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Screening of Promising Dolichos Bean Genotypes based on Better Seed Quality Attributes

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ABSTRACT The seeds of Dolichos bean genotypes showed varying germination and vigour. Among the 44 genotypes investigated, germinability and seedling vigour ranged from 18% to 98% and 559 to 4614, respectively. Three varieties, namely CHDB-2, Dolichos 2 and Dolichos 3, exhibited a very high germination (>90 %). Germination percentage had significant positive correlation with seedling vigour index and total seedling length. Of these, root length was most significant. However, negative correlation existed between seedling vigour and abnormal or dead seeds. The multivariate clustering analysis following Ward method classified the Dolichos genotypes into two major groups and 5 sub groups.

Key words: Dolichos bean, fresh un-germinated seeds, germination percentage, hard seeds, seedling vigour

The scope to increasing area under vegetables, cultivation is very difficult. In this context, there would be a tremendous emphasis on the availability of high quality seed of improved vegetable varieties and hybrids [1]. In days to come, seed quality would not only mean high germination, physical, genetic purity attributes but also uniform, healthy and vigorous seedlings. The marketable yield and time of maturity is influenced by the time taken for seedling to emerge and so, the assumptions and concerted efforts on developing and screening for promising genotypes with high seed germinability and vigour would help in enhancing the overall productivity [2].

Dolichos bean is one of the most popular legume vegetable crops, which has been assuming importance being an important source of nutrients, vitamins and fiber [3]. Though there is a wide range of variability in this crop, but was not completely exploited due to limited breeding experiments. Among the available genotypes, morphology of edible part varies for the pod shape, pod colour, number of seeds/pod, seed colour, size and seed coat intactness [4]. In addition, major bottleneck in cultivation of the crop is poor germinability and seedling vigour. Having understood the varying germination behaviour of 44 Dolichos bean genotypes, we studied the ability of seeds to develop into vigorous seedlings.

MATERIALS AND METHODS

For screening of promising Dolichos bean genotypes based on better seed quality attributes, 10 seedlings were measured for calculating the seedling vigour index by following a modified formula of Abdul-Baki and Anderson [6].

$$SV\ I = \frac{\text{Germination\%} \times \text{Mean seedling length (cm)}}{100}$$

RESULTS AND DISCISSION

Data depicting the variability among Dolichos genotypes for seed germination percentage presented in Table 1. The genotypes under study exhibited a very wider range of germination per cent, *i.e.* 18.33-98.33 in Dolichos-IC and CHDB-2, respectively. Only 23 per cent of seeds germination was recorded in JDL-101, whereas

