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Yield and Yield components of several Faba Bean (*Vicia faba* L.) Genotypes Analysed using Correlation and Path Coefficients

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ABSTRACT: The underutilization of faba beans in India is a result of their low output and acreage. Despite its rich nutritional content, the present investigation aims were to quantify the relationship between yield and features associated with yield and to identify crucial qualities for indirect selection to increase faba bean grain yield. The results of the correlation analysis showed that there were highly significant (p<0.01) and. The results of the genotypic and phenotypic correlation showed that the number of branches (0.590, 0.567**), pods (0.751**, 0.755**), seeds per pod (0.364**, 0.364**), seeds per plant (0.926**, 0.920**), and pod length (ml) (0.289*, 0.274*) all had a positive and significant correlation with the seed yield, indicating the possibility of simultaneously improving grain yield with these traits through selection. The number of seeds per plant (0.308) and the number of seeds per pod (0.574) were found to have phenotypic path coefficient study results. The high positive genotypic path coefficient direct effects on grain yield were exerted by the number of seeds per plant (0.724) and the number of seeds per pod (0.756), which had stronger positive direct impacts on grain production at both the phenotypic and genotypic levels. These traits may be used as indirect selection criteria to increase the yield of grains from faba beans.**

Keywords: Faba bean, Correlation, Path coefficient, Phenotype, Genotype.

INTRODUCTION

Faba bean (*Vicia faba* L.), is one of the earliest domesticated food legumes in the world (Singh *et. al.*, 2013). Faba bean is one of the most important legume crops and is believed to have originated in the Near East and cultivation started early in Neolithic times, 8000 B.C. (Cubero, 1974; Torres *et. al.*, 2006; Karkanis *et. al.*, 2018) and it was introduced in India by Arab traders. China is leading in faba bean concerning area and production. Broad bean has a total area and production of 2.58 million hectares and 5.43 million tonnes worldwide (FAO, 2019). India ranks 22nd with a 0.31% share of exports which is a major reason due to low area and production it comes as in underutilized crop. (NHB, 2019). Gujarat ranks first in bean production (645.56 thousand tonnes), From $3.32 billion in 2022 to $3.41 billion in 2023, the global faba bean market grew at an annual growth rate (CAGR) of 2.6%. According to the Faba Beans Global Industry Report 2022, the industry is anticipated to rise to $3.58 billion by 2026 at an annual compound growth rate (CAGR) of 2.1%. It contains carbohydrate (7.2 g/100g), fat (0.1 g/100g), calcium (50 mg/100g), vitamin C (12mg/100g), thiamine (0.08 mg/100g), iron (1.4 mg/100g) and some amount of other minerals (Singh, 2017). The seeds of faba bean are a good source of L-DOPA, a precursor dopamine, which is used as a medicine for the treatment of Parkinson's disease. Faba beans also contain certain anti-nutritional factors in fresh pods as well as in immature seeds such as polyphenols which impart beany flavour which known to cause astringency (Bjerg *et. al.*, 1988; Kumar *et. al.*, 2019).

Correlations between various traits of crops can result from either genotypic or environmental factors, and environmental correlations result from the effect of environmental factors that vary in different environments. (Ngoc *et. al.*, 2019) Studies on genotypic and phenotypic correlations among traits of crop plants are helpful in planning, evaluating, and setting selection criteria for the desired traits in breeding programmes (Johanson *et. al.*, 1955). According to Falconer and Mackay (1996), pleiotropic effects and linkage between genes impacting many phenotypes are the key components of genetically based correlations. Correlation studies grow more difficult as more qualities are taken into account, therefore route analysis after a correlation research will help to uncover traits that contribute to yield.

Path analysis gives a clear image of character relationships to help in selection strategy formulation. In contrast to simple correlation, which just considers the reciprocal relationship and ignores the causation, it highlights the causes and their relative importance.

