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Correlation and path analysis studies in winged bean (*Psophocarpus tetragonolobus* L.)

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Abstract
A field experiment was conducted to analyze the correlation between yield parameters and their direct and indirect effects on the pod yield in winged bean using thirty genotypes at the Instructional-Cum-Research Farm of Horticulture Section, Rajarshee Chhatrapati Shahu Maharaj College of Horticulture, Kolhapur during the *Kharif* season 2021-22. The correlation coefficients indicated that there were highly significant and positive correlations between 10 pods weight and number of primary branches per plant and pod yield per plant. At genotypic level, high positive direct effect towards pod yield per vine was exerted by number of pods per vine followed by 10 pods weight, days to fifty percent flowering, number of primary branches per plant and vine length. Therefore, this study suggested that winged bean improvement program could be based on these traits, especially number of pods per plant and 10 pods weight.

Keywords: Winged bean, correlation, path analysis

Introduction
Winged bean [*Psophocarpus tetragonolobus* (L.) DC.] is an herbaceous, perennial, multipurpose, neglected, tuberous leguminous vegetable crop. It is a member of family Fabaceae and have diploid chromosome number 2n=2x=18 (Sarode and Dodake, 2019) [6]. It is rich in nutrients and contains a remarkable amount of proteins, vitamins and fatty oils which may help people in sub-Saharan African countries improve their diets. People of tribal areas make use of winged bean in their daily diet in the form of seeds and young pods (Yadav, 2018) [7]. Winged bean requires minimal inputs and produces sufficient amount of food from plant parts to give adequate dietary maintenance (Lepcha *et al*., 2017) [3]. It helps in increasing soil fertility by fixing atmospheric nitrogen. One remarkable attribute of winged bean is that it has a potential for about all plant parts are to be eaten, from the seeds, pods, and flowers to the tuberous roots and leaves, with the leaves and stems as a fodder therefore, it is well known as multipurpose vegetable crop. The seeds can be used in the same way as soybean, tubers can be eaten cooked or raw, flowers can be used in salads, and leaves can be eaten like spinach. The most nutritious part of the winged bean is the mature dry seeds and it make a delightful nut-like snack when fried or baked. Winged bean is primarily grown in Bangladesh, Pupua New Guinea, Indonesia, Malaysia, Thailand, Ghana and India. In India, it is commonly grown and consumed by local peoples in southern and north-eastern regions, such as Mizoram, Manipur and Tripura. Also, in Male Mahadeshwara Hills of South Karnataka, winged bean is grown by twining on wild trees (Mohamadali and Madalageri, 2003) [5].

Materials and Methods
Thirty winged bean genotypes collected from different locations of Maharashtra, Manipur, Kerala, and Goa were evaluated at Instructional-Cum-Research Farm of Horticulture Section, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur during *Kharif*, 2021 in a Randomized Block Design with two replications. Each treatment comprise of a row of 7.0 m length plant to plant distance of 1.0 m and a row to row distance of 1.2 m. Recommended agronomic operations were followed to grow a good crop of winged bean. Morphological observations on different traits *viz*., days to fifty percent flowering, days to last pod maturity, number of primary branches per plant, vine length, pod length, pod width, 10 pods weight, number of pods per plant, pod yield per plant were recorded from five randomly selected winged bean plants of each genotype and the average values were used for statistical study. Correlation coefficient analysis was done according to Miller *et al*. (1958) [4] and the methodology suggested by Dewey and Lu (1959) [1] was followed to carry out the path

coefficient study for green pod yield and its elements, keeping pod yield as dependent variable and other variables as independent ones.

Results and Discussion

Correlation coefficient gives a clear idea of the extent of inter-relationship between a pair of attribute and shows whether simultaneous improvement of the correlated attributes may be possible or not. Genotypic and phenotypic correlation coefficients between nine quantitative characters of thirty winged bean genotypes is reproduced in table 1 and partitioning of genotypic correlation coefficient into direct and indirect effect of component characters on pod yield per plant is shown in table 2.

The evaluation of correlation between pod yield and various component characters revealed that 10 pods weight had highly significant and positive association with pod yield per plant at genotypic and phenotypic levels; number of primary branches per vine recorded highly significant positive correlation with pod yield at genotypic level and significant and positive correlation at phenotypic level; vine length was significantly and positively correlated with pod yield per vine at genotypic level. It indicates that while going for mare selection of yield improvement in winged bean these traits should be taken into consideration as simultaneous improvement on these traits will be helpful in improving pod yield in winged bean. Along with above results pod yield per vine recorded a positive but non-significant correlation with pod length, pod width and number of pods per plant at both genotypic and phenotypic levels. The magnitude of genotypic correlation was greater than the phenotypic correlation for most of the characters that indicated inherent inter-relationship between various characters. Similar findings were reported by Kalambe *et al*. (2019) [2] for number of primary branches per plant and pod length in cowpea.

Path analysis is a standardized partial regression coefficient which estimates the direct impact of one variable upon another and permits the partition of correlation coefficient into the component of direct and indirect effects. At genotypic level, high positive direct effects towards pod yield per plant were exerted by number of pods per plant followed by 10 pods weight, days to fifty percent flowering, vine length and number of primary branches per plant whereas the magnitudes of direct effects of pod length, pod width were positive but negligible. The results of direct and indirect effects exhibited by different parameters on pod yield per plant indicated that there was an agreement between the direction and magnitude of direct effects of various characters and correlation with pod yield per plant. The magnitude of residual effect was high, which indicated that major part of contribution towards pod yield per plant might be explained on the basis of characters included in the present experiment.

