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Path coefficient analysis of dolichos bean (*Lablab purpureus* L.) genotypes

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Abstract
The investigation was carried out at All India Coordinated Research Project on Vegetable Crops, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (MS), which was conducted during the year 2018-19 with an objectives to assess the direct and indirect effect of traits on fresh pod yield. Path coefficient analysis of M_3 generation revealed that the number of fresh pod per vine exhibited high positive direct effect on pod yield followed by fresh pod shelling percentage, average weight of fresh pod, days to fresh pod harvest, number of locules per fresh pod, leaflet length, number of nodes per raceme, raceme length, number of buds per nodes, fresh pod width, and fresh seed length at phenotypic level, while fresh seed yield per vine exhibited high positive direct effect on fresh pod yield followed by days to fresh pod harvest, number of seeds per fresh pod, number of fresh pods per vine, leaf length, fresh 100 seed weight, fresh seed length, number of nodes per raceme, number of buds per nodes, pod setting per cent, fresh pod width and average weight of fresh pod at genotypic level. Therefore the characters displayed direct positive effect on fresh pod yield per hectare could be considered in selection criteria for increasing fresh pod yield.

Keywords: Path coefficient analysis, dolichos bean, M_3 generation

Introduction
Dolichos bean is an ancient crop widely distributed in the tropics where it is being used as a grain legume and vegetable as well as for animal fodder and green manure in mixed crop-livestock systems (Smartt, 1985; Shivashankar and Kulkarni, 1989) [14, 12]. It is botanically known as *Dolichos lablab* Linn. Within India, lablab as a field crop mostly confined to the peninsular region. Karnataka alone is contributing nearly ninety per cent of both area and production of dolichos bean. The rest area is concentrated in nearby district of Tamil Nadu, Andhra Pradesh and Maharashtra. Dolichos bean is mainly grown for its green pods, while the dry seeds are used in various vegetable preparations. In Maharashtra, a special spicy curry, known as “walache birde”, is often used during fasting festivals.
Dolichos bean it is an excellent crop to be grown in dry lands with limited rainfall. The crop prefers relatively cool season with sowing done in July- August. It starts fruiting in winter and continues to grow indeterminately in the following spring. Despite having many good attributes, the crop has remained unexploited owing to low productivity, long duration, photosensitivity and indeterminate growth habit. The consumer preference also varies with pod shape, size, colour and aroma. A wide range of variations exist for the plant and pod characters amongst the accessions grown all over the country.
The success of any breeding programme in general and improvement of specific trait through selection in particular, totally depends upon the genetic variability present in the available germplasm of a particular crop (Parmar *et al*. 2013) [9]. Since, many of the plant characters are governed by polygenes and greatly influenced by environmental conditions; the progress of breeding is, however, conditioned by the magnitude, nature and interrelationship of genotypic and non-genotypic variation. Among the quantitative characters, yield is a complex character, which is dependent on a number of yield contributing characters (Savitha, 2008) [11]. 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 provide basis for further breeding programme. Selection of superior genotypes based on yield as such may not be effective for the enhancement of yield and hence selection should be made for component traits as well. Path analysis permits the understanding of cause and effect of related characters (Wright, 1921) [16]. Path analysis helps us in partitioning total correlations into direct and indirect contribution thereby suggesting the degree of importance of each of character towards yield. Keeping in view the above facts, the present investigation was planned.

Materials and Methods

The experimental material consists of 36 genotypes (mutants) of Phule gauri along with one standard check Phule gauri (37 genotypes) for evaluation of M_3 generation. M_3 generation was evaluated during *kharif*-2018 in Randomized Block Design with two replications. The experiment was conducted at All India Coordinated Research Project on Vegetable Crops, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (MS). Ten plants from each replication were randomly selected for recording observation on 26 characters *viz.* leaf length, leaf width, leaflet length, primary branches, vine length, days to 50 per cent flowering, number of flower buds per raceme, number of racemes per vine, raceme length, number of nodes per raceme, number of buds per nodes, pod setting per cent, fresh pod length, fresh pod width, number of fresh pods per vine, number of locules per fresh pod, number of seeds per fresh pod, fresh pod shelling per cent, fresh pod coat thickness, days to fresh pod harvest, average weight of fresh pod, fresh pod yield per hectare, fresh seed length, fresh seed width, fresh 100 seed weight and fresh seed yield per vine.

