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Variability and character association studies in dolichos bean (*Lablab purpureus* L.) genotypes

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ABSTRACT

The present investigation was carried out at Horticultural College and Research Institute, Venkataramannagudem, West Godavari Dist. (Andhra Pradesh). The experimental material comprised of 12 genotypes of *Lablab purpureus* collected from IIPR Kanpur and AICRP on pigeon pea Bangalore. A wide range of variability was reported in most of the characters. The highest genotypic coefficient of variation was recorded for number of pods per plant followed by pod yield per hectare and lowest in days to first pod harvest. Higher heritability estimates coupled with high genetic advance as per cent of mean were observed for all the characters except days to first harvest and pod width. Correlation coefficient analysis revealed that number of secondary branches per plant, number of inflorescences per plant, number of pods per inflorescence, number of pods per plant, number of seeds per pod, pod width, days to last harvest and 100 seed weight had the significant positive correlation with marketable green pod yield per plant. Path analysis revealed true relationship between yield and number of secondary branches per plant, number of pods per inflorescence and number of pods per plant and direct selection for these traits will be rewarding for yield improvement as correlation was due to direct effect of the characters. Hence, selection based on these characters could be effective in developing high yielding varieties of dolichos bean for coastal Andhra Pradesh.

Key words: Biometrical studies, Correlation, Path analysis

INTRODUCTION

Dolichos bean or Hyacinth bean or Sem (*Dolichos lablab* L.) is an important leguminous vegetable grown throughout the country and is distributed in Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu and North eastern states. Great range of variation exists in the plant and pod characters among the cultivars grown all over the country (Peter and Kumar 2008). Genetic variability, character association and path coefficient are pre-requisite for improvement of any crop for the selection of superior genotypes and improvement of any traits. It is very difficult to judge whether observed variability is heritable or due to environment alone. Knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of a character in future generations. Knowledge of correlation between yield and its contributing characters are basic and for most endeavor to find out guide lines for plant selection. Partitioning of total correlation into direct and indirect effect by path coefficient analysis helps in making the selection more effective (Biju *et al.* 2001).

Among the quantitative characters, yield is a complex character, which is dependent on a number of yield contributing characters. The knowledge of the association of yield components and their relative contribution shown by path analysis has practical significance in selection. The study of the association between pairs of characters and yield provides basis for further breeding programme. Therefore, the present studies were aimed at to study the correlation and path analysis among twelve genotypes of dolichos bean.

MATERIALS AND METHODS

A field experiment was conducted at Horticultural College and Research Institute, Venkataramannagudem, West Godavari Dist. (Andhra Pradesh) during *Kharif* season of 2012. Twelve genotypes of dolichos bean *viz.* Culture 4, Culture 7, Culture 47, Culture 62, GL-243, GL-388, GL-411, GL-671, GL-416, HA-4, Arka Jay (C) and Arka Vijay (C) were grown in a randomized block design with three replications. These were planted in a two row plot. The plot size and spacing were 3.6 × 3.0 m and 60 × 30 cm, respectively. Five plants were taken for recording

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observations on eighteen characters *viz.* plant height (cm), number of primary branches per plant, number of secondary branches per plant, days to first flowering, days to 50 per cent flowering, number of pods per inflorescence, number of inflorescences per plant, days to first pod harvest, days to last pod harvest, pod length (cm), pod width (cm), number of seeds per pod, number of pods per plant, mean pod weight, 100 seed weight (g), protein content (%), pod yield per plant (g) and pod yield per hectare (q).

The data were statistically analyzed for computation of genetic coefficients of variation and broad sense heritability was estimated as per the formula suggested by Burton (1952). The expected genetic advance was calculated by using formula as suggested by Johnson *et al.* (1955). Correlation coefficients were carried out according to the method suggested by Al-Jibouri *et al.* (1958) and path coefficient analysis was adopted as given by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Variability, heritability and genetic advance analysis: The analysis of variance revealed significant differences among the genotypes indicating presence of sufficient amount of variability in all the characters studied. Wide range of variability was observed for plant height, number of secondary branches per plant, number of inflorescences per plant, number of pods per inflorescence, number of pods per plant, pod yield per plant, 100 seed weight and pod yield per hectare indicating the scope for selection of suitable initial breeding material for further improvement. A wide range of variations existing for various quantitative traits has also been reported in dolichos bean by Nahar and Newaz (2005) and Upadhyay and Mehta (2010).