Wright (1921) created the idea of route coefficient, and Dewey and Lu (1959) applied it for the first time in plant selection. The direct and indirect effects of independent characteristics on a dependent trait are measured using path coefficient analysis, a type of standardised partial regression. This allows the correlation coefficient to be divided into components of direct and indirect effects, measuring the influence of one feature on another (Dewey and Lu 1959). Therefore, the objective of the current study was to evaluate the relationship between yield and qualities associated with yield and to identify key features for indirect selection to increase faba bean grain production.

MATERIALS AND METHOD

A. Experimental Site, Materials and Design

The current study was conducted at Babasaheb Bhimrao Ambedkar University Vidya-Vihar, Rae Bareli Road, Lucknow-226025 (U.P.), during the Rabi season of 2021-2022. Lucknow is located in the Gangetic alluvial plain of eastern Uttar Pradesh at 26° 50 North latitude, 80° 52 East longitude, and 111 metres above mean sea level (MSL). The experimental field has a level landscape. This region is covered under Uttar Pradesh's fifth agricultural climatic zone. (ICAR).

The 18 faba bean accessions used in this study all were derived from the Indian Institute of Vegetable Research Institute Varanasi (Uttar Pradesh) (Table 1).

Table 1.

1	EC-841540	7	EC-841587	13	EC-841603
2	EC-628934	8	EC-591828	14	EC-841617
3	EC-841595	9	EC-841577	15	EC-628939
4	EC-628940	10	EC-841580	16	EC-841579
5	EC-1521	11	EC-841563	17	EC-628930
6	EC-841532	12	EC-841597	18	EC-841571

The investigation was done in a Randomised Block Design, the 18 genotypes of broad beans (*Vicia faba* L.) were planted in Lucknow conditions during the Rabi season year 2022–2023. There were 3 replications, each with 18 blocks and 1 germplasm in each block. Plant to plant spacing was 15 x 15 and row to row spacing was 45 x 45.

B. Phenotypic measurements

At maturity, eighteen guarded plants were used to measure

1. Germination %, 2. Plant height (cm), 3. No. of branches/plant, 4. Days to First Flowering, 5. Days to 50 % Flowering, 6. Days to first fruit set, 7. Number of pods per plant, 8. Days to maturity, 9. Pod length (cm), 10. Pod diameter (mm), 11. Pod volume (ml), 12. Number of seeds per pod, 13. Number of seeds per plant, 14. 100 Seed Weight(gm), 15. Specific gravity, 16. Titratable acidity, 17. Total soluble solids, 18. seed yield/plant (gm)

Correlation analysis. Using the Miller *et al.* (1958) formula, phenotypic correlation, the observable correlation between variables that is the total of genotypic and environmental influences, was derived from variance and covariance components as follows:

Genotypic correlation= $\sigma g\ xy / \sqrt{(\sigma 2\ g\ x\ \sigma 2\ g\ y)}$

Phenotypic correlation= $\sigma p\ xy / \sqrt{(\sigma 2\ p\ x\ \sigma 2\ p\ y)}$

Where $\sigma p\ x\ y$ = phenotypic covariance between character x and y, $\sigma 2\ p\ x$ = phenotypic variance for character x, $\sigma 2\ p\ y$ = phenotypic variance for character y, $\sigma g\ xy$ = genotypic covariance between characters x and y, $\sigma 2\ g\ x$ = genotypic variance for character x, and $\sigma 2\ g\ y$ = genotypic variance for character y

The significance of phenotypic correlation coefficients was tested by the formula of Singh and Chaudhary (1985): $t' = r\ p\ xy \sqrt{(n-2 / 1-rp\ 2\ xy)}$

Path coefficient analysis. Based on the correlation, the path coefficient, which refers to the direct and indirect effects of the yield attributing traits (independent trait) on grain yield (dependent trait), was calculated in accordance with Dewey and Lu (1959) as follows:

$rij = Pij + \Sigma\ rikpkj$ Where rij = mutual association between the independent character (i) and dependent character (j) as measured by the genotypic correlation coefficients. Pij = direct effects of the independent character (i) on the dependent variable (j) as measured by the genotypic path coefficients, and $\Sigma rikpkj$ = Summation of components of indirect effects of a given independent character (i) on a given dependent character (j) via all other independent characters (k). Residual factor (R2),

the contribution of the remaining unknown factor was estimated using Singh and Chaudhury (1985) method: $R2 = \sqrt{(1 - \Sigma Pij\ rij)}$

