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Correlation and path analysis study in Yardlong bean genotypes

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Abstract
The present investigation entitled "Correlation and path analysis study in yardlong bean genotypes" was carried out during *kharif* season of the year 2021. The field experiment was carried out at the Experimental Farm (Block VII) of the Department of Vegetable Science, Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi District (Karnataka). The study was undertaken on fifty one genotypes of yardlong bean using randomized complete block design with two replications. A wide range of variation observed among the genotypes for all the character. Analysis of variance indicated significant differences among the genotypes for different morphological characters. In the present investigation, the results revealed comparatively higher degree of genotypic correlation coefficients than their phenotypic correlation coefficients in most of the characters. The characters like pod length, pod weight and number of green pods per plant had highly significant positive correlation with pod yield per plant at both the genotypic and phenotypic point. Green pod yield per plant also showed significant positive correlations with the number of flowers per cluster at the phenotypic level only, which indicating dependence of these characters on each other. Path coefficient analysis reveals that the characters like number of pods per plant, length of the pod, weight of the fresh pod, days to first picking, number of primary branches, days to 50 per cent flowering and number of flowers per cluster contributed direct and indirect effect towards the yield. Therefore yield can be improved in yardlong bean by improving these traits.

Keywords: Yardlong bean**,** yield, genotypic correlation, phenotypic correlation, path analysis

Introduction
Yardlong bean [*Vigna unguiculata* ssp. *sesquipedalis* (L.) Verdc.] is an important leguminous vegetable crop mainly grown in both *kharif* and *spring* summer season in most of the parts of India. It is a self pollinated crop with the chromosome number 2n=2x=22.

Yardlong bean is believed to have been domesticated from cultivated cowpea in Asia. It is widely grown as a vegetable in China and South-East Asia. The area under of yardlong bean cultivation in India is about 18,560–20,160 ha annually (Toppo *et al.*, 2018) [7]. In Karnataka, it is cultivated in South-western districts like Kodagu, Belgaum, Uttara Kannada, Dakshina Kannada, Udupi, Chikkamagaluru, Hassan, and some parts of Bengaluru as intercrop, mixed crop and sole crop. The crop is neither grown commercially on large scale nor traded widely, thus it is termed as underutilized leguminous crop.

Yardlong bean is a significant source of nutrition particularly Vitamin-A and C, providing 17% and 31% respectively and 100g beans contains 47 calories (USDA, 2005).

The leaves of yardlong bean are somewhat shiny and flower color is either purple or white. Usually, flower size is larger than that of cowpea. Seed color ranges from black, brown and various types of mottled color. Young pods are used as vegetables and the pods are used much like traditional field beans (FAO, 2013) [3].

For the study of genetic variability and correlation of characters, yardlong bean offers a good scope because of its extravert nature of pistil comparatively easier handling, wider adaptability and presence of maximum variability. Correlation simply measures the mutual relationship between yield and yield attributing characters. Thus correlation helps in the selection of superior genotype from diverse genetic populations.

As there are number of factors involved in correlation studies, their indirect associations become more complex and confusing but path analysis helps to avoid this complication by measuring the direct influence of one character on the other as well as permits the portioning of given correlation coefficients into components of direct and indirect effects.

The path coefficient analysis helps to avoid complications by measuring direct influence of one character upon other as well as permits the partitioning of a given correlation coefficients into its components of direct and indirect effects.

Materials and Methods

The present investigation "Correlation and path analysis Study in yardlong bean genotypes" was carried out between June 2021 to September 2021 at the Experimental Farm (Block VII) of the Department of Vegetable Science, Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi District (Karnataka).

The study was undertaken on fifty one genotypes of yardlong bean using randomized complete block design with two replications. Yardlong bean seeds were dibbled at the spacing of 1m × 0.6m. Each treatment consists of 10 plants. Five competitive plants were randomly selected from each treatment to record observations on twelve characters. Genotypic and phenotypic correlation coefficients were estimated as suggested by Al-Jibourie *et al*. (1958) [1] and Path coefficient analysis suggested by Wright (1921) [10] and Dewey and Lu (1959) [2] was carried out to know the direct and indirect effect of the morphological traits on plant yield.

Results and Discussion

Correlation studies

In order to find out the association between yield and yield attributing characters the genotypic and phenotypic correlation coefficients were estimated and presented in Table 1.