A wide range of variation was found for mean performances of the 18 quantitative characters in twelve genotypes of dolichos bean (Table 1). On the basis of the mean performance of the genotypes among traits studied, the following were identified as promising lines for further crop improvement in dolichos bean *viz.*, GL-243, Culture-47 and GL-671. Among all the genotypes studied, genotypes GL-243 recorded the highest pod yield per plant and found suitable to the local agro-climatic conditions. Genotype GL-243, GL-671 recorded significantly better performance than the checks for marketable pod yield per plant along with more number of inflorescences per plant, number of pods per inflorescence, number of pods per plant, days to last harvest and 100 seed weight. Hence, the genotypes GL-243, Culture-47 and GL-671 can be used for further improvement.

Estimates of variability, heritability and genetic advance as per cent of mean for eighteen characters in twelve

TABLE 1: Mean performances of the 18 quantitative characters in twelve genotypes of dolichos bean

S. No.	PH	NPB	NSB	DFF	DF50%	NIP	NPI	NPP	NSP	MPW	PL	PW	DFH	DLH	PYPP	HSW	PC	PYPH
Culture-4	97.20	4.26	8.05	66.88	68.90	5.87	3.85	20.50	3.90	4.30	6.65	1.64	90.16	115.39	86.30	29.84	27.65	47
Culture -7	110.13	4.30	9.05	57.49	60.42	11.29	2.91	30.16	4.08	3.82	7.66	1.57	83.39	148.85	116.65	23.62	26.04	64
Culture -47	109.26	2.60	14.56	46.84	48.85	12.81	7.34	78.34	4.65	3.57	6.52	1.80	73.75	170.26	265.84	54.42	19.60	147
Culture -62	121.53	3.30	12.73	63.23	67.16	12.25	6.18	70.27	3.54	2.86	4.92	1.98	89.34	131.75	203.27	19.68	27.66	112
GL-243	85.43	2.50	15.28	44.76	46.76	13.53	7.93	93.12	3.77	3.41	5.57	2.06	70.35	175.51	300.83	61.63	17.74	167
GL-388	79.23	3.25	13.50	49.40	52.40	11.39	6.45	71.14	3.40	2.98	5.31	1.84	76.48	157.42	212.50	43.24	24.65	118
GL-411	75.63	2.92	12.26	55.39	58.42	10.46	6.86	68.38	3.63	2.42	4.73	1.52	83.13	146.29	166.11	33.83	25.64	92
GL-671	74.70	2.89	13.85	48.65	50.65	12.57	7.15	75.64	3.67	3.43	5.73	1.71	75.49	167.31	252.61	53.85	20.57	140
GL-416	73.67	3.28	9.93	60.71	63.72	8.48	6.38	53.13	3.58	2.13	5.00	2.02	86.58	141.42	113.69	33.80	26.82	63
HA-4	68.33	3.46	6.36	48.48	51.44	4.07	5.73	20.53	3.35	4.44	5.49	1.83	72.82	137.67	91.38	30.36	19.25	50
Arka Jay(C)	68.40	3.50	10.18	42.69	44.68	10.88	5.32	57.79	4.10	4.04	8.55	1.76	71.49	139.84	234.37	32.50	22.80	130
ArkaVijay(C)	63.91	3.47	10.26	40.26	42.38	11.50	5.39	62.20	4.64	3.90	6.79	2.08	68.46	151.92	242.40	41.47	20.19	134
Grand mean	**85.62**	**3.31**	**11.33**	**52.06**	**54.65**	**10.42**	**5.95**	**58.43**	**3.86**	**3.44**	**6.07**	**1.82**	**78.45**	**148.63**	**190.49**	**38.19**	**23.21**	**105**
SEm ±	0.63	0.05	0.34	0.44	0.50	0.32	0.20	0.38	0.04	0.03	0.19	0.05	0.61	0.76	2.81	0.66	0.17	0.19
CV (%)	1.27	2.86	5.30	1.46	1.61	5.43	5.88	1.15	1.94	1.98	5.65	5.02	1.34	0.89	2.56	3.02	1.26	0.32
CD (P=0.05)	1.85	0.16	1.01	1.29	1.49	0.95	0.59	1.14	0.12	0.11	0.58	0.15	1.79	2.24	8.26	1.95	0.49	0.58