RESULT AND DISCUSSION

A. Correlation Coefficient Analysis

A measurement known as correlation identifies the relationships between distinct plant properties and also identifies the traits that selection will enhance. A plant breeder has to be aware of the relationships between various features to maximise the effectiveness of selection. The selection process to increase yield is made easier by knowing the important correlation coefficients between various plant features. Table 2 displays the findings of the genotypic and phenotypic association of seed yield with component characteristics. The results of genotypic and phenotypic correlation revealed that the Seed yield had a positive and significant correlation with the number of branches per plant (0.590**,0.567**), number of pods per plant (0.751**,0.755**), number of seed per pod (0.364**, 0.364**), number of seed per plant (0.926**,0.920**) and pod length (ml) (0.289*,0.274*), while negative and significant correlation with Days to first fruit set (-0.270*, -0.267), specific gravity (-0.073, -0.072). It was also noted from the correlation coefficient results that

genotypic correlation coefficient estimates were more valuable than phenotypic correlation coefficient estimates, indicating a strong intrinsic link between the variables under study. When it comes to days to 50% blooming and days to maturity (Ahmed *et al.*, 2016). According to Osman *et al.* (2013), the number of pods per plant According to Verma *et al*. (2013) data on the number of branches per plant, pods per plant, seeds per pod, biological yield, and harvest index, according to Mulualem *et al.* (2013) and Sharifi and Aminpane (2014), the number of branches, clusters, pods, and seeds per plant, as well as the number of seeds per pod and the weight of 100 seeds, are all measured per plant. Singh *et al.* (2017). Raiger *et al.* (2021) for the number of branches per plant, the number of pods per plant, the number of seeds per pod, and the weight of 100 seeds.

B. Path Coefficient Analysis

Studies on correlation coefficients only reveal the type of associations between two qualities; they do not, by themselves, give a precise picture of the proportionate contribution of each component trait to the main economic output under study. For selection to enhance the population, understanding the direct and indirect impacts of many characteristics on desirable traits is crucial since it is conceivable for a component trait to not directly affect the concerned economic feature but to influence other related components. Through the use of path coefficient analysis, the phenotypic and genotypic correlation coefficients were divided into their corresponding direct and indirect effects. Tables 2 and 3 show, respectively, the direct and indirect phenotypic and genotypic impacts of several variables on grain yield.

C. Phenotypic path coefficient

Using the phenotypic correlation coefficients of 18 trait variables, the path of coefficient analysis for the current study was conducted. Number of pods per plant, Pod volume(ml), Number of seeds per pod, and Number of seeds per plant had positive direct effects on grain yield. However, exerted by number of seeds per plant (0.308) and number of seeds per pod (0.574) (Table 2). The results indicate the number of seeds per plant and number of seeds per pod are the most important traits which emphasis should be given during simultaneous selection aimed at improving grain yield in faba bean. These results are in close association with previous workers (Bora *et. al.*, 1998; Kumar *et. al.*, 2013 Lal, 2019) for biomass yield in faba bean. it was also observed that the number of pods per plant (-0.173) and pod diameter(mm) (-0.072) had direct negative effects on seed yield. Similar results were found in the research work carried by Tadesse *et al*. (2011), Chaubey *et al.* (2012), Verma *et al.* (2013), Cokkizgin *et al.* (2013), Kumar *et al.* (2017) and Dewangan *et al.* (2019).

Table 2: Genotypic and Phenotypic Correlation Coefficient of Yield and its Components in Faba bean.

