Assessment of character association in pole type French bean (*Phaseolus vulgaris* L.) genotypes

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Abstract

The investigation was carried out at the Regional Agricultural Research Station (RARS), Vijayapura during *Rabi* 2022-23. The experiment was laid out in Randomized Complete Block Design (RCBD) with two replications. Character association in thirty two genotypes of pole type French bean was studied for 14 important characters. The correlation studies revealed that pod yield per plant was found positively and significantly associated with number of pods per plant (r_g=0.668 and r_p=0.620), pod length (r_g= 0.526 and r_p =0.431), average 10 pod weight (r_g= 0.657 and r_p = 0.660), number of pods per cluster (r_g=0.373 and r_p= 0.344) and number of clusters per plant (r_g =0.365 and r_p= 0.345) at both genotypic and phenotypic level. The direct selection for these traits would be rewarding for improvement of pod yield per plant in pole type French bean.

Keywords: Character association, pole type French bean

Introduction: French bean (*Phaseolus vulgaris* L.) is one of the most common and widely grown vegetable crop in India with a chromosome number of 2n=22. According to Vavilov (1950) the origin of French bean is Southern Mexico and Central America, while, Peruvian-Ecuadorian-Bolivian area is considered to be secondary centre of origin. It was originated from wild species *Phaseolus aborigineus* (L.) and domesticated in Mexico, Peru and Colombia about 8000 years ago.

It is cultivated all over the world and has a wide geographical distribution. French bean is mainly used for immature green pods. Rajmash or dried pods are utilized as a pulse and provide a good source of proteins for humans (Abate, 2006). Immature pods are eaten fresh and can be easily preserved by freezing, canning or dehydrating. Dried beans are eaten as boiled, baked, fried or ground into flour. It is highly nutritious as 100 g of green pods contain 1.7 g protein, 4.5 g carbohydrates, 221 IU vitamin A, 11 mg vitamin C and 50 mg calcium (Gopalakrishnan, 2007).

Yield is a complex character influenced by several genetic factors interacting with environment. Success of any breeding programme for its improvement depends on the existing genetic variability in the base population and on the efficiency of selection. A study of correlation between different quantitative characters provides an idea of association. It could be effectively exploited to formulate selection strategies for improving yield and quality. Association of characters like yield, its components and other economical traits is important for making selection in the breeding programme. It suggests the advantage of a scheme of selection for more than one character at a time (Kalloo. 1994). Further in order to have clearer picture of yield components for effective selection progamme, it would be desirable to consider the relative magnitude of association of various characters with yield.

Material and Methods: The experiment was conducted at the Regional Agricultural Research Station (RARS), Vijayapura during *Rabi* 2022-23. Thirty two genotypes of pole type French bean were grown in randomized block design with two replications. The ridges and furrows were opened at 120 cm and seeds of different genotypes were sown by dibbling on one side of the ridge at 30 cm and plots were irrigated immediately after the completion of sowing. Wherever, seeds did not germinate, gaps were filled by re-sowing seeds within a week. All other activities were carried out as per the recommended package of practices (RPP) given by University of Horticultural Sciences (UHS), Bagalkot (Anon., 2022) to grow the crop. Observations were recorded on five randomly selected plants from each genotype for fourteen characters *viz*., plant height (cm) at 90 DAS, number of primary branches at 60 DAS, days to first flowering, days to 50 per cent flowering, days to first pod picking, number of pods per plant, pod length (cm), pod width (cm), average 10 pod weight (g), number of pods per cluster, number of clusters per plant, number of seeds per pod, seed test weight (g) and pod yield per plant (g).

Results and Discussion: Variability studies reveal how much a given quality can be improved upon, but they don't explain the nature or depth of the correlations that exist between different characteristics. Because there may not be genes for yield *per se*, but rather for different yield components, selection for yield components is necessary for a viable approach to yield improvement (Grafius, 1959). Moreover, there's a chance that a lot of these supporting individuals will interact in both positive and negative ways. Thus, it is crucial for understanding the connections between different traits

The phenotypic and genotypic correlation coefficients for growth, earliness, yield and quality components in pole type French bean genotypes were investigated in this study. In the current findings (Table 1 and 2), the observed difference between genotypic and phenotypic correlation coefficients were narrow for multiple traits, indicating a decreased influence of environment on the expression of these traits and the presence of strong intrinsic link among the traits. As a result, only genotypic associations are presented..