Table 1: Genotypic correlation coefficient between growth and yield parameters in yardlong bean

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	0.407**	0.130	0.020	0.106	0.074	0.398**	0.077	0.055	0.123	0.122	0.092
2		1	-0.123	-0.171	-0.174	0.209*	0.334**	-0.162	0.046	0.217*	0.395**	-0.003
3			1	0.332**	0.917**	0.207*	-0.010	-0.177	-0.215*	0.257**	-0.033	-0.085
4				1	0.899**	0.292**	-0.002	-0.255**	-0.391**	0.347**	-0.036	-0.136
5					1	0.108	-0.038	-0.122	-0.078	0.161	-0.026	-0.033
6						1	0.329**	-0.165	-0.217*	0.977**	-0.006	-0.237*
7							1	-0.100	-0.101	0.374**	0.159	-0.197*
8								1	0.714**	-0.084	0.069	0.456**
9									1	-0.262**	0.134	0.300**
10										1	0004	-0.192
11											1	0.227*
12												1

Critical r_g value at 5%= 0.194 Critical r_g value at 1% = 0.253 *Significant at 5% **Significant at 1%

1. Vine length 2. Number of primary branches per plant 3. Days to first flowering 4. Days to 50 per cent flowering
5. Days to first picking 6. Number of flowers per cluster 7. Number of cluster per plant 8. Green pod length
9. Green pod weight 10. Number of green pods per cluster 11. Number of green pods per plant 12. Green pod yield per plant

Genotypic and Phenotypic correlation coefficients

The vine length was found to have significant (p = 0.01 and 0.05) and showed a positive correlation with number of primary branches per plant (0.407) and number of clusters per plant (0.398).

The number of primary branches per plant was connected positively and substantially (p = 0.01 and 0.05) with number of flowers per cluster (0.209), number of clusters per plant (0.334), number of green pods per cluster (0.217) and number of green pods per plant (0.395).

Days to first flowering had positive and significant association with days to 50 per cent flowering (0.332), days to first picking (0.917), number of flowers per cluster (0.207) and number of green pods per cluster (0.257). It was negatively significant with green pod weight (0.215).

Days required for 50 per cent flowering would have positive and significant (p = 0.01 and 0.05) association with days to first picking (0.899), number of flowers per cluster (0.292) and number of green pods per cluster (0.347). It was negative and significantly related to green pod length (-0.255) and green pod weight (-0.391).

The character number of flowers per cluster showed positive and significant (p = 0.01 and 0.05) association with number of clusters per plant (0.329) and number of green pods per cluster (0.977). It was negatively correlated with green pod weight (-0.217) and green pod yield per plant (-0.237).

Number of cluster per plant was positive and significantly correlated with number of green pods per cluster (0.374). Negative significant association was observed for green pod yield per plant (-0.197).

The length of the pod had a clear positive significant association green pod weight (0.714) and green pod yield per plant (0.456).

At the genotypic level, the weight of the green pod was significant (p = 0.01 and 0.05) positively correlated with the total yield per plant (0.300) whereas, number of green pods per cluster (-0.262) association was extremely significant but negative.

At the genotypic stage, it has been discovered that the sum of pods per plant is highly significant and positive association on green pod yield per plant (0.227).

At the genotypic level, green pod yield per plant revealed highly significant (p = 0.01 and 0.05) and positive relationship with green pod length (0.456), green pod weight (0.300) and number of green pods per plant (0.227). It also showed negative and significant (p = 0.01 and 0.05) relationship with number of flowers per cluster (-0.237) and number of clusters per plant (-0.197).

Phenotypic correlation coefficient

The vine length showed positive and significant (p = 0.01 and 0.05) connection with number of primary branches per plant (0.382) and number of clusters per plant (0.380).

The number of primary branches per plant documented positive association with number of flowers per cluster (0.200), number of clusters per plant (0.319) and number of green pods per plant (0.373).

At the phenotypic level, days to first flowering was significant

(p = 0.01 and 0.05) and positively connected with days to 50 per cent flowering (0.843), days to first picking (0.879), number of flowers per cluster (0.202) and number of green pods per cluster (0.219).

The positive significant interaction was documented for days to 50 per cent flowering with days to first picking (0.729), number of flowers per cluster (0.225) and number of green pods per cluster (0.198) but significant negative association recorded for green pod length (-0.221) and green pod weight (-0.218) at the phenotypic level.

Number of flowers per cluster showed positive significant correlation with number of clusters per plant (0.318), number of green pods per cluster (0.840) and green pod yield per plant (0.232). The green pod weight (-0.203) showed negative significant association.

Number of clusters per plant was proven strong and positive interaction with number of green pods per cluster (0.327) and number of seeds per pod (0.275).

At the phenotypic points, length of the pod had a strong positive and significant correlation with pod yield per plant (0.420) and pod weight (0.617).

Green pod weight recorded positive and significant association with fresh pod yield per plant (0.287).

Number of green pods per plant showed strong and positive association with green pod yield per plant (0.212). These results were in accordance with Vidya (2000) [9] and Parmar *et al*. (2014) [5].

Path coefficient analysis

The genotypic correlation coefficient of all the characters with yield was further partitioned into direct and indirect effects utilizing path coefficient analysis. The result on path analysis of various causes influencing yield per plant have been presented in Table 2.