genotypes of dolichos bean (Table 2) revealed that PCV estimates of all characters were slightly higher than that of GCV indicating the less influence of environment. Among the characters studied, high PCV and GCV were observed for characters like plant height, number of secondary branches per plant, number of inflorescences per plant, number of pods per inflorescence, number of pods per plant, pod yield per plant, 100 seed weight and pod yield per hectare indicating high variability available in the germplasm for these characters for further improvement. Present results were similar with the findings of Mishra *et al.* (2008), Savitha (2008), Rai *et al.* (2009) and Upadhyay and Mehta (2010).

High heritability coupled with high genetic advance as per cent of mean was recorded for all the characters except days to first harvest and pod width indicated that these characters were least influenced by the environmental effects and these characters were governed by additive genes and selection will be rewarding for improvement of such traits. High heritability and moderate GA as per cent mean values were observed for the characters *viz.*, days to first pod harvest and pod width. This indicates the influence of non additive gene action and considerable influence of environment on the expression of these traits. These traits could be exploited through manifestation of dominance and epistatic components through heterosis breeding. Hence, the breeder should adopt suitable breeding methodology to utilize both additive and non additive gene effects simultaneously, since varietal and hybrid development will go a long way in the breeding programmes, especially in case of dolichos bean.

Correlation analysis: Phenotypic (P) and genotypic (G) correlation coefficients among eighteen yield and yield attributes in twelve genotypes of dolichos bean (Table 3) revealed that genotypic correlations were higher than respective phenotypic correlations indicating strong inherent relationship among the characters studied. From correlation studies, it was observed that marketable pod yield per plant exhibited highly significant positive association with number of secondary branches per plant, number of inflorescences per plant, number of pods per inflorescence, number of pods per plant, number of seeds per pod, pod width, days to last harvest and 100 seed weight. These results are in consonance with the findings of Sirohi (2005), Chauhan *et al*. (2007), Bangar *et al.* (2008), Konda *et al*. (2008), Mishra *et al.* (2008), Nahar and Newaz (2005) and Rai *et al*. (2009). Present results indicated the importance of these traits in selection for marketable pod yield per plant. Hence, direct selection based on these traits would result in simultaneous improvement of aforesaid traits and yield in dolichos bean.

TABLE 2: Estimates of variability, heritability and genetic advance as per cent of mean for eighteen characters in twelve genotypes of dolichos bean

Characters	Range		Mean	Variance		PCV (%)	GCV (%)	h^2 (%)	Genetic Advance	GA as of mean per cent
	Minimum	Maximum		Phenotypic	Genotypic					
Plant height (cm)	63.91	121.53	85.62	369.24	368.05	22.44	22.40	99.67	39.45	46.08
No. of 1° branches per plant	2.50	4.30	3.31	0.32	0.31	17.10	16.85	97.19	1.13	34.23
No. of 2° branches per plant	6.36	15.28	11.33	7.96	7.60	24.90	24.33	95.47	5.55	48.98
Days to first flowering	40.26	66.88	52.06	73.01	72.42	16.41	16.34	99.20	17.46	33.53
Days to 50 per cent flowering	42.38	68.90	54.65	79.30	78.53	16.29	16.21	99.02	18.16	33.24
No. of inflorescences per plant	4.07	13.53	10.42	8.50	8.18	27.96	27.43	96.22	5.77	55.43
No. of pods per inflorescences	2.91	7.93	5.95	2.16	2.04	24.70	23.99	94.33	2.86	48.01
Number of pods per plant	20.50	93.12	58.43	547.05	546.60	40.02	40.00	99.92	48.14	82.38
No. of seeds per pod	3.35	4.65	3.86	0.19	0.18	11.40	11.24	97.09	0.88	22.81
Mean pod weight (g)	2.13	4.44	3.44	0.52	0.53	21.09	20.99	99.12	1.48	43.06
Pod length (cm)	4.73	8.55	6.07	1.46	1.34	19.92	19.10	91.94	2.29	37.74
Pod width (cm)	1.52	2.08	1.82	0.041	0.03	11.19	10.00	79.86	0.33	18.41
Days to first pod harvest	68.46	90.16	78.45	59.69	58.57	9.84	9.75	98.12	15.61	19.90
Days to last pod harvest	115.39	175.51	148.63	298.63	296.88	11.62	11.59	99.41	35.39	23.80
Pod yield per plant (g)	86.30	300.83	190.49	5434.25	5410.42	38.69	38.61	99.56	151.19	79.36
100 seed weight (g)	19.68	61.63	38.19	169.15	167.82	34.05	33.92	99.21	26.58	69.60
Protein content (%)	17.74	27.66	23.21	13.09	13.00	15.58	15.53	99.34	7.40	31.89
Pod yield per ha (q)	47.82	167.48	105.80	1676.80	1676.69	38.70	38.69	99.99	84.34	79.71