Table 1: Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients for pod yield and its component characters in winged bean

Characters	Days to 50% Flowering	Days to last pod maturity	No. of primary branches per plant	Vine length (cm)	Pod length (cm)	Pod width (cm)	10 Pods weight (g)	No. of pods per plant	Pod yield per plant (kg)
Days to 50% flowering	1.0000	0.3379**	-0.0027	-0.0754	-0.3309**	-0.1619	0.2551*	-0.5733**	0.0188
Days to last pod maturity	0.1473	1.0000	-0.2582*	0.7666**	-0.3536**	-0.5244**	-0.0438	-0.3500**	-0.1305
No. of primary branches per plant	0.0097	-0.1067	1.0000	0.3518**	0.4514**	0.1020	0.2561*	-0.3953**	0.3387**
Vine length (cm)	0.0115	0.1477	0.2349	1.0000	0.3049*	-0.3061*	-0.0231	-0.1305	0.2605*
Pod length (cm)	-0.3006*	-0.2491	0.3957**	0.1820	1.0000	0.3125*	0.2797*	-0.1552	0.2369
Pod width (cm)	-0.0857	-0.3481**	0.0925	-0.2103	0.2968*	1.0000	0.4438**	-0.1679	0.0866
10 Pods weight (g)	0.1978	-0.1001	0.2065	-0.0103	0.2497*	0.4126**	1.0000	-0.5472**	0.4000**
No. of pods per plant	-0.3479**	0.0068	-0.2456*	-0.0314	-0.1813	-0.1560	-0.4199**	1.0000	0.1510
Pod yield per plant (kg)	0.0192	0.0045	0.3102*	0.1294	0.2020	0.0591	0.3649**	0.1066	1.0000

Table 2: Direct and indirect effect of component characters on pod yield per vine

Characters	Days to 50% Flowering	Days to last pod maturity	No. of primary branches per plant	Vine length (cm)	Pod length (cm)	Pod width (cm)	10 pods weight (g)	No. of pods per plant	R_g
Days to 50% flowering	0.4792	-0.0373	-0.0010	-0.0306	-0.0029	-0.0070	0.1791	-0.5606	0.0188
Days to last pod Maturity	0.1619	-0.1104	-0.0948	0.3116	-0.0031	-0.0226	-0.0308	-0.3423	-0.1305
No. of primary branches per plant	-0.0013	0.0285	0.3670	0.1430	0.0040	0.0044	0.1797	-0.3866	0.3387**
Vine length (cm)	-0.0361	0.0846	0.1291	0.4064	0.0027	-0.0132	-0.0162	-0.1276	0.2605*
Pod length (cm)	-0.1586	0.0390	0.1657	0.1239	0.0088	0.0135	0.1963	-0.1517	0.2369
Pod width (cm)	-0.0776	0.0579	0.0374	-0.1244	0.0028	0.0432	0.3115	-0.1642	0.0866
10 Pods weight (g)	0.1223	-0.0048	0.0940	0.0094	0.0025	0.0192	0.7019	-0.5351	0.4000**
No. of pods per plant	-0.2747	0.0386	-0.1451	-0.0530	-0.0014	-0.0072	-0.3841	0.9779	0.1510

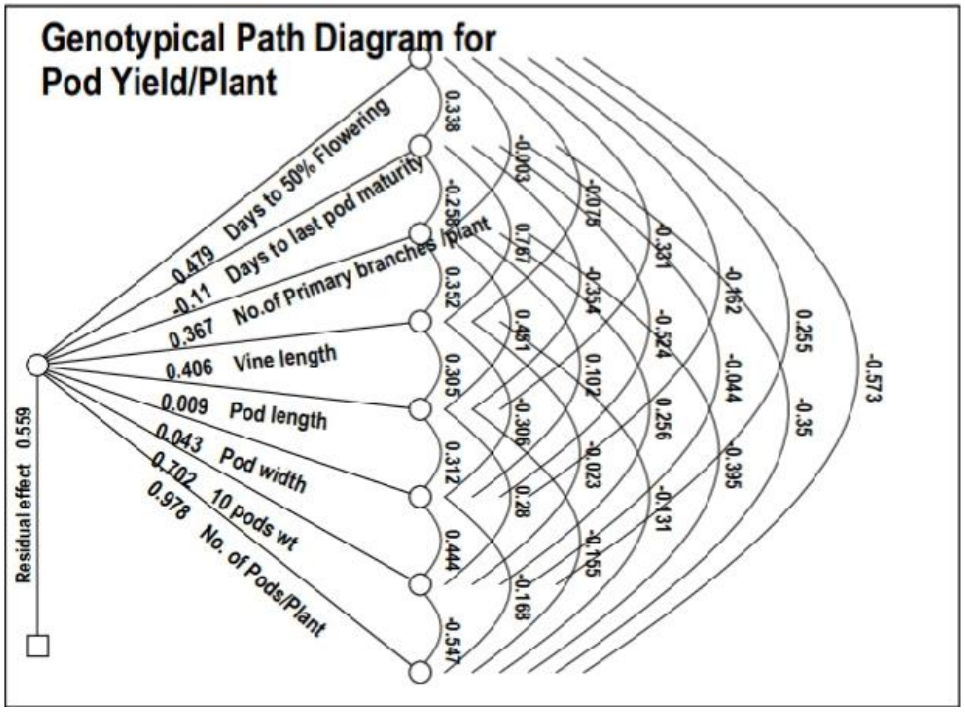

Fig: Direct and indirect effects of component characters on pod yield

Conclusion

On the basis of present study, it might be concluded that quantitative characters *viz*., number of pods per plant, 10 pods weight, days to fifty percent flowering, vine length and number of primary branches per plant are the important characters affecting pod yield in winged bean.

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