Pod yield per plant (Table 1) was found positively and significantly (at p=0.01) associated with number of pods per plant (r_g=0.668), pod length (r_g= 0.526), average 10 pod weight (r_g= 0.657), number of pods per cluster (r_g=0.373) and number of clusters per plant (r_g =0.365) at genotypic level. Whereas, pod yield per plant was found positively and significantly (at p=0.05) associated with plant height at 90 DAS (r_g= 0.293), pod width (r_g =0.312) and number of seeds per pod (r_g = 0.355) at genotypic level. But it was negatively and significantly (at p=0.01) associated with days to first pod picking (r_g= -0.348) at genotypic level. Hence, direct selection for growth and yield components could be made for improving yield. Several researchers like Guruprasad (2023), Murry *et al.* (2022), Mesera *et al.* (2022), Shah *et al.* (2021), Punithkumar (2021), Singh *et al*. (2020), Al-Ballat and Al-Araby (2019), Lyngdoh *et al*. (2018), Singh *et al.* (2018), Patil (2018), Panchbhaiya *et al.* (2017), Alemu *et al.* (2017), Lad *et al*. (2017) and Panda *et al.* (2016) were reported similar results.

The plant height at 90 DAS had positive and significant (at p=0.01) correlation with days to first flowering (0.592), days to 50 per cent flowering (0.476), average 10 pod weight (0.409), number of pods per cluster (0.440) and number of seeds per pod (0.489). While, it had significant (at p= 0.05) and positive association with pod length (0.296) and pod yield per plant (0.293). But, it had negative and significant (at p= 0.01) association with number of primary branches at 60 DAS (-0.350), days to first pod picking (-0.477) and number of clusters plant (-0.330). These results are resemblance with Guruprasad (2023), Punithkumar (2021), Al-Ballat and Al-Araby (2019), Lyngdoh *et al*. (2018), Jhanavi (2016), Alemu *et al.* (2017) and Panda *et al.* (2016)

A significant (at p= 0.01) and positive (Table 1) correlation of number of primary branches at 60 DAS with seed test weight (0.524). It had significant (at p= 0.05) and positive association with number of clusters per plant (0.304). While, it had negative and significant (at p= 0.01) association with number of pods per cluster (-0.496) and number of seeds per pod (-0.719) and it was negative and significant (at p= 0.05) association with pod length (-0.262). The findings of Punithkumar (2021) and Lyngdoh *et al*. (2017) reported similar results.

It was noted that days to first flowering significant (at p=0.01) and positive association with days to 50 per cent flowering (0.970), days to first pod picking (0.774), pod length (0.884), average 10 pod weight (0.944), number of pods per cluster (0.690) and number of seeds per pod (0.505). Whereas, this trait had negative (at p=0.05) and significant association with number of pods per plant (-0.836), number of clusters per plant (-0.931) and seed test weight (-0.734). The findings of Guruprasad (2023) and Al-Ballat and Al-Araby (2019) were found identical with these results.

It was evident that days to 50 per cent flowering was positively and significantly (at p=0.01) correlated with days to first pod picking (0.806), pod length (0.661), average 10 pod weight (0.729) and number of pods per cluster (0.464). But, this trait had significant (at p=0.05) and positive association with number of seeds per pod (0.308) and pod width (0.252). Whereas, it had significant (at p=0.01) and negative association with number of pods per plant (-0.770), number of clusters per plant (-0.801) and seed test weight (-0.519). Several investigators like Guruprasad (2023), Panchbhaiya *et al.* (2017), Lad *et al*. (2017) and Panda *et al.* (2016) reported similar findings.