Direct and indirect effects of component characters on pod yield were computed using appropriate correlation coefficient of different component characters as suggested by Wright (1921) [16] and elaborated by Dewey and Lu (1959) [4]. Thus, the correlation coefficient of any character with pod yield was split into the direct and indirect effects adopting the standard formula.

riy= rliP1+ r2iP2 + rziP3 +………… + rniPn + ... riiPI

Where,
Riy = Correlation of i^{th} character on pod yield
ri1 = Indirect effect of i^{th} character on pod yield through first character
rniPn = Correlation between n^{th} character and i^{th} character
n = Number of independent variables
Pi = Direct effect of i^{th} character on pod yield

Direct effects of component characters on pod yield were obtained by solving the following equations.
riy = (Piy) (rij) which can also be rearranged as
(Pi) = (rij) – 1 (rij)

Result and discussion

Path coefficient analysis is an important tool for partitioning the correlation coefficients into the direct and indirect effects of independent variables on a dependent variable. Their indirect association becomes more complex. Two characters may show correlation, just because they are correlated with a common third one. In such circumstances, path coefficient analysis provides an effective means of a critical examination of specific forces action to produce a given correlation and measure the relative importance of each factor.

Fresh seed yield per vine (0.6018) exhibited high positive direct effect on fresh pod yield per hectare followed by days to fresh pod harvest (0.5578), number of seeds per fresh pod (0.4270), number of fresh pods per vine (0.4142), leaf length (0.3454), fresh 100 seed weight (0.3240), fresh seed length (0.3137), number of nodes per raceme (0.3038), number of buds per node (0.2430), pod setting per cent (0.2259), fresh pod width (0.1539) and average weight of fresh pod (0.0623). These findings were in agreement with the results reported by Desai *et al.* (2003) [3] for direct positive effect of the number of branches per plant, Chattopadyay and Dutta (2011) [2] for days to 50 per cent flowering, Upadhyay and Mehta (2011) [15] for length of inflorescence, Chaitanya *et al.*, (2014) [1] for number of pods per plant and days to 50 per cent flowering, Singh *et al*. (2015) [13] for days to 50 per cent flowering, Patil *et al*. (2017) [8] for days to 50 per cent flowering on pod yield, Noorjahan *et al.*, (2019) [7] for days to 50 per cent flowering, length of inflorescence and number of grains per pod.

Fresh pod coat thickness (-0.0171) exhibited highest negative direct effect on fresh pod yield per hectare followed by number of flower buds per raceme (-0.0779), number of locules per fresh pod (-0.1059), fresh pod shelling per cent (-0.1449), raceme length (-0.1780), number of racemes per vine (-0.1806), primary branches (-0.2391), leaflet length (-0.2545), vine length (-0.2657), fresh seed width (-0.2745), fresh pod length (-0.2937), leaf width (-0.3374) and days to 50 per cent flowering (-0.8685). Similar results were obtained by Rai *et al*., (2009) [10] for negative direct effect of pod length, Kiran *et al*., (2014) [15] for raceme length and branch per plant, Kujur *et al*., (2017) [6] for inflorescence length.

Highest positive indirect effect of number of fresh seed yield per vine (0.6018) on fresh pod yield per hectare was recorded through number of fresh pod per vine (0.5683), pod setting per cent (0.4878), number of racemes per vine (0.4785), vine length (0.3918), days to fresh pod harvest (0.3753), days to 50 per cent flowering (0.3739), average weight of fresh pod (0.3347), number of flower buds per raceme (0.3015), number of nodes per raceme (0.2335), fresh pod length (0.2029), number of buds per nodes (0.1206), fresh 100 seed weight (0.1050), raceme length (0.0900), fresh pod coat thickness (0.0365) and primary branches (0.0084).

In the present investigation the residual effect of path coefficient analysis were 0.0692 at phenotypic level and 0.0946 at genotypic level, which clearly indicated that the 26 characters taken for this investigation were sufficient for genetic analysis in dolichos bean.