Table 1. Seed characters and quality details of *Dolichos* genotypes

Genotype	Seed colour	100-SW	GP	AS	DS	FUS	SL	RL	TSL	SV I
BDB-2	Dark brown speckled	29.71	39.67	30.33	31.50	0.00	9.40	13.47	23.34	861.50
CHDB-1	Black	37.92	88.33	16.00	0.00	0.00	23.87	14.30	38.53	3351.00
CHDB-2	Black	34.39	98.33	10.50	0.00	0.00	20.70	27.43	47.63	4614.30
DC-60	Black	16.96	78.33	25.50	0.00	0.00	11.87	16.63	28.50	2190.53
DOLICHOS 1	Black dimpled	17.36	73.33	30.33	0.00	0.00	20.80	16.53	36.57	2670.60
DOLICHOS 2	Black	21.75	93.33	10.67	0.00	0.00	27.63	16.50	43.83	4053.20
DOLICHOS 3	Black speckled	25.45	94.00	15.83	0.00	0.00	16.63	18.67	34.83	3301.97
DOLICHOS 4	Dark brown	27.00	63.67	46.67	0.00	0.00	12.90	14.40	27.40	1706.20
DOLICHOS 5	Light brown	26.11	53.33	55.17	0.00	0.00	17.63	15.43	33.80	1753.50
DOLICHOS 6	Brown dimpled	16.67	58.33	5.50	36.50	0.00	26.27	18.73	44.53	2585.50
DOLICHOS-l0c	Brown	28.85	18.33	90.67	0.00	0.00	16.57	14.43	31.03	559.50
DOLICHOS 10	Light brown	25.56	74.67	26.16	0.00	0.00	23.33	20.20	43.60	3181.30
DOLICHOS 141a	Black	21.93	31.33	80.50	0.00	0.00	27.60	17.57	43.23	1220.30
DOLICHOS 141b	Light brown	20.56	72.33	16.33	11.50	0.00	16.67	14.33	30.80	2292.03
DR/SP-122	Creamy white	26.79	74.33	30.33	0.00	0.00	15.40	15.47	28.57	2050.13
DR-SP-7	Creamy white	28.08	39.67	45.33	0.00	0.00	26.77	17.57	44.50	2777.27
EC 454157	Black	16.17	63.33	55.50	6.50	0.00	17.83	12.63	33.67	1163.37
EC 454158	Black	19.51	83.00	16.00	1.50	0.00	27.17	22.57	43.40	3575.90
EC 454159	Black	13.04	84.64	10.33	1.50	2.00	15.77	16.43	31.80	2579.67
FD-54	Light brown	29.23	48.33	30.50	21.50	3.50	16.43	11.37	27.80	1324.00
Gomichi green	Light brown	13.92	33.00	15.00	51.83	0.00	17.37	9.40	27.10	893.70
JDL-10	Light brown	24.21	68.33	20.33	11.50	0.00	17.80	23.37	41.80	2793.60
JDL-21	Creamy white	22.07	31.00	60.17	0.00	10.17	10.73	11.80	22.50	745.50
JDL-23	Creamy brown	26.64	54.33	45.50	1.67	0.00	16.63	23.37	40.87	2124.40
JDL-29	Light brown	20.36	60.67	45.33	0.00	0.00	12.50	15.20	27.47	1769.20
JDL-40	Light brown	22.93	70.67	35.17	0.00	0.00	21.00	7.77	28.57	2086.50
JDL-44	Light brown	18.15	73.33	20.50	6.67	0.00	25.37	14.20	39.73	2889.50
JDL-63	Light brown	26.45	78.67	20.50	1.67	0.00	18.10	17.50	35.27	2736.40

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Table 1. contd ...

JDL-71	Black	22.40	82.33	15.50	0.00	10.00	22.20	14.57	36.93	3036.40
JDL-101	Light brown	19.65	23.00	35.50	41.50	0.00	12.03	16.27	27.97	645.90
JDL-403	Light brown	24.45	67.00	25.33	6.50	0.00	17.73	18.70	36.83	2487.60
JDR-01-85	Black round	20.47	88.33	20.33	0.00	0.00	13.27	21.67	34.90	3043.30
KDB 403	Black dimpled	30.93	73.67	35.83	0.00	0.00	8.80	9.40	22.17	1320.10
KDB 405	Black	25.81	52.33	30.50	0.00	5.00	10.27	20.83	30.87	1620.90
RHRDB1	Creamy white	22.01	54.33	50.33	0.00	2.17	18.67	12.17	30.93	1625.70
RHRDB-2	Light brown speckled	26.96	52.67	35.67	11.67	0.00	13.03	22.60	35.60	1859.30
RHRWL-2	Black dimpled	36.64	38.00	55.33	6.50	0.00	16.57	14.57	30.77	1162.20
SEM-7	Light brown	29.73	73.67	20.50	0.00	0.00	18.57	14.27	32.57	2378.20
SP-04-13	Black	32.21	37.33	45.17	16.33	0.00	11.57	11.30	23.47	877.10
VRD-19	Dark brown speckled	34.81	42.67	61.17	1.67	0.00	14.63	9.40	24.57	921.30
VRD-1	Dark brown	22.68	30.33	25.50	46.00	0.00	9.53	5.67	14.63	408.27
VRD-11	Dark brown	28.56	69.33	25.83	1.83	5.00	18.50	11.43	33.90	2025.60
VRD-12	Black	24.28	58.00	40.33	0.00	5.17	19.27	11.73	30.50	1773.76
VRD-14	Black	17.19	68.33	35.50	0.00	0.00	12.57	12.53	26.60	1739.60
CD (5%)		8.32	7.44	6.88	2.87	1.39	7.67	5.69	8.34	14.89