A significant (at p=0.01) and positive association of days to first pod picking with pod length (0.376), pod width (0.452), average 10 pod weight (0.407), number of pods per cluster (0.415). Whereas, it had significant (at p=0.01) and negative association with number of pods per plant (-0.948), number of clusters per plant (-0.833), seed test weight (-0.331) and pod yield per plant (-0.348). These findings are validated by Punithkumar (2021) and Panda *et al.* (2016).

It was recorded that number of pods per plant had significant (at p=0.01) and positive correlation with number of clusters per plant (0.811) and pod yield per plant (0.668). But, this trait had significant (at p=0.05) and positive association with seed test weight (0.306). While, this trait had negative (at p=0.05) and significant association with number of seeds per pod (-0.257). These results are confirmed with Guruprasad (2023), Punithkumar (2021), Al-Ballat and Al-Araby (2019), Alemu *et al.* (2017) and Panda *et al.* (2016).

It was recorded that pod length had significant (at p=0.01) and positive association with pod width (0.451), average 10 pod weight (0.894), number of pods per cluster (0.597), number of seeds per pod (0.565) and pod yield per plant (0.526). Whereas, this character had significant (at p=0.01) and negative association with number of clusters per plant (-0.417) and significant (at p=0.05) seed test weight (-0.286). These results are aligned with Guruprasad (2023), Panchbhaiya *et al. (*2017), Lyngdoh *et al*. (2018) and Panda *et al.* (2016).

It was recorded that pod width had significant (at p=0.01) and positive association with average 10 pod weight (0.415). Whereas, this trait had significant (at p=0.05) and positive association with seed test weight (0.278) and pod yield per plant (0.312). These results are identical with Lyngdoh *et al*. (2018) and Panda *et al.* (2016).

It was observed that average 10 pod weight exhibited positive and significant (at p=0.01) relationship with number of pods per cluster (0.581), number of seeds per pod (0.571) and pod yield per plant (0.657). Whereas, this character had significant (at p=0.01) and negative association with number of clusters per plant (-0.330). Similar results were also reported by Guruprasad (2023), Punithkumar (2021), Singh *et al.* (2020), Al-Ballat and Al-Araby (2019) and Panda *et al.* (2016),

It was reported that number of pods per cluster was positively and significantly (at p=0.01) relationship with number of seeds per pod (0.797) and pod yield per plant (0.373). While, this trait had significant (at p=0.01) and negative relationship with number of clusters per plant (-0.616) and seed test weight (-0.521). These results are parallel with Guruprasad (2023), Al-Ballat and Al-Araby (2019), Mammo *et al.* (2019) and Panda *et al.* (2016).

It was noted that number of clusters per plant was positively and significantly (at p=0.01) relationship with seed test weight (0.547) and pod yield per plant (0.365). Whereas, this trait had significant (at p=0.01) and negative association with number of seeds per pod (-0.652). This view was supported by Panchbhaiya *et al.* (2017).

It was noted that number of seeds per pod had significant (at p=0.05) and positive association with pod yield per plant (0.355). But, this trait had significant (at p=0.01) and negative association with seed test weight (-0.690). These outcomes are validated by Al-Ballat and Al-Araby (2019), Mammo *et al.* (2019), Thirugnanavel *et al. (*2019), Panchbhaiya *et al.* (2017) and Ejara *et al.* (2017).

Conclusion: From the study, highly significant outcomes observed for correlation coefficient among 32 pole type French bean genotypes for most of the studied traits. On the basis of results obtained from the present investigation, it can be concluded that the selection for number of pods per plant pod length average 10 pod weight, number of pods per cluster and number of clusters per plant could be criteria for simultaneously increasing pod yield per plant and selection of these traits will be helpful in developing high yielding genotypes in pole type French bean.