TABLE 3: Phenotypic (P) and genotypic (G) correlation coefficients among eighteen yield and yield attributes in twelve genotypes of dolichos bean

Character		PH	NPB	NSB	DFF	DF50%	NIP	NPI	NPP	SP	MPW	PL	PW	DFH	DLH	HSW	PC
PH	**G**	**1.000**															
	P	**1.000**															
NPB	G	0.153	**1.000**														
	P	0.154	**1.000**														
NSB	**G**	0.217	-0.798**	**1.000**													
	P	0.213	-0.768**	**1.000**													
DFF	**G**	0.545**	0.473**	-0.285	**1.000**												
	P	0.544**	0.468**	-0.273	**1.000**												
DF50%	**G**	0.548**	0.467**	-0.281	1.000**	**1.000**											
	P	0.545**	0.454**	-0.276	0.989**	**1.000**											
NIP	**G**	0.268	-0.528**	0.869**	-0.368*	-0.362*	**1.000**										
	P	0.261	-0.515**	0.838**	-0.357*	-0.355*	**1.000**										
NPI	**G**	-0.205	-0.993**	0.760**	-0.388*	-0.378*	0.439**	**1.000**									
	P	-0.194	-0.953**	0.732**	-0.374*	-0.367*	0.403*	**1.000**									
NPP	**G**	0.007	-0.858**	0.958**	-0.433**	-0.425**	0.855**	0.827**	**1.000**								
	P	0.007	-0.846**	0.935**	-0.431**	-0.424**	0.839**	0.804**	**1.000**								
NSP	**G**	0.126	0.025	0.093	-0.399*	-0.423*	0.358*	-0.171	0.119	**1.000**							
	P	0.124	0.029	0.092	-0.388*	-0.418*	0.351*	-0.166	0.118	**1.000**							
MPW	**G**	-0.045	-0.438**	-0.479**	-0.298	-0.322	-0.349*	-0.488**	-0.584**	0.352*	**1.000**						
	P	-0.044	-0.426**	-0.463**	-0.295	-0.320	-0.341*	-0.473**	-0.505**	0.349*	**1.000**						
PL	**G**	0.006	0.487**	-0.302	-0.317	-0.343*	0.054	0.596**	-0.297	0.655**	0.670**	**1.000**					
	P	0.006	0.453**	-0.281	-0.306	-0.332*	0.079	0.566**	-0.285	0.614**	0.645**	**1.000**					
PW	**G**	-0.165	-0.364*	0.221	-0.320	-0.306	0.201	0.407*	0.400*	0.071	-0.154	-0.242	**1.000**				
	P	-0.146	-0.331*	0.193	-0.285	-0.271	0.191	0.383*	0.361*	0.057	-0.146	-0.211	**1.000**				
DFH	**G**	0.541**	0.454**	-0.233	0.990**	0.993**	-0.279	-0.377*	-0.366*	-0.367*	-0.386*	-0.304	-0.341*	**1.000**			
	P	0.534**	0.442**	-0.220	0.978**	0.976**	-0.275	-0.354*	-0.362*	-0.354*	-0.382*	-0.287	-0.304	**1.000**			
DLH	**G**	-0.099	-0.741**	0.756**	-0.658**	-0.658**	0.715**	0.649**	0.744**	0.239	-0.173	-0.083	0.233	-0.649**	**1.000**		
	P	-0.098	-0.725**	0.741**	-0.655**	-0.654**	0.698**	0.625**	0.741**	0.235	-0.172	-0.079	0.205	-0.644**	**1.000**		
HSW	**G**	-0.250	-0.749**	0.697**	-0.612**	-0.635**	0.494**	0.709**	0.682**	0.243	-0.023	-0.096	0.284	-.642**	0.852**	**1.000**	
	P	-0.248	-0.731**	0.679**	-0.605**	-0.630**	0.477**	0.694**	0.678**	0.240	-0.027	-0.108	0.260	-0.629**	0.846**	**1.000**	
PC	**G**	0.380*	0.580**	-0.283	0.852**	0.859**	-0.218	-0.503**	-0.366*	-0.297	-0.398*	-0.112	-0.350*	0.910**	-0.699**	-0.748**	**1.000**
	P	0.378*	0.561**	-0.274	0.846**	0.854**	-0.213	-0.487**	-0.366*	-0.294	-0.392*	-0.108	-0.309	0.901**	-0.696**	-0.742**	**1.000**
PYPP	**G**	**-0.039**	**-0.728****	**0.844****	**-0.680****	**-0.683****	**0.848****	**0.658****	**0.896****	**0.376***	**-0.090**	**0.072**	**0.405***	**-0.634****	**0.764****	**0.738****	**-0.596****
	P	**-0.040**	**-0.715****	**0.820****	**-0.676****	**-0.678****	**0.832****	**0.640****	**0.893****	**0.370***	**-0.092**	**0.067**	**0.367***	**-0.625****	**0.760****	**0.735****	**-0.594****