Table 1: Phenotypic direct and indirect effects of 25 characters on fresh pod yield (q/ha) in thirty seven genotypes of dolichos bean

	1	2	3	4	5	6	7	8	9
1	-0.0066	-0.0052	-0.0049	-0.0018	0.0013	0.0017	-0.0004	0.0022	-0.0016
2	-0.0386	-0.0491	-0.0357	-0.0119	0.0078	0.0139	-0.0049	0.0161	-0.0147
3	0.0744	0.0732	0.1006	0.0266	-0.0243	-0.0240	-0.0041	-0.0394	0.0216
4	-0.0174	-0.0149	-0.0163	-0.0615	0.0097	-0.0007	-0.0256	0.0043	-0.0101
5	0.0187	0.0146	0.0224	0.0147	-0.0927	-0.0710	-0.0320	-0.0807	0.0096
6	0.0462	0.0518	0.0437	-0.0021	-0.1400	-0.1829	-0.0816	-0.1443	-0.0072
7	-0.0137	-0.0247	0.0102	-0.1032	-0.0855	-0.1105	-0.2476	-0.1069	-0.0633
8	0.2111	0.2043	0.2446	0.0432	-0.5441	-04933	-0.2700	-0.6252	0.0359
9	0.0202	0.0248	0.0179	0.0137	-0.0086	0.0033	0.0213	-0.0048	0.0832
10	0.0061	0.0064	-0.0055	0.0378	0.0376	0.0445	0.0708	0.0396	0.0152
11	0.0027	0.0091	0.0053	0.0038	-0.0140	-0.0048	0.0141	-0.0065	0.0162
12	0.0278	0.0406	0.0211	-0.0011	-0.0444	-0.0491	-0.0245	-0.0687	-0.0094
13	0.0208	0.0359	0.0007	-0.0066	-0.0554	-0.0859	-0.0155	-0.0533	-0.0219

14	-0.0012	0.0016	0.0070	0.0081	-0.0046	0.0007	-0.0011	-0.0022	0.0031
15	-0.6639	-0.7459	-0.781	0.1089	1.6432	1.6576	1.2667	2.1314	0.2906
16	0.0110	0.0090	0.0175	0.0140	-0.0028	-0.0049	0.0013	-0.0155	0.0049
17	-0.0086	-0.0072	-0.0091	-0.0060	-0.0018	-0.0038	-0.0056	0.0020	-0.0096
18	0.1377	0.1539	0.1542	-0.0130	-0.1197	-0.1296	-0.0677	-0.1525	0.0024
19	-0.0087	-0.0126	-0.0202	0.0005	-0.0062	0.0041	0.0044	0.0077	-0.0029
20	-0.0368	-0.0420	-0.0336	-0.0025	0.1170	0.1548	0.0658	0.1211	0.0072
21	-0.0498	-0.0391	-0.0349	-0.0180	0.0334	0.0195	-0.0010	0.0612	-0.0077
22	0.0041	0.0023	0.0062	0.0038	0.0004	0.0069	-0.0045	0.0011	0.0085
23	0.0008	0.0003	-0.0016	-0.0027	0.0019	-0.0002	0.0007	0.0009	-0.0003
24	-0.0135	-0.0288	-0.0442	-0.0103	-0.0083	-0.0136	0.0036	-0.0082	-0.0130
25	0.1433	0.1263	0.1495	-0.0033	-0.4327	-0.4330	-0.3347	-0.5533	-0.0916

Table 1: Contt….