Table 1. Genotypic correlation coefficients among growth, earliness and yield parameters in pole type French bean genotypes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**1.000**	-0.350**	0.592**	0.476**	-0.477**	-0.085	0.296*	-0.055	0.409**	0.440**	-0.330**	0.489**	-0.159	0.293*
2		**1.000**	0.069	0.056	0.107	-0.010	-0.262*	0.155	-0.135	-0.496**	0.304*	-0.719**	0.524**	-0.098
3			**1.000**	0.970**	0.774**	-0.836**	0.884**	0.223	0.944**	0.690**	-0.931**	0.505**	-0.734**	0.118
4				**1.000**	0.806**	-0.770**	0.661**	0.252*	0.729**	0.464**	-0.801**	0.308*	-0.519**	0.013
5					**1.000**	-0.948**	0.376**	0.452**	0.407**	0.415**	-0.833**	-0.031	-0.331**	-0.348**
6						**1.000**	-0.192	0.009	-0.130	-0.054	0.811**	-0.257*	0.306*	0.668**
7							**1.000**	0.451**	0.894**	0.597**	-0.417**	0.565**	-0.286*	0.526**
8								**1.000**	0.415**	-0.157	0.159	-0.005	0.278*	0.312*
9									**1.000**	0.581**	-0.330**	0.571**	-0.099	0.657**
10										**1.000**	-0.616**	0.797**	-0.521**	0.373**
11											**1.000**	-0.652**	0.547**	0.365**
12												**1.000**	-0.690**	0.355**
13													**1.000**	0.191
14														**1.000**

Critical r_g value at 1 per cent = 0.319, Critical r_g value at 5 per cent = 0.246, **indicates significant at P=0.01 *indicates significant at P= 0.05

Characters:

1. Plant height (cm) at 90 DAS
2. Number of primary branches at 60 DAS
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first pod picking
6. Number of pods per plant
7. Pod length (cm)
8. Pod width (cm)
9. Average 10 pod weight (g)
10. Number of pods per cluster
11. Number of clusters per plant
12. Number of seeds per pod
13. Seed test weight (g)
14. Pod yield per plant (g)

Table 2. Phenotypic correlation coefficients among growth, earliness and yield parameters in pole type French bean genotypes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**1.000**	-0.258*	0.355**	0.300*	-0.198	-0.046	0.210	-0.041	0.292*	0.281*	-0.270*	0.433**	-0.142	0.180
2		**1.000**	-0.125	-0.104	0.033	-0.016	-0.187	0.213	-0.111	-0.434**	0.272*	-0.484**	0.371**	-0.051
3			**1.000**	0.941**	0.523**	-0.352*	0.412**	-0.025	0.302*	0.352**	-0.430**	0.344**	-0.318*	-0.069
4				**1.000**	0.602**	-0.405**	0.406**	-0.017	0.310*	0.286*	-0.448**	0.292*	-0.279*	-0.091
5					**1.000**	-0.397**	0.198	0.007	0.113	0.118	-0.335**	0.100	-0.139	-0.251*
6						**1.000**	-0.168	0.001	-0.136	-0.063	0.801**	-0.217	0.297*	0.620**
7							**1.000**	0.360**	0.767**	0.490**	-0.364**	0.485**	-0.260*	0.431**
8								**1.000**	0.295*	-0.169	0.132	-0.097	0.187	0.228
9									**1.000**	0.517**	-0.317*	0.404**	-0.073	0.660**
10										**1.000**	-0.579**	0.594**	-0.413**	0.344**
11											**1.000**	-0.542**	0.516**	0.345**
12												**1.000**	-0.605**	0.140
13													**1.000**	0.180
14														**1.000**

Critical r_g value at 1 per cent = 0.319, Critical r_g value at 5 per cent = 0.246, **indicates significant at P=0.01 *indicates significant at P= 0.05

Characters:

1. Plant height (cm) at 90 DAS
2. Number of primary branches at 60 DAS
3. Days to first flowering
4. Days to 50 per cent flowering
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6. Number of pods per plant
7. Pod length (cm)
8. Pod width (cm)
9. Average 10 pod weight (g)
10. Number of pods per cluster
11. Number of clusters per plant
12. Number of seeds per pod
13. Seed test weight (g)
14. Pod yield per plant (g)

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