	Germination%	**Plant height(cm)**	**No. of branches/plant**	**Days to the first flowering**	**Days to 50% flowering**	**Days to 1st fruit set**	**No. of pod/plant**	**Days to maturity**	**Pod length (cm)**
Germination%	**1**	0.006	0.422**	0.304*	0.153	-0.205	0.184	0.016	0.311*
Plant height	-0.017	**1**	0.394**	0.026	0.042	-0.322*	0.161	-0.227	0.345*
No. of branch/Plant	0.414**	0.354**	**1**	0.089	0.069	-0.332*	0.376**	-0.137	0.308*
Days to 1st flowering	0.285*	-0.001	0.065	**1**	0.914**	-0.503**	0.493**	0.540**	-0.281*
Days to 50% flowering	0.086	0.045	0.037	0.797**	**1**	-0.585**	0.496**	0.530**	-0.406**
Days to 1st fruit set	-0.185	-0.335*	-0.320*	-0.498**	-0.558**	**1**	-0.311*	-0.151	-0.088
No. of pod/plant	0.190	0.161	0.356**	0.467**	0.449**	-0.305*	**1**	0.256	0.085
Days to maturity	-0.023	-0.079	-0.087	0.320*	0.381**	-0.156	0.206	**1**	-0.333*
Pod length(cm)	0.308*	0.294*	0.333*	-0.248	-0.400**	-0.093	0.073	-0.297*	**1**
Pod diameter(mm)	-0.376**	0.104	-0.193	-0.539**	-0.543**	0.091	-0.442**	-0.481**	0.461**
Pod volume(ml)	-0.011	0.243	0.151	-0.511**	-0.461**	-0.062	-0.135	-0.471**	0.673**
No.of seed per pod	0.460**	0.066	0.375**	0.494**	0.349**	-0.169	0.522**	0.260	-0.132
No.of seed/plant	0.301*	0.140	0.613**	0.299*	0.266	-0.358**	0.818**	0.173	0.333*
100 seed weight(gm)	-0.377**	-0.088	-0.029	-0.704**	-0.658**	0.201	-0.508**	-0.328*	0.290*
Specific gravity	-0.236	0.054	-0.093	-0.132	-0.125	-0.069	-0.144	-0.250	0.065
Titratable acidity	0.257	-0.159	-0.079	-0.065	-0.062	0.337*	-0.212	-0.162	0.049
Total soluble solids	0.241	-0.013	0.218	-0.219	-0.261	0.240	-0.140	-0.210	0.190
Seed yield/plant	0.151	0.193	0.567**	0.182	0.139	-0.267	0.755**	0.159	0.274*

*: Significance at 5 per cent, **: Significance at 1 per cent.
Above diagonal: Genotypic Correlation Coefficient
Below diagonal: Phenotypic Correlation Coefficient

Table 3: Genotypic and Phenotypic Correlation Coefficient of Yield and its Components in Faba bean.

	Pod diameter(mm)	Pod volume(ml)	No. of seed per pod	No. of seed/plant	100 seed weight (gm)	Specific gravity	Titratable acidity	Total soluble solids	Seed yield/plant
Germination%	-0.383**	0.006	0.435**	0.313*	-0.389**	-0.252	0.301*	0.235	0.146
Plant height	0.137	0.251	0.098	0.127	-0.082	0.077	-0.179	0.015	0.196
No.of branch/Plant	-0.177	0.166	0.385**	0.632**	-0.056	-0.083	-0.063	0.227	0.590**
Days to 1st flowering	-0.659**	-0.514**	0.528**	0.314*	-0.736**	-0.231	-0.077	-0.203	0.194
Days to 50% flowering	-0.637**	-0.538**	0.433**	0.283*	-0.689**	-0.126	-0.166	-0.268*	0.163
Days to 1st fruit set	0.103	-0.071	-0.192	-0.358**	0.209	-0.063	0.369**	0.206	-0.270*
No.of pod/plant	-0.453**	-0.136	0.525**	0.822**	-0.510**	-0.148	-0.210	-0.143	0.751**
Days to maturity	-0.537**	-0.561**	0.344*	0.187	-0.409**	-0.204	-0.182	-0.220	0.203
Pod length(cm)	0.507**	0.716**	-0.142	0.348*	0.276*	0.060	0.075	0.201	0.289*
Pod diameter(mm)	**1**	0.624**	-0.590**	-0.315*	0.681**	0.535**	-0.054	0.160	-0.259
Pod volume(ml)	0.591**	**1**	-0.521**	0.054	0.545**	-0.155	-0.126	0.109	0.050
No.of seed per pod	-0.574**	-0.517**	**1**	0.383**	-0.743**	-0.012	-0.025	-0.194	0.364**
No.of seed/plant	-0.308*	0.054	0.369**	**1**	-0.142	-0.141	-0.026	-0.006	0.926**
100 seed weight(gm)	0.645**	0.530**	-0.726**	-0.144	**1**	0.231	0.205	0.142	0.008
Specific gravity	0.552**	-0.166	-0.009	-0.139	0.221	**1**	0.130	0.033	-0.073
Titratable acidity	-0.033	-0.107	-0.051	-0.023	0.189	0.121	**1**	-0.101	0.001
Total soluble solids	0.143	0.115	-0.170	-0.014	0.135	0.020	0.113	**1**	-0.064
Seed yield/plant	-0.256	0.048	0.364**	0.920**	0.006	-0.072	-0.005	-0.064	**1**