Where, GP: Germination percentage; AS: abnormal seedlings; DS: dead seeds; FUS: fresh un-germinated seeds; SL: shoot length; RL: root length; TSL: total seedling length; 100-SW- hundred seed weight

eight other genotypes (CRD-1, JDL-21, Dolichos-141 A, Gomichi green, SP-04013, RHRWL-2, BDB-2 and DR-SP-7) recorded less than 40 per cent germination. Only two genotypes (VRD-19 and FD-54) showed 40-50 per cent germination. However, 50-60 per cent and 60-70 per cent germination was found in 7 genotypes each.

The germination (70%), relatively satisfactory, was recorded in 10 genotypes (Table 1). More than 80 per cent germination was found in five genotypes, whereas only 3 varieties (Dolichos-2, Dolichos-3 and CHDB-2) exhibited germination of more than 90 per cent. Data depicted that number of abnormal seedlings varied with the genotypes, *i.e.* 90.7 (Dolichos-IC) to 5.5 per cent (Dolichos-6) and showed inverse relationship with germination per cent. Dolichos-6 showed a very few abnormal seedlings despite the effective germination percentage of 58.33. Abnormal seedlings were those, which possess disproportionate seedling development, *viz.* reduced/distorted shoot and root growth.

The most probable reasons for appearance of abnormal seedlings were inappropriate seed development and maturity, defective and injured seed coat, imbalance between growth promoting and growth inhibiting hormones, affecting the germination and adverse environmental conditions during seed development and germination. However, in the present study, though the standard temperature and humidity were maintained during seed germination testing, the vagaries in the data on abnormal seedlings was due to thin seed coat, improper seed filling and low seed weight. The number of dead seeds varied among the varieties (0 to 52 %).

Descriptive and correlation analysis

Highest variability was observed in seedling vigour index, followed by abnormal seeds, germination percentage and dead seeds (Table 2). Consistent performance was exhibited by fresh ungerminated seeds. Germination percentage had significant positive correlation with seedling vigour index, followed by total seedling length and root length in particular (Table 3). However, negative correlation existed between germination percentage and abnormal seeds or dead seeds. Similarly, significant negative correlation was observed between abnormal seeds and seedling vigour index. Dead seeds had negative empirical relationship with seedling vigour index, whereas significant positive correlation existed between seedling vigour index and shoot length, root length and total seedling length. Thus, total seedling length had significant direct correlation with shoot length and/or root length. The 100-seed weight expressed moderate correlation with abnormal seedlings and dead seeds.

Table 2. Descriptive statistics of morphological traits of dolichos genotypes

Statistics	GP	AS	DS	FUS	SL	RL	TSL	SV I	100-SW
Mean	61.63	33.39	7.18	0.98	17.45	15.55	33.04	2063.09	24.47
Standard error	3.10	2.81	2.04	0.37	0.79	0.69	1.10	147.52	0.89
Median	65.34	30.33	0.00	0.00	17.02	14.89	32.19	2037.87	24.37
Mode	39.67	30.33	0.00	0.00	16.63	9.40	28.57		
Standard deviation	20.53	18.64	13.55	2.45	5.26	4.56	7.31	978.54	5.90
Sample variance	421.52	347.32	183.70	6.02	27.65	20.76	53.50	957534.42	34.86
Kurtosis	-0.76	1.18	3.79	7.59	-0.58	0.15	-0.30	-0.21	-0.27
Skewness	-0.29	1.04	2.17	2.80	0.38	0.35	0.00	0.38	0.25
Range									
Minimum	18.33	5.50	0.00	0.00	8.80	5.67	14.63	408.27	13.04
Maximum	98.33	90.67	51.83	10.17	27.63	27.43	47.63	4614.30	37.92