*significant at 0.05% LOS ** significant at 0.01 % Level of significance
If correlation r => 0.32910 0.42379

TABLE 4: Direct and indirect effects of various yield and yield attributes on pod yield in twelve genotypes of dolichos bean

Character		NPB	NSB	DFF	DF50%	NIP	NPI	NPP	DFH	DLH	HSW	PC
NPB	G	**-0.225**	0.179	-0.106	-0.105	0.119	0.223	0.193	-0.102	0.167	0.168	-0.130
	P	**0.196**	-0.150	0.091	0.089	-0.101	-0.187	-0.166	0.086	-0.142	-0.143	0.110
NSB	G	-0.576	**0.721**	-0.205	-0.202	0.627	0.548	0.691	-0.168	0.545	0.502	-0.204
	P	-0.213	**0.277**	-0.075	-0.076	0.232	0.203	0.259	-0.061	0.205	0.188	-0.076
DFF	G	-0.317	0.191	**-0.670**	-0.672	0.247	0.260	0.290	-0.664	0.441	0.410	-0.571
	P	-0.252	0.146	**-0.538**	-0.533	0.192	0.201	0.232	-0.527	0.353	0.326	-0.456
DF50%	G	0.021	-0.013	0.046	**0.046**	-0.017	-0.017	-0.019	0.046	-0.030	-0.029	0.040
	P	0.105	-0.064	0.229	**0.232**	-0.082	-0.085	-0.098	0.226	-0.151	-0.146	0.198
NIP	G	-0.087	0.143	-0.060	-0.059	**0.165**	0.072	0.141	-0.046	0.118	0.081	-0.036
	P	-0.229	0.373	-0.159	-0.158	**0.445**	0.179	0.373	-0.122	0.310	0.212	-0.095
NPI	G	0.538	-0.412	0.210	0.205	-0.238	**0.542**	-0.448	0.204	-0.352	-0.384	0.272
	P	-0.003	0.002	-0.001	-0.001	0.001	**0.003**	0.002	-0.001	0.002	0.002	-0.001
NPP	G	-0.335	0.373	-0.169	-0.166	0.333	0.322	**0.390**	-0.143	0.290	0.266	-0.143
	P	-0.371	0.410	-0.189	-0.186	0.368	0.352	**0.438**	-0.159	0.325	0.297	-0.160
DFH	G	0.175	-0.090	0.382	0.383	-0.108	-0.145	-0.141	**0.386**	-0.250	-0.248	0.351
	P	0.038	-0.019	0.085	0.085	-0.024	-0.031	-0.031	**0.087**	-0.056	-0.055	0.078
DLH	G	0.467	-0.476	0.415	0.416	-0.451	-0.409	-0.469	0.409	**-0.630**	-0.537	0.441
	P	0.405	-0.414	0.366	0.365	-0.390	-0.349	-0.414	0.360	**-0.558**	-0.473	0.389
HSW	G	-0.079	0.074	-0.065	-0.067	0.052	0.075	0.072	-0.068	0.091	**0.106**	-0.079
	P	-0.153	0.142	-0.127	-0.132	0.100	0.145	0.142	-0.132	0.177	**0.210**	-0.156
PC	G	-0.311	0.152	-0.457	-0.461	0.117	0.270	0.196	-0.488	0.375	0.401	**-0.536**
	P	-0.238	0.116	-0.359	-0.362	0.090	0.207	0.155	-0.382	0.295	0.315	**-0.424**
PYPP	G	**-0.728**	**0.844**	**-0.680**	**-0.683**	**0.848**	**0.658**	**0.896**	**-0.634**	**0.764**	**0.738**	**-0.596**
	P	**-0.715**	**0.820**	**-0.676**	**-0.678**	**0.832**	**0.640**	**0.893**	**-0.625**	**0.760**	**0.735**	**-0.594**

