeding values. This indicated that substantial genetic improvement can be achieved for these characters. The moderate level of heritability was noted in leaf breadth and internode length and low heritability for pod weight. Heritability only denotes the percentage of effectiveness with which the selection can be based on the phenotypic performance. In order to assess the genetic progress, genetic gain should be measured along with heritability. The value of expected genetic advance was high for the characters like leaf length, pedicel length, number of primary branches, internode length, pod length, pod width, pod yield/plant, number of pods/plant and 100 seed weight and this suggested that these characters are governed by additive gene action and selection will be rewarding for improvement of these traits. Moderate and low genetic advance was recorded for leaf breadth and 100 seed weight. For more reliable conclusion, estimates of heritability and genetic advance should be considered together, which is more useful than heritability alone (Singh and Narayan, 1993). High heritability combined with high genetic advance was recorded for characters like leaf length, pedicel length, number of primary branches, internode length, pod length, pod width, pod yield/plant, number of pods/plant and 100 seed weight and moderate heritability and genetic advance was seen

Table 5. Range, mean and co-efficient of variations of quantitative characters

Character	Mean	GCV (%)	PCV (%)	Heritability (h^2)	Genetic advance as % of mean
Leaf length (cm)	10.82	12.85	24.85	72.06	22.45
Leaf breadth (cm)	9.92	11.63	15.09	56.36	17.94
Pedicel length (cm)	15.36	22.33	25.76	78.53	40.88
No. of primary branches	3.95	16.2	17.22	89.18	31.62
Internode length (cm)	14.24	13.69	16.5	68.59	23.34
Pod length (cm)	11.35	21.49	22.56	90.04	42.11
Pod width (cm)	2.15	22.79	24.19	88.88	44.19
Pod yield per plant (kg)	1.26	52.89	54.47	94.36	112.18
No. of pods per plant	436.44	59.36	61.38	93.49	118.24
Pod weight (g)	3.42	6.41	11.62	30.38	7.28
100 seed weight (g)	30.32	18.84	25.02	88.33	36.44

Table 6. Superior lines identified on the basis of quantitative characters

Character	Accessions (no.)
Pod length (cm) > 14.0 cm	IC427424A, 427427, 427423, 427436, 427463, 427456, 427421, 427428, 427413A, 427424B
Pod width (cm)	IC427424, 427457, 427437, 427445, 426975, 426976
Pod yield/plant (g)	IC426983, 426970B, 427413C, 426980, 426960, 426961, 427462, 427419, 426993, 427421
No. of pods per plant	IC426983, 427413C, 426980, 426970B, 426960, 427419
Pod weight (g)	IC427462, 426959, 427457, 27445, 426958, 427427, 427424A, 427436, 426968, 427428A, 427463, 427424, 427423

in leaf breadth. Hence these characters are governed by additive gene action and can be of help in direct selection from phenotypic performance. On the basis of evaluation of germplasm for various traits, accessions which were found superior were selected and presented in Table 6. IC426983, 426970B, 427413C, 426980, 426960, 426961, 427462, 427419, 426993 and 427421 were potential lines which need to be evaluated further under multi-location testing.

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