	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	-0.0004	-0.0004	0.0013	0.0008	0.0002	0.0018	-0.0007	-0.0016	-0.0027
2	-0.0035	-0.0094	0.0141	0.0103	-0.0024	0.0147	-0.0044	-0.0096	-0.0226
3	-0.0061	0.0113	-0.0151	-0.0004	0.0220	-0.0306	0.0174	0.0250	0.0463
4	-0.0257	-0.0049	-0.0005	-0.0024	-0.0156	-0.0027	-0.0085	-0.0100	0.0024
5	-0.0387	0.0272	-0.0292	-0.0301	0.0133	-0.0612	0.0026	-0.0045	0.0331
6	-0.0902	0.0183	-0.0637	-0.0923	-0.0042	-0.1218	0.0088	-0.0189	0.0707
7	-0.1942	-0.0732	-0.0430	-0.0225	0.0083	-0.1260	-0.0032	-0.0380	0.0501
8	-0.2745	0.0858	-0.3044	-0.1955	0.0425	-0.5352	0.0958	0.0344	0.2846
9	0.0140	0.0283	0.0055	0.0107	0.0080	0.0097	0.0040	0.0218	0.0006
10	0.0903	-0.0090	-0.0006	0.0110	-0.0136	0.0328	0.0014	0.0135	-0.0091
11	-0.0048	0.0476	0.0101	0.0019	0.0105	0.0061	-0.0011	0.0026	0.0066
12	0.0010	-0.0300	-0.1411	-0.0629	-0.0110	-0.1172	-0.0101	-0.0095	0.0392
13	-0.0208	-0.0068	-0.0760	-0.1704	0.0128	-0.0673	-0.0891	-0.0764	0.0501
14	-0.0048	0.0071	0.0025	-0.0024	0.0320	-0.0003	-0.0133	-0.0075	-0.0080
15	0.9036	0.3174	2.0668	0.9838	-0.0231	2.4899	-0.1947	0.0252	-1.0302
16	0.0015	-0.0024	0.0072	0.0530	-0.0422	-0.0079	0.1013	0.0792	0.0144
17	-0.0055	-0.0020	-0.0025	-0.0165	0.0086	-0.0004	-0.0287	-0.0367	0.0009
18	-0.0336	0.0463	-0.0931	-0.0986	-0.0839	-0.1386	0.0476	-0.0086	0.3350
19	-0.0033	0.0101	-0.0060	0.0182	-0.0022	0.0018	-0.0082	-0.0104	-0.0303
20	0.0731	-0.0150	0.0528	0.0787	0.0040	0.1018	-0.0123	0.0154	-0.0591
21	-0.0180	0.0414	0.0922	0.0344	0.0008	0.0822	-0.0021	-0.0225	-0.0239
22	-0.0031	0.0000	0.0008	0.0106	0.0097	0.0010	-0.0032	-0.0020	-0.0070
23	0.0010	-0.0014	0.0005	0.0012	-0.0103	0.0008	0.0060	0.0036	0.0038
24	0.0040	-0.0010	-0.0199	-0.0071	-0.0491	-0.0130	0.0121	0.0204	-0.0173
25	-0.2641	-0.1270	-0.5481	-0.2349	0.0845	-0.6588	0.0343	1.0016	0.0743

Table 1: Contt….

	19	**20**	**21**	**22**	**23**	**24**	**25**	**26**
1	-0.0007	0.0016	0.0020	-0.0009	0.0004	-0.0009	0.0013	-0.1339
2	-0.0071	0.0132	0.0116	-0.0037	0.0012	-0.0147	0.0088	-0.2156
3	0.0230	-0.0216	-0.0211	0.0208	0.0135	0.0462	-0.0214	-0.1632
4	0.0004	0.0010	0.0067	-0.0077	-0.0139	-0.0066	-0.0003	0.0311
5	-0.0065	-0.0695	-0.0186	-0.0011	0.0144	-0.0080	-0.0571	0.2673
6	0.0085	-0.1814	-0.0214	-0.0421	-0.0036	-0.0258	-0.1128	0.2997
7	0.0123	-0.1043	0.0014	0.0366	0.0138	0.0094	-0.1180	0.378
8	0.0545	-0.4849	-0.2304	-0.0225	0.0484	-0.0534	-0.4926	0.5261
9	0.0027	0.0038	-0.0039	0.0235	0.0017	0.0113	0.0108	0.2451
10	0.0034	0.0423	-0.0098	-0.0092	-0.0073	-0.0038	0.0340	0.0973
11	-0.0055	-0.0046	0.0118	0.0000	0.0057	0.0005	0.0086	0.3581
12	-0.0096	-0.0477	-0.0783	-0.0035	0.0055	-0.0292	-0.1102	0.9108
13	0.0352	-0.0859	-0.0352	-0.0596	0.0166	-0.0126	-0.0570	0.2787
14	0.0008	0.0008	0.0002	0.0103	0.0275	0.0163	-0.0039	-0.0004
15	-0.0510	1.6229	1.2311	0.0790	-0.1724	0.3356	2.3359	0.8615
16	0.0094	-0.0080	-0.0013	-0.0108	-0.0510	-0.0127	-0.0049	-0.0484
17	-0.0043	-0.0036	0.0050	0.0025	0.0111	0.0078	0.0001	-0.0135
18	0.1154	-0.1268	-0.0482	-0.0776	-0.1073	0.0602	-0.0354	-0.1979
19	**-0.0880**	0.0066	0.0044	0.0137	0.0163	-0.0143	-0.0054	0.0120
20	-0.0117	**0.1561**	0.0217	0.0379	0.0067	0.0171	0.0953	0.3007
21	-0.0083	0.0231	**0.1662**	-0.0006	-0.0137	-0.0042	0.0881	0.6246
22	-0.0047	0.0073	-0.0001	**0.0301**	0.0147	0.0094	-0.0016	0.0167
23	0.0022	-0.0005	0.0010	-0.0059	**-0.0120**	-0.0042	0.0023	-0.0836
24	-0.0157	-0.0106	0.0024	-0.0300	-0.0337	**-0.0962**	-0.0167	0.1051
25	-0.0429	-0.4285	-0.3722	0.0375	0.1337	-0.1220	**-0.7023**	0.8456