Phenotypic Residual effect = 0.1837; Genotypic Residual effect= 0.087; Diagonal (under lined) values indicate direct effects

PH= Plant height (cm); PBPP= Primary branches per plant ; SBPP= Secondary branches per plant, DFF= Days to first flowering; D50% F = Days to 50% flowering; NPI= Number of pods per inflorescence; NIP=Number of inflorescences per plant; DFH= Days to first pod harvest; DLH= Days to last pod harvest; PL= Pod length (cm); PW=Pod width (cm); NSP=Number of seeds per pod; NPP= Number of pods per plant; MPW=Mean pod weight, HSW= 100 seed weight; PC= Protein content (%); PYPP= Pod yield per plant (g)

The earliness attributes like number of primary branches, days to first pod harvest, days to first flowering, days to 50% flowering and protein content had negative significant association with the marketable pod yield per plant. These results are in agreement with the earlier findings of Bangar *et al*. (2008), Mishra *et al.* (2008) and Katiyar and Dixit (2009).

Path coefficient analysis: Path coefficient splits the interrelationship between two characters into direct and indirect effects (Table 4). Among all the pod traits under study, number of secondary branches per plant, number of pods per plant exhibited high positive direct effect on marketable pod yield per plant followed by number of pods per inflorescence, days to first harvest and 100 seed weight at both levels of significance. This suggested that direct selection based on these traits will be rewarding for yield improvement in dolichos bean. Similar results have been reported by Bangar *et al.* (2008), Konda *et al*. (2008), Mishra *et al*. (2008), Rai *et al*. (2009) and Chattopadhyay and Dutta (2010).

Days to last pod harvest recorded high negative direct effect on marketable pod yield per plant but positive correlation suggesting that direct selection for such trait should be practised to reduce the undesirable indirect effect. These results are in agreement with the findings of Golani *et al*. (2007), Rai *et al.* (2009) and Chattopadhyay and Dutta (2010).

Days to first flowering showed very high negative direct effect on pod yield per plant which is in agreement with the results of Konda *et al*. (2008), Rai *et al.* (2009) and Chattopadhyay and Dutta (2010) which means that the genotypes having earlier flowering will give more yield compared to late flowering types. So this character could be considered as selection criteria for high yield.

From the foregoing discussion, it can be concluded that number of pods per plant, pod width, number of secondary branches per plant, number inflorescences per plant, number of pods per inflorescence and hundred seed weight had the positive correlation as well as direct positive effect on marketable pod yield per plant suggested that the direct selection for these traits would be effective for the improvement in yield of dolichos bean. These were identified as superior yield components. Hence, the genotypes which exhibited better performance for these characters can be used in further improvement of dolichos bean. Three genotypes *viz*., GL-243, Culture-47 and GL-671 showed significantly higher yield over the checks. There is a need to evaluate these high yielding genotypes in large plots and over locations in coastal Andhra Pradesh for their commercial utilization. A large number of pests and diseases affect the crop. There is a need to systematically test the genotypes for pest and disease reaction. They can be directly selected for general cultivation after confirming their performance in large plots across environments.

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