

Evaluation of Indian bean genotypes under hot arid environment

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Abstract

Horticultural and morphological studies among twelve genotypes of Indian bean were made for growth, pod quality and yield contributing characters under arid environment to select desirable types for commercial exploitation. Significant variation in all the important characters was observed in the genotypes especially for days to first picking, pods per plant, pod yield per plant, fresh weight, length and width of pod and these characters are of great significance in redesigning the plant architecture of the genotype having higher early yield with better quality pods. The genotypes AHDB-16 (818.0 g), AHDB-15 (707.1 g), AHDB-3 (698.3 g) and AHDB-7 (147.7 g) were found to be promising on the basis of important traits like plant type, fruiting, quality of pod and yield under arid conditions.

Key word: *Indian bean, Lablab purpureus, arid environment.*

Introduction

Indian bean or sem (*Lablab purpureus*) is adapted to a wide range of climatic conditions and also has ability to tolerate the extremes of temperature and drought conditions. It is grown for tender pods and immature and mature seeds. In western parts of India particularly in tribal areas of Rajasthan and Gujarat it is being cultivated as a rescue vegetable crop under rainfed situations. In these areas, farmers generally grow perennial and vine type landraces having low harvest index. In spite of the potentials for crop diversification under drought conditions, suitable cultivars have not yet been developed for arid and semi-arid areas. Its current status as a minor legume vegetable is due to its underexploitation (Samadia *et al.*, 2002). The present need is to develop early maturing and high yielding genotypes with better pod quality attributes. Preliminary identification of desirable genotypes can be done based on characters like days to first picking, number of pods per plant, pod yield per plant and pod quality (Singh *et al.*, 1985; Chattopadhyay *et al.*, 1996 and Pan *et al.*, 2001). Therefore, diverse genotypes collected indigenously were evaluated for horticultural and morphological traits and tested for yield potential to identify suitable types in Indian bean for the cultivation under arid and semi-arid environment.

Materials and methods

The experimental material for the study comprised of twelve indigenous Indian bean genotypes collected from tribal areas of Rajasthan and Gujarat. These genotypes were evaluated during 2000-2001 and 2001-2002 as a rainy-winter season crop at Central Institute for Arid Horticulture, Bikaner. The agro-climate of Bikaner is characterized by extremes of temperature (as low as 1°C in winter and as high as 48°C in summer), low rainfall (250-350 mm) in few spells from July to September, high vapour pressure deficit, intense solar radiation and high wind velocity besides poor soil fertility and water holding capacity. For the experiment, a spacing of 1.5 m was kept between the rows and 3.0 m long channels were made for six plants per genotype which were replicated three times. Thorny twigs support in between wires on iron poles were provided for supporting vining plants. The crop was grown with proper care during both the years (July to February) for recording the observations. Morphological characters were recorded on five plants in a genotype whereas 10 pods at tender stage were harvested/plant from the marked plants of the genotype in each replication. Pooled data were statistically analyzed (Panse and Sukhatme, 1985).

Results and discussion

Data pertaining to various horticultural and morphological characters of twelve genotypes are presented in Table 1 and 2. The plant structure in Indian

bean is one of the important parameters for the feasibility of its economical cultivation. In the present study, there were three types of plant structure *i. e.* viny, inter-mediate and erect. However, most of the genotypes were viny types having moderate to vigorous growth habit except AHDB-7 (erect) and AHDB-12 (semi-erect). The plant height ranged from 0.95 m to 4.12 m. The least inter-nodal length was measured 5.23 cm in the genotype AHDB-7 and maximum for AHDB-15 (15.33 cm). The genotype AHDB-2 and AHDB-9 showed recordable variation in plant pigmentation on leaf stalk base, base of primary branches, inter-nodal region, base of mid rib of leaflet and tender pods.

The period of appearance of flowering in the genotypes ranged from 81.33 to 141.0 days after sowing (DAS). Among the genotypes tested, the appearance of the flowers was earliest in AHDB-16 (81.33) followed by AHDB-15 (83.33) and AHDB-7 (85.33). However, one of the potential genotype AHDB-3 (125.67) was amongst the late flowering types. Days taken for first picking is one of the most important parameters for higher and early yields especially in beans where pods have to be harvested at tender stage for vegetable purpose. Under arid and semi arid conditions of western India short duration genotypes with early flowering and fruit setting (October to February) are desirable. This results in higher productivity because the crop is able to give maximum fruit pickings under moderate range of climatic conditions during period of cultivation. In the present study the range of days to first harvesting varied from 96.33 to 167.67 days. As far as earliness for first picking is concern, the genotype AHDB-16 (96.33 days) gave significantly earliest harvest compared to general mean (105.94 days). The potential genotypes AHDB-15 and AHDB-7 were amongst the early group whereas AHDB-3 (150.6 days) showed late harvesting.