Table 3. Correlation studies of seed quality attributes

GP	AS	DS	FUS	SL	RL	TSL	SV I	100-SW
1.0	–0.677**	–0.492*	–0.068	0.305*	0.376*	0.441*	0.857**	–0.084
	1.0	–0.222	0.029	–0.181	–0.252	–0.260	–0.647**	0.227
		1.0	–0.155	–0.208	–0.263	–0.314*	–0.424*	–0.217
			1.0	–0.084	–0.171	–0.147	–0.097	–0.049
				1.0	0.272	0.817**	0.608*	–0.099
					1.0	0.747**	0.626*	0.003
						1.0	0.772**	–0.037
							1.0	–0.024
								1.0

Where, GP: Germination percentage; AS: abnormal seedlings; DS: dead seeds; FUS: fresh un-germinated seeds; SL: shoot length; RL: root length; TSL: total seedling length; 100-SW- hundred seed weight
* and ** - significant at 5% and 1 % level of significance, respectively

Multivariate hierarchical analysis

Multivariate hierarchical clustering was carried for nine morphological characters (Fig. 1). Distance between all pairs of genotypes was calculated using Squared Euclidean Distance method. The genptypes were clustered based on Ward's method [7]. Cluster analysis showed mainly 2 clusters. From the dendrogram, it can be concluded that the genotypes were mainly divided at the first node into 2 clusters of 18 and 26 genotypes in different groups. Cluster with 26 genotypes was further divided into 2 parts at the second node, with 13 genotypes in each group. The remaining 18 genotypes were divided into 2 groups at the second node, with 13 genotypes in each group. The remaining 18 genotypes were further divided into 2 groups at the third node with 2 and 16 genotypes, which further sub-divided into 2 groups with 6 and 10, genotypes, respectively.

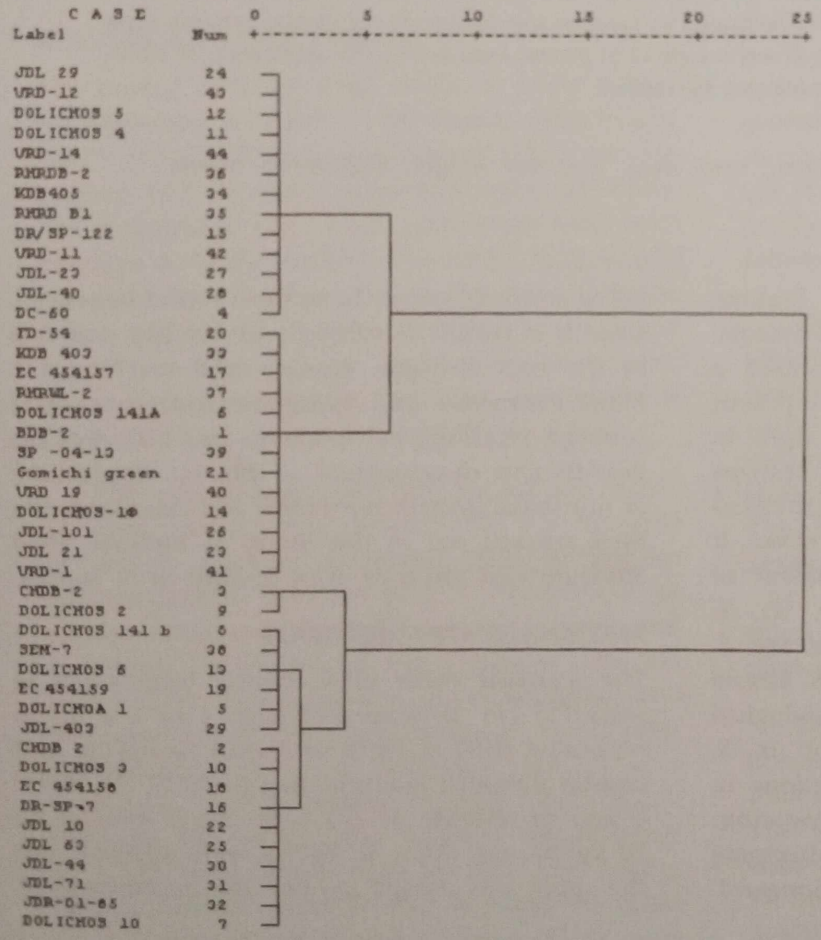

Fig. 1. Multivariate cluster analysis of 44 genotypes using Ward's method

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