Table 2: Phenotypic correlation coefficient among growth and yield parameters in yardlong bean

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	0.382**	0.114	-0.006	0.097	0.072	0.380**	0.062	0.026	0.103	0.133	0.082
2		1	-0.115	-0.158	-0.168	0.200*	0.319**	-0.153	0.036	0.191	0.373**	0.002
3			1	0.843**	0.879**	0.202*	-0.008	-0.172	-0.192	0.219*	-0.041	-0.078
4				1	0.729**	0.225*	0.014	-0.221*	-0.218*	0.198*	-0.024	-0.109
5					1	0.103	-0.040	-0.120	-0.060	0.106	-0.021	-0.010
6						1	0.318**	-0.163	-0.203*	0.840**	-0.008	0.232*
7							1	-0.092	-0.095	0.327**	0.151	-0.191
8								1	0.617**	-0.080	0.062	0.420**
9									1	-0.189	0.115	0.287**
10										1	-0.006	-0.162
11											1	0.212*
12												1

Critical r_g value at 5%= 0.194 Critical r_g value at 1% = 0.253 *Significant at 5% **Significant at 1%

1. Vine length 2. Number of primary branches per plant 3. Days to first flowering 4. Days to 50 per cent flowering
5. Days to first picking 6. Number of flowers per cluster 7. Number of cluster per plant 8. Green pod length
9. Green pod weight 10. Number of green pods per cluster 11. Number of green pods per plant 12. Green pod yield per plant

Direct effect

The direct effect of different characters on yield estimated from the path coefficient analysis reveals that the characters flowers per clusters (11.844), green pod length (4.3048), days to first picking (2.7420), number of primary branches per plant (1.4122), days to 50 per cent flowering (0.6889) and number of clusters per plant (0.4498). Number of pods per cluster would have the highest negative direct effect on pod yield per plant (-12.913) followed by the green pod weight (-3.6058), days to first flowering (-2.263), vine length (-0.0896) and number of pods per plant (-0.0534). Similar findings were reported by Litty (2015) [4].

Indirect effect

Vine length had high positive and indirect effects through number of flowers per cluster (0.8799) followed by number of primary branches (0.5754). Number of primary branches per plant had very high indirect effect through number of flowers per cluster (2.4843), days to first flowering (0.2802) and number of clusters per plant (0.1505). Days to first flowering had positive indirect effect through days to first picking (2.5150), number of flowers per cluster (2.4568). Days to 50 per cent flowering had maximum positive indirect effect on pod yield per plant through number of flowers per cluster (3.4697). Days to first picking had high positive and indirect effect through number of flowers per cluster (1.2816). Number of flowers per cluster had high positive indirect effect through green pod weight (0.7830). Number of clusters per plant had high positive indirect effect through number of flowers per cluster (3.9072). Green pod length had positive indirect effect through number of pods per cluster (1.0870). Green pod weight had positive indirect effect through number of pods per cluster (3.3894). Number of pods per cluster had high positive indirect effect through number of flowers per cluster (11.574). Number of pods per plant had positive indirect effect through number of primary branches (0.5581). These results are in consonance with the findings of Rambabu *et al*. (2016) [6].

Table 3: Genotypic path coefficient observation for yield and its components in yardlong bean

	1	2	3	4	5	6	7	8	9	10	11	rG
1	-0.0896	0.5754	-0.2957	0.0140	0.2931	0.8799	0.1793	0.3339	-0.1995	-1.5919	-0.0065	0.0925
2	-0.0365	1.4122	0.2802	-0.1180	-0.4776	2.4843	0.1505	-0.7002	-0.1667	-2.8105	-0.0211	-0.0034
3	-0.0117	-0.1749	-2.2630	0.7140	2.5150	2.4568	-0.0046	-0.7655	0.7764	-3.3298	0.0018	-0.0854
4	-0.0018	-0.2419	-2.3454	0.6889	2.4663	3.4697	-0.0012	-1.1011	1.4128	-4.4845	0.0019	-0.1364
5	-0.0096	-0.2460	-2.0756	0.6196	2.7420	1.2816	-0.0172	-0.5276	0.2814	-2.0830	0.0014	-0.0331

6	-0.0067	0.2962	-0.4694	0.2018	0.2967	11.844	0.1484	-0.7130	0.7830	-12.619	0.0004	-0.2373*
7	-0.0357	0.4727	0.0229	-0.0018	-0.1050	3.9072	0.4498	-0.4306	0.3641	-4.8328	-0.0085	-0.1978*
8	-0.0069	-0.2297	0.4024	-0.1762	-0.3361	-1.9618	-0.0450	4.3048	-2.5779	1.0870	-0.0037	0.4568**
9	-0.0050	0.0653	0.4873	-0.2699	-0.2140	-2.5720	-0.0454	3.0776	-3.6058	3.3894	-0.0072	0.3003**
10	-0.0110	0.3074	-0.5835	0.2392	0.4423	11.574	0.1683	-0.3624	0.9464	-12.913	-0.0002	-0.1929
11	-0.0190	0.5581	0.0748	-0.0249	-0.0722	-0.0803	0.0719	0.3010	-0.4854	-0.0516	-0.0534	0.2271*

Diagonal indicates direct effect *Significant at 5% **Significant at 1% rG- Genotypic correlation with pod yield per plant, Residual effect = 0.7359

1. Vine length
2. Number of primary branches per plant
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first picking
6. Number of flowers per cluster
7. Number of cluster per plant
8. Green pod length
9. Green pod weight
10. Number of green pods per cluster
11. Number of green pods per plant
12. Green pod yield per plant

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