The number of flower per floret, pods per floret, pods per plant and pod weight are the major characters to assess the yield potential of Indian bean genotype. The genotype with more number of pods per floret and per plant along with early setting and picking should result in higher and early production. In the present study, number of flower/floret, pods/floret and pods/plant ranged from 3.4-14.53, 1.16-7.73 and 12.67-116.0, respectively. The significantly highest flowers/floret was recorded for AHDB-16 (14.53). The number of pods per floret was found to maximum in AHDB-7 (7.73) followed by AHDB-16 (6.66) and AHDB-15 (5.50). The genotype AHDB-16 (116.0) followed by AHDB-15 (107.0), AHDB-12 (82.32) and AHDB-3 (85.0) produced significantly higher number of pods per plant than the mean (67.11). Marketable tender pod yield per plant ranged from 58.0 to 818.0 g in the tested genotypes under arid conditions. The genotype

AHDB-16 (818 g) recorded significantly higher tender pod yield per plant, which was followed by AHDB-15 (707.6 g) and AHDB-3 (698.3). However, the genotype AHDB-7 produces only 147.7 g tender pod per plant have also better scope for its utilization owing to erect plant growth habit which does not required any support for the cultivation in open fields. Although, the pods of this early fruit setting genotype are smaller but the number of seeds/pod (4.13) and tender seed weight per pod (1.25 g) are equally better and comparable with other genotypes.

The physical characteristics of tender pods/seeds are very important deciding parameters of a genotype for its palatable acceptability, quality and yield. In the present study wide variations were observed for fresh pod colour (dark green, green, light green to whitish green), pod shape (sickle and slightly sickle or curved and straight) and texture at marketable stage (smooth and rough or glossy and dull). Among the high yielding genotypes, in order of physical characters and acceptable quality of pods are AHDB-3, AHDB-16, AHDB-15, AHDB-17 and AHDB-18. Weight of tender fresh pod varied from 1.84 to 8.47 with a mean 5.77 g/pod. The range for length and width of pod were from 4.15 to 13.55 cm and 0.72 to 2.50 cm, respectively. The genotypes possessing better pod quality traits, *i. e.* AHDB-3, AHDB-16, AHDB-15 and AHDB-18 have desirable pod characters (which require for higher yields and acceptability) like weight, length and width of the pods at tender stage. The weight, length and width of pod and number of seeds per pod in high yielding genotypes were in AHDB-16 (7.09, 9.67, 1.70 and 5.11), AHDB-15 (6.54, 9.24, 1.74 and 5.03) and AHDB-3 (8.47, 13.55, 0.98 and 5.03), respectively. The genotype AHDB-7 (erect type) possessing desirable character for the cultivation without support produces smaller sized pods of 1.84 g in weight, 4.15 cm in length, 0.75 cm in width and 4.13 seeds per pod.

In the present study, the genotypes emerging out superior on the basis of mean values for pod yield and quality contributing traits and also potentialities for successful cultivation under extremes of arid environmental conditions are AHDB-16, AHDB-15, AHDB-3 and AHDB-7 respectively, 1 to 4 in order of merit. Among viny types AHDB-16 and AHDB-15 are early whereas AHDB-3 is late bearer and produces excellent quality pods. The erect and early maturing genotype AHDB-7 is equally potential even with smaller sized pods, since in this genotype the total pod yield could be compensated by more number of plants per unit area in the field resulting in to higher early yields.

Table-1 : Morphological characteristics of Indian bean germplasm under hot arid environment