Residual effect: 0.0692

Table 2: Genotypic direct and indirect effects of 25 characters on fresh pod yield (q/ha) in thirty seven genotypes of dolichos bean

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	0.3454	0.2628	0.2590	0.1496	-0.1004	-0.1040	0.0210	-0.1442	0.1103
2	-0.2566	-0.3374	-0.2455	-0.1065	0.0732	0.1132	-0.0319	0.1399	-0.1210
3	-0.1908	-0.1851	-0.2545	-0.0896	0.0887	0.0725	0.0206	0.1308	-0.0547
4	-0.1035	-0.0755	-0.0842	-0.2391	0.0585	-0.0140	-0.1106	0.0205	-0.0342
5	0.0773	0.0577	0.0926	0.0650	-0.2657	-0.2157	-0.1033	-0.2463	0.0291
6	0.2616	0.2914	0.2475	-0.0509	-0.7053	-0.8685	-0.4238	-0.6934	-0.0511
7	-0.0047	-0.0074	0.0063	-0.0360	-0.0303	-0.0380	-0.0779	-0.0344	-0.0170
8	0.0754	0.0749	0.0928	0.0155	-0.1674	-0.1442	-0.0796	-0.1806	0.0133
9	-0.0568	-0.0639	-0.0383	-0.0254	0.0195	-0.0105	-0.0389	0.0131	-0.1780
10	0.0127	0.0068	-0.0389	0.1522	0.1421	0.1559	0.2529	0.1373	0.0479
11	0.0007	0.040	0.0224	0.0430	-0.0934	-0.0310	0.0952	-0.0377	0.1158
12	-0.0543	-0.0800	-0.0389	-0.0007	0.0790	0.0821	0.0431	0.1148	0.0196
13	0.0489	0.0813	0.0044	-0.0147	-0.1013	-0.1493	-0.0287	-0.0933	-0.0420
14	-0.0062	0.0047	0.0409	0.0475	-0.0242	0.0042	-0.0069	-0.0118	0.0146
15	-0.1365	-0.1536	-0.1643	0.0235	0.2876	0.2785	0.2173	0.3556	0.0496
16	-0.0115	-0.0102	-0.0206	-0.0202	0.0059	0.0059	0.0002	0.0181	-0.0017
17	0.1252	0.1075	0.1313	0.1220	0.0284	0.0481	0.0702	-0.0260	0.1379
18	-0.0705	-0.0793	-0.0840	0.0062	0.0556	0.0566	0.0301	0.0665	-0.0028
19	-0.0020	-0.0030	-0.0052	-0.0004	-0.0014	0.0009	0.0008	0.0015	-0.0007
20	-0.1669	-0.1895	-0.1547	-0.0097	0.4468	0.5632	0.2455	0.4406	0.0134
21	-0.0256	-0.0214	-0.0199	-0.0079	0.0137	0.0077	-0.0012	0.0242	-0.0051
22	0.0532	0.0290	0.0862	0.0472	0.0046	0.0728	-0.0493	0.0108	0.0970
23	0.0206	0.0067	-0.0477	-0.0772	0.0448	-0.0055	0.0166	0.0215	-0.0054
24	0.0549	0.1159	0.1857	0.0438	0.0292	0.0461	-0.0131	0.0276	0.0477
25	-0.1519	-0.1325	-0.1572	0.0084	0.3918	0.3739	0.3015	0.4785	0.0900