*: Significance at 5 per cent, **: Significance at 1 per cent.
Above diagonal: Genotypic Correlation Coefficient
Below diagonal: Phenotypic Correlation Coefficient

Table 4: Phenotypic path coefficient analysis of seed yield with its component characters in 18 genotypes of faba bean.

Germination%	Plant height(cm)	No. of branches/plant	Days to the first flowering	Days to 50%flowering	Days to 1st fruit set	No. of pod/plant	Days to maturity	Pod length(cm)
0.404	0.012	-0.225	0.139	0.110	-0.208	-0.046	0.000	-0.096
0.011	0.439	-0.221	0.016	0.020	-0.307	-0.040	-0.007	-0.116
0.174	0.186	-0.521	0.046	0.053	-0.318	-0.096	-0.003	-0.092
0.129	0.016	-0.055	0.436	0.571	-0.503	-0.129	0.014	0.095
0.082	0.016	-0.051	0.457	0.545	-0.587	-0.134	0.012	0.125
-0.090	-0.144	0.177	-0.235	-0.343	0.935	0.078	-0.003	0.027
0.075	0.071	-0.202	0.228	0.295	-0.296	-0.247	0.006	-0.027
0.006	-0.182	0.102	0.372	0.399	-0.169	-0.085	0.016	0.121
0.128	0.168	-0.157	-0.136	-0.225	-0.083	-0.022	-0.006	-0.304
-0.159	0.068	0.092	-0.333	-0.391	0.106	0.115	-0.011	-0.168
0.004	0.113	-0.091	-0.233	-0.327	-0.072	0.034	-0.012	-0.227
0.173	0.051	-0.206	0.245	0.271	-0.196	-0.130	0.008	0.045
0.130	0.053	-0.336	0.145	0.164	-0.338	-0.204	0.004	-0.110
-0.162	-0.034	0.036	-0.341	-0.401	0.200	0.126	-0.009	-0.084
-0.106	0.040	0.044	-0.128	-0.073	-0.055	0.037	-0.004	-0.019
0.133	-0.086	0.029	-0.032	-0.130	0.365	0.052	-0.004	-0.028
0.094	0.015	-0.123	-0.091	-0.153	0.174	0.036	-0.004	-0.066

The residual effect is 0.024

Table 5: Phenotypic path coefficient analysis of seed yield with its component characters in 18 genotypes of faba bean.