Genotype	Plant growth habit	Leaf colour	Plant pigmentation	Flower bud colour	Open flower colour	Fresh pod colour	Pod shape	Pod texture	Pod angle	Seed shape	Seed testa colour	Seed coat colour
AHDB-2	Climbing	Light green	L, P, I, M	Dark purple	Purple	Light green*	Sickle	Smooth, glossy	Pendent	Kidney, long	Whitish green	Dark brown
AHDB-3	Climbing	Green	--	Dark purple	Purple	Green	Slightly sickle	Smooth, glossy	Pendent	Kidney, long	Greenish white	Dark brown-greenish
AHDB-6	Climbing	Dark green	I	Dark purple	Purple	Dark green	Sickle curved	Smooth, glossy	Pendent	Kidney, long	White	Dark brown-black
AHDB-7	Erect	Light green	--	Whitish green	White	Whitish green	Sickle curved	Smooth, dull	Horizontal	Round	Whitish brown	Greenish
AHDB-9	Climbing	Dark green	L, P, I, M	Dark purple	Purple	Whitish green*	Straight	Rough, glossy	Pendent	Reniform, kidney	Whitish green	Dark black-brown
AHDB-12	Semi-erect	Green	--	Whitish green	White	Whitish green	Sickle curved	Smooth, dull	Horizontal	Kidney	White	Greenish
AHDB-13	Climbing	Dark green	--	Greenish white	White	Light green	Slightly sickle	Smooth, dull	Horizontal	Kidney	Whitish green	Yellowish
AHDB-15	Climbing	Green	--	Greenish white	White	Light green	Slightly sickle	Smooth, glossy	Pendent	Kidney	Whitish yellow	Creamy white
AHDB-16	Climbing	Dark green	--	Greenish white	White	Light green	Slightly sickle	Smooth, glossy	Pendent	Kidney	Whitish green	Yellowish-white
AHDB-17	Climbing	Green	--	Whitish green	White	Light green	Sickle	Smooth, glossy	Pendent	Kidney	White	Creamy white
AHDB-18	Climbing	Dark green	--	Whitish green	White	Light green	Sickle	Smooth, dull	Pendent	Kidney	Whitish yellow	Yellowish-white
AHDB-19	Climbing	Green	L, P, I	Dark purple	Purple	Green	Sickle	Rough, dull	Pendent	Kidney	Whitish yellow	Creamy white

Pigmentation at leaf stalk base(L), base of primary branches(P), inter-nodal region(I), base of middle rib of leaflets(M) and fresh pod(*).

Table-2: Growth, pod quality and yield contributing characters of Indian bean genotypes.

Genotype	Flowers /flore	Pods /flore	Fresh pod weight (g)	Pod length (cm)	Pod width (cm)	Seeds /pod	Fresh seed weight/ pod (g)	Seed length (cm)	Days to flower (DAS)	Days to harvest (DAS)	Pods/ plant	Pod yield/ plant (g)	Plant height (m)	Inter- nodal length (cm)
AHDB-2	8.46	3.10	3.15	8.46	0.83	4.10	1.62	1.33	130.00	152.33	60.66	185.5	2.13	10.26
AHDB-3	8.93	4.33	8.47	13.55	0.98	5.03	1.81	1.55	125.67	150.60	85.00	698.3	2.82	15.67
AHDB-6	5.66	3.20	8.12	13.17	0.81	4.16	1.76	1.42	110.66	134.25	35.00	104.6	3.24	16.53
AHDB-7	12.43	7.73	1.84	4.15	0.75	4.13	1.25	0.75	85.33	98.33	78.00	147.7	0.95	5.23
AHDB-9	4.56	2.13	8.08	11.85	2.50	4.66	1.84	1.35	111.66	136.30	18.12	144.1	2.52	11.50
AHDB-12	7.60	4.06	2.19	4.52	0.72	3.10	1.19	0.96	120.33	139.66	87.33	191.6	1.51	8.13
AHDB-13	10.86	4.43	7.07	9.03	1.62	4.20	1.78	1.25	89.66	125.00	70.66	489.7	3.46	11.30
AHDB-15	9.33	5.50	6.54	9.24	1.74	5.03	1.72	1.14	83.33	98.67	107.05	707.6	3.13	15.33
AHDB-16	14.53	6.66	7.09	9.67	1.70	5.11	1.76	1.32	81.33	96.33	116.00	818.0	3.24	8.83
AHDB-17	14.43	4.10	5.60	8.25	1.84	4.91	2.35	1.45	94.25	130.65	70.66	404.2	3.56	10.96
AHDB-18	13.73	4.0	6.45	9.06	1.61	5.20	2.13	1.23	98.00	125.00	65.00	419.1	3.56	10.23
AHDB-19	3.40	1.16	4.69	10.12	1.64	5.40	2.06	1.32	141.00	167.67	12.67	58.0	4.12	13.53
CD (5%)	0.57	0.28	0.22	0.26	0.05	0.27	0.13	0.06	4.27	5.27	6.48	16.64	0.18	0.68
CV (%)	3.6	4.1	2.3	1.7	2.0	2.5	4.5	3.1	2.4	2.4	5.7	2.7	3.7	3.5

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