Table 2: Contt….

	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	0.0144	0.0010	-0.0831	-0.0575	-0.0139	-0.1138	0.0376	0.1013	0.1681
2	-0.0075	-0.0611	0.1195	0.0935	-0.0103	0.1251	-0.0325	-0.0850	-0.1847
3	0.0326	-0.0235	0.0438	0.0038	-0.0676	0.1010	-0.0495	-0.0782	-0.1476
4	-0.1198	-0.023	0.0007	-0.0120	-0.0738	-0.0136	-0.0455	-0.0683	0.0103
5	-0.1243	0.1022	-0.0929	-0.0916	0.0419	-0.1845	0.0147	-0.0177	0.1019
6	-0.4458	0.1107	-0.3157	-0.4416	-0.0238	-0.5839	0.0484	-0.0978	0.3393
7	-0.0648	-0.0305	-0.0149	-0.0076	0.0035	-0.0409	0.0002	-0.0128	0.0162
8	-0.0816	0.0280	-0.0917	-0.0574	0.0139	-0.1550	0.0309	0.0110	0.0829
9	-0.0281	-0.0849	-0.0154	-0.0255	-0.0169	-0.0213	-0.0028	-0.0575	-0.0034
10	0.3038	-0.0322	-0.0100	0.0378	-0.0539	0.1133	0.0120	0.0536	-0.0308
11	-0.0258	0.2430	0.0627	0.0122	0.0695	0.0334	-0.0143	0.0090	0.0366
12	-0.0075	0.0583	0.2259	0.1042	0.0178	0.1965	0.0225	0.0193	-0.0659
13	-0.0366	-0.0147	-0.1355	-0.2937	0.0231	-0.1173	-0.1686	-0.1441	0.0878
14	-0.0273	0.0441	0.0121	-0.0121	0.1539	-0.0024	-0.0713	-0.0434	-0.0400
15	0.1546	0.0570	0.3604	0.1655	-0.0063	0.4142	-0.0383	0.0045	-0.1736
16	-0.0042	0.0062	-0.0106	-0.0608	0.0491	0.0098	-0.1059	-0.0878	-0.0168
17	0.0754	0.0157	0.0364	0.2095	-0.1203	0.0046	0.3542	0.4270	-0.0144
18	0.0147	-0.0218	0.0423	0.0434	0.0377	0.0607	-0.0231	0.0049	-0.1449
19	-0.0006	0.0022	-0.0011	0.0037	-0.0006	0.0004	-0.0016	-0.0020	-0.0062
20	0.2723	-0.0652	0.1985	0.2896	0.0178	0.3709	-0.0580	0.0675	-0.2129
21	-0.0068	0.0173	0.0389	0.0132	0.0016	0.0325	-0.0025	-0.0080	-0.0093
22	-0.0321	0.0032	0.0089	0.1108	0.1058	0.0105	-0.0351	-0.0173	-0.0724
23	0.0236	-0.0374	0.0118	0.0271	-0.2435	0.0191	0.1490	0.0867	0.0879
24	-0.0146	0.0041	0.0697	0.0242	0.1700	0.0437	-0.0436	-0.0734	0.0584
25	0.2335	0.1206	0.4878	0.2029	-0.0757	0.5683	-0.0298	-0.0026	-0.0660

Table 2: Contt….