Pod diameter(mm)	Pod volume(ml)	No. of seed per pod	No. of seed/plant	100 seed weight (gm)	Specific gravity	Titratable acidity	Total soluble solids
0.268	0.008	0.324	0.362	-0.553	-0.160	-0.185	-0.011
-0.105	0.231	0.088	0.135	-0.107	0.055	0.110	-0.002
0.120	0.156	0.299	0.724	-0.094	-0.051	0.031	-0.011
0.519	-0.477	0.424	0.374	-1.078	-0.180	0.041	0.010
0.488	-0.535	0.375	0.338	-1.015	-0.082	0.134	0.013
-0.077	-0.069	-0.158	-0.406	0.295	-0.036	-0.219	-0.009
0.317	-0.122	0.400	0.927	-0.707	-0.092	0.119	0.007
0.466	-0.641	0.355	0.246	-0.747	-0.135	0.140	0.013
-0.374	0.667	-0.112	0.404	0.379	0.037	-0.051	-0.010
-0.680	0.584	-0.463	-0.367	0.984	0.329	0.037	-0.008
-0.445	0.893	-0.398	0.062	0.768	-0.091	0.079	-0.005
0.417	-0.470	0.756	0.440	-1.043	-0.009	0.005	0.010
0.223	0.049	0.296	1.122	-0.195	-0.088	0.016	0.000
-0.485	0.497	-0.571	-0.159	1.379	0.146	-0.121	-0.007
-0.366	-0.133	-0.011	-0.162	0.329	0.611	-0.075	-0.002
0.045	-0.125	-0.007	-0.033	0.298	0.082	-0.561	0.005
-0.114	0.097	-0.159	-0.004	0.200	0.025	0.054	-0.047

The magnitude of residual effect (0.246) indicated that the traits included in the study accounted for most of the variability present in grain yield, indicating that the contribution of traits considered was 75.4 % and the rest 24.6 % was the contribution of other traits which were not considered in the present study.

D. Genotypic path coefficient

Using the genotypic correlation coefficients of 18 trait variables, the path of coefficient analysis for the current study was conducted. Number of pods per plant, Pod volume(ml), Number of seeds per pod, and Number of seeds per plant had positive direct effects on grain yield. The high positive direct effects on grain yield were exerted number of seeds per plant (0.724) and the number of seeds per pod (0.756) Similar results were also obtained by Lal (2019). The direct effects of the remaining traits were low to be considered important. Biomass yield exerted considerable positive indirect effects on grain yield via a number of pods per plant, plant height, pod length and 100-seed mass. it was also observed that Days to 50 % Flowering (-0.343) and pod diameter (-0.680). These findings were consistent with those of Jivani *et al*. (2013), who found that harvest index and biomass production had the strongest direct influence on chickpea grain yield. At the genotypic level, plant height, number of pods per plant, and number of branches per plant all had a positive direct impact on grain output; however, days to flowering, number of pods per plant, 100-seed mass, and number of pods per plant scores all had a negative direct impact.

According to Singh and Chaudhary (1985), the residual impact demonstrates how well the explanatory factors capture the variability of the dependent variable. In the result, the examined characteristics explained 95% of the variability in seed yield due to the genotypic path coefficient analysis's residual impact of 0.0byates that certain qualities that are connected to grain yield were overlooked.

Table 6: Genotypic path coefficient analysis of seed yield with its component characters in 18 genotypes of faba bean.

Germination%	Plant height(cm)	No. of branches/plant	Days to the first flowering	Days to 50%flowering	Days to 1st fruit set	No. of pod/plant	Days to maturity	Pod length(cm)
0.117	-0.004	-0.073	0.043	0.026	-0.050	0.074	-0.001	-0.001
-0.002	0.232	-0.063	0.000	0.014	-0.090	0.063	-0.003	-0.001
0.049	0.082	-0.177	0.010	0.011	-0.086	0.139	-0.003	-0.001
0.033	0.000	-0.012	0.151	0.243	-0.135	0.182	0.012	0.001
0.010	0.010	-0.007	0.121	0.305	-0.151	0.175	0.015	0.001
-0.022	-0.078	0.057	-0.075	-0.170	0.270	-0.119	-0.006	0.000
0.022	0.037	-0.063	0.071	0.137	-0.082	0.390	0.008	0.000
-0.003	-0.018	0.015	0.049	0.116	-0.042	0.080	0.039	0.001
0.036	0.068	-0.059	-0.038	-0.122	-0.025	0.029	-0.012	-0.003
-0.044	0.024	0.034	-0.082	-0.165	0.025	-0.173	-0.019	-0.001
-0.001	0.056	-0.027	-0.077	-0.141	-0.017	-0.053	-0.018	-0.002
0.054	0.015	-0.066	0.075	0.106	-0.046	0.204	0.010	0.000
0.035	0.032	-0.108	0.045	0.081	-0.097	0.319	0.007	-0.001
-0.044	-0.020	0.005	-0.107	-0.200	0.054	-0.198	-0.013	-0.001
-0.028	0.013	0.017	-0.020	-0.038	-0.019	-0.056	-0.010	0.000
0.030	-0.037	0.014	-0.010	-0.019	0.091	-0.083	-0.006	0.000
0.028	-0.003	-0.039	-0.033	-0.080	0.065	-0.055	-0.008	-0.001