	19	**20**	**21**	**22**	**23**	**24**	**25**	**26**
1	0.0407	-0.1034	-0.1420	0.0586	-0.0259	0.0585	-0.0872	-0.1623
2	-0.0595	0.1146	0.1160	-0.0312	0.0083	-0.1207	0.0743	-0.2560
3	-0.0771	0.0706	0.0812	-0.0699	-0.0443	-0.1458	0.0665	-0.1848
4	-0.0056	0.0042	0.0305	-0.0360	-0.0673	-0.0324	-0.0033	0.0455
5	-0.0225	-0.2128	-0.0586	-0.0039	0.0434	-0.020	-0.1730	0.2798
6	0.0433	-0.8769	-0.1075	-0.2016	-0.0174	-0.1237	-0.5397	0.3008
7	0.0038	-0.0343	0.0015	0.0122	0.0047	0.0032	-0.0390	0.3499
8	0.0157	-0.1426	-0.0702	-0.0062	0.0141	-0.0154	-0.1436	0.5337
9	-0.0077	-0.0043	0.0145	-0.0551	-0.0035	-0.0262	-0.0266	0.2724
10	0.0103	0.1483	-0.0330	-0.0311	-0.0261	-0.0137	0.1179	0.0974
11	-0.0310	-0.0284	0.0676	0.0025	0.0331	0.0031	0.0487	0.4000

12	0.0139	0.0804	0.1412	0.0064	-0.0097	0.0486	0.1831	0.9485
13	0.0632	-0.1525	-0.0622	-0.1037	0.0289	-0.0220	-0.0990	0.2816
14	0.0057	0.0049	0.0039	0.0519	0.1365	0.0808	-0.0194	-0.0012
15	-0.0088	0.2754	0.2158	0.0139	-0.0288	0.0559	0.3912	0.8714
16	-0.0096	0.0110	0.0042	0.0118	0.0575	0.0143	0.0052	-0.0529
17	0.0503	0.0517	-0.0551	-0.0236	-0.1348	-0.0967	-0.0019	-0.0113
18	-0.0524	0.0553	0.0216	0.0335	0.0464	-0.0261	0.0159	-0.1997
19	-0.0171	0.0013	0.0009	0.0027	0.0033	-0.0029	-0.0010	0.0050
20	-0.0420	0.5578	0.0752	0.1369	0.0240	0.0619	0.3479	0.3052
21	-0.0031	0.0084	0.0623	-0.0004	-0.0056	-0.0018	0.0346	0.6559
22	-0.0488	0.0770	-0.0021	0.3137	0.1534	0.0985	-0.0163	0.0176
23	0.0523	-0.0118	0.0245	-0.1342	-0.2745	-0.0963	0.0525	-0.0857
24	0.0546	0.0359	-0.0092	0.1017	0.1137	0.3240	0.0565	0.1059
25	0.0365	0.3753	0.3347	-0.0312	-0.1151	0.1050	0.6018	0.8461

Residual effect: 0.0946

1. Leaf length (cm)	14. Fresh pod width (cm)
2. Leaf width (cm)	15. Number of fresh pods per vine
3. Leaflet length (cm)	16. Number of locules per fresh pod
4. Primary branches	17 Number of seeds per fresh pod
5. Vine length (cm)	18. Fresh pod shelling per cent
6. Days to 50 per cent flowering	19. Fresh pod coat thickness (mm)
7. Number of flower buds per raceme	20. Days to fresh pod harvest
8. Number of racemes per vine	21. Average weight of fresh pod (g)
9. Raceme length (cm)	22. Fresh seed length (mm)
10. Number of nodes per raceme	23. Fresh seed width (mm)
11. Number of buds per nodes	24. Fresh 100 seed weight (g)
12. Pod setting per cent	25. Fresh seed yield per vine (g)
13. Fresh pod length (cm)	26. Fresh pod yield per hectare (q)

Conclusion

Fresh seed yield per vine exhibited high positive direct effect on fresh pod yield followed by days to fresh pod harvest, number of seeds per fresh pod, number of fresh pods per vine, leaf length, fresh 100 seed weight, fresh seed length, number of nodes per raceme, number of buds per nodes, pod setting per cent, fresh pod width and average weight of fresh pod. This indicated that these characters played an important role in increasing the fresh pod yield. Therefore, the direct selection of these characters may about bring an overall improvement in fresh pod yield.

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