The residual effect is -0.0053

Table 7: Genotypic path coefficient analysis of seed yield with its component characters in 18 genotypes of faba bean.

Pod diameter(mm)	Pod volume(ml)	No. of seed per pod	No. of seed/plant	100 seed weight (gm)	Specific gravity	Titratable acidity	Total soluble solids
0.049	-0.001	0.264	0.151	-0.407	-0.002	-0.037	0.003
-0.014	0.021	0.038	0.071	-0.095	0.001	0.023	0.000
0.025	0.013	0.215	0.308	-0.032	-0.001	0.011	0.003
0.071	-0.045	0.284	0.151	-0.761	-0.001	0.009	-0.003
0.071	-0.040	0.200	0.134	-0.710	-0.001	0.009	-0.003
-0.012	-0.005	-0.097	-0.180	0.217	-0.001	-0.049	0.003
0.058	-0.012	0.299	0.411	-0.549	-0.001	0.031	-0.002
0.063	-0.041	0.149	0.087	-0.354	-0.002	0.023	-0.002
-0.060	0.059	-0.076	0.167	0.313	0.001	-0.007	0.002
-0.131	0.052	-0.329	-0.155	0.696	0.005	0.005	0.002
-0.077	0.087	-0.297	0.027	0.572	-0.002	0.015	0.001
0.075	-0.045	0.574	0.186	-0.784	0.000	0.007	-0.002
0.040	0.005	0.212	0.503	-0.155	-0.001	0.003	0.000
-0.084	0.046	-0.416	-0.072	1.080	0.002	-0.027	0.002
-0.072	-0.014	-0.005	-0.070	0.239	0.010	-0.018	0.000
0.004	-0.009	-0.029	-0.011	0.204	0.001	-0.144	-0.001
-0.019	0.010	-0.097	-0.007	0.146	0.000	0.016	0.012

Characters:1. Germination %, 2. Plant height (cm), 3. No. of branches/plant, 4. Days to First Flowering, 5. Days to 50 % Flowering, 6. Days to first fruit set, 7. Number of pods per plant, 8. Days to maturity, 9. Pod length (cm), 10. Pod diameter (mm), 11. Pod volume (ml), 12. Number of seeds per pod, 13. Number of seeds per plant, 14. 100 Seed Weight(gm), 15. Specific gravity, 16. Titratable acidity, 17. Total soluble solids, 18. seed yield/plant (gm)

CONCLUSION

The number of branches per plant, the number of pods per plant, the pod volume (ml), the number of seeds per pod, and the number of seeds per plant all demonstrated extremely significant ($p < 0.01$) and favourable phenotypic and genotypic correlations with grain yield. These findings suggested that these qualities may be selected for while simultaneously increasing grain output. Harvest index and biomass yield exhibited the strongest direct effects on yield at both the phenotypic and genotypic levels, according to a path coefficient analysis, highlighting the significance of these characteristics for the indirect selection of faba bean accessions to increase grain output. Because of this, while planning any plant breeding strategy using these 18 genotypes, attention should be placed on these attributes.

Conflict of interest. There isn't one, and there are no moral concerns with how animals behave.

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