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Correlation and Path Analyses of Quantitative Component Traits in *Rabi* Pigeonpea [*Cajanus cajan* (L.) Millsp.

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A B S T R A C T

Twenty genotypes of pigeonpea were evaluated for the nature and magnitude of association of seed yield with agronomic characters *viz.*, days to flower initiation, days to 50 % flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod length number of seeds per pod, 100 seed weight, seed yield per plant, protein content percent and pod borer incidence score. Other than this investigation was also carried out to know the direct and indirect contribution of yield traits on seed yield by path coefficient analysis. Correlation studies revealed a positive and significant relationship between the number of seeds per pod followed by the number of secondary branches per plant. The path coefficient analysis showed that the number of secondary branches per plant had the highest direct effect on seed yield. Hence, this character must be considered in the selection for high seed yield.

Introduction

Due to a major source of protein, pulses are consumed globally to meet the protein requirement of the growing population. Generally, pulses contain 20 to 25 percent of protein, which is thrice in comparison to rice and twice in comparison to wheat. Among all the pulses, pigeon pea [*Cajanus cajan* (L.) *Millsp*] is a predominant seed legume and also the second most important pulse crop next to chickpea in India. It is mostly being cultivated in Africa, Asia, and America and is also predominantly grown and consumed in India. It is consumed as dry split "daal" besides several other uses of various parts of the pigeonpea plant. It is an excellent source of protein (24-25%) and minerals and also the supplementing energy-rich cereal diets in a mainly vegetarian population (Sodavadiya *et al.*, 2009). Due to wide distribution and diversity in India, pigeon pea was considered to be the Indian origin (Vavilov, 1951). In India, pigeonpea share 19.11 percentage of total production and yield of 4.23 million tonnes during 2016-17 (Directorate of

Economics and Statistics). Pigeonpea is usually grown as a Kharif crop under rainfed conditions. However, rabi pigeonpea had the potential for high seed yield. The productivity of pigeonpea was found to be very low under rainfed conditions. However, the demand for pigeonpea dal is increasing at a premium price. So, a complete Knowledge and understanding of the correlation between yield and yield components and the direct-indirect effect of different characters towards the yield is a must for a plant breeder towards the improvement of any crop. However, the yield is a complex character that is associated with the various contributing characters which are interrelated among themselves. According to Pandey *et al.,* (2015), correlation and path analysis is useful for understanding the interrelationships of various traits. Correlation studies measure the only mutual association between two traits and it does not imply the cause and effect of the relationship. Path coefficient analysis has been found useful for direct and indirect causes of association and allows a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each causal factor. The measurement of phenotypic, genotypic, and environmental correlations between yield and other characters has basic and foremost endeavors to find out guidelines for plant selection. The magnitude and direction of correlation offer an idea for future improvement concerning traits. In situations where more variables are included in correlation studies, the indirect association becomes complex and the path analysis is proved to be a useful tool in finding out the direct and indirect causes of association. Similarly, the direct and indirect effects for different characters can be determined by the path analysis. Whenever plant breeder goes for selection for yield, it always misleads because yields depend on various characters (BalChinmayee, 2016). So, path analysis could be a good approach for knowing the relationship between yield and different yield attributing characters and their direct and indirect effects on yield in pigeon pea.

Materials and Methods

A total of 20 pigeonpea cultures were utilized for the present study. The experiment was conducted in the experimental area of the department of Genetics & Plant Breeding at Research cum Instructional Farm, Indira Gandhi Krishi Viswavidyalaya, Raipur during rabi 2016-17. The experiment was laid out in Randomized Complete Block Design (RBD) in three replications. Each entry was sown in two rows of four-meter length keeping 30 cm between rows and 10 cm between plant spacing. All the recommended agronomic practices were strictly followed. Observations on metric traits were recorded on a single plant basis from five randomly selected competitive plants from each genotype for characters viz., days to flower initiation, days to 50 % flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, Pod length (cm), number of seeds per pod, 100 seed weight (g), Seed yield plant-1 (g), Protein content percent and pod borer incidence score. The data were subjected to statistical analysis i.e, correlation, and path analysis as per the standard procedure.

Results and Discussion

The variance of each character was analysed separately in randomised block design to test the significance of difference among the varietal means for twelve quantitative characters of pigeonpea genotypes and results are presented in Table 1. Table indicated that the mean sum of squares due to genotypes were highly significant for all the characters.

Table.1 Analysis of variance for seed yield and its components in *rabi* pigeonpea

Source of variation	DF	Days to flower initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches plant^{-1}	No. of secondary branches plant^{-1}	No. of Pods Plant^{-1}(cm)	Pod length	No. of Seeds pod^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)	Protein content %
Replication	2	4.51**	6.06**	5.06*	2.14	0.02	2.18**	16.26	0.005	0.16*	0.02	4.33	0.08
Treatment	19	24.68**	32.54**	17.42**	114.92**	2.68**	6.67**	1011.45**	0.33**	0.37**	0.81*	46.06**	38.37**
Error	38	0.62	0.59	1.14	5.40	0.19	0.28	8.14	0.06	0.03	0.17	2.31	1.00

** Significant at 1% probability * Significant at 5% probability

Table.2 Genotypic (G), Phenotypic (P) and Environmental (E) correlation coefficients for seed yield and its components in rabi pigeonpea

Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches plant-1	Secondary branches plant-1	Pods plant-1	Pod length cm	Number of seeds pod-1	100 seed weight (g)	Seed yield (Kg/ha)	Protein content %
Days to flower initiation	**G**	**0.659****	**0.2**	**-0.380****	**-0.720****	**-0.684****	**-0.564****	**-0.149**	**-0.552**	**0.072**	**-0.216**	**-0.318***
	P	**0.622****	**0. 149**	**-0.362****	**-0.612****	**-0.621****	**0525****	**-0.082**	**-0.467****	**0.05**	**-0.206**	**-0.286***
	E	**0.059**	**-0**	**-0.207**	**0.109**	**-0.01**	**0.289***	**0.192**	**0.004**	**-0.011**	**0.048**	**0.121**
Days to 50% flowering	**G**		**0.2**	**-0.056**	**-0.349****	**-0.359****	**-0.007**	**0.046**	**0.087**	**0.293**	**0.133**	**0.609****
	P		**0.2**	**-0.065**	**-0.314***	**-0.345****	**-0.013**	**0.019**	**0.052**	**0.21**	**0.126**	**-0.579****
	E		**0.2**	**-0.17**	**0.079**	**0.202**	**-0.177**	**-0.116**	**-0.203**	**0.031**	**-0.097**	**0.14**
Days to maturity	**G**			**0.234**	**-0.131**	**0.005**	**0.167**	**-0.018**	**-0.252**	**-0.034**	**0.047**	**-0.033**
	P			**0.19**	**-0.094**	**-0.072**	**-0.152**	**0.021**	**-0.202**	**0.069**	**0.044**	**-0.024**
	E			**-0.056**	**0.075**	**-0.539****	**-0.025**	**0.132**	**-0.005**	**0.335****	**-0.044**	**-0.04**
Plant height (cm)	**G**				**0.291***	**0.369****	**0.576****	**0.118**	**0.476****	**-0.115**	**0.306***	**-0.158**
	P				**0.261***	**0.324***	**0.538****	**0.088**	**0.435****	**-0.08**	**0.281***	**-0.166**
	E				**0.105**	**0.002**	**0.126**	**0.005**	**0.262***	**0.001**	**-0.063**	**-0.245**
Primary branches plant-1	**G**					**0.555****	**0.725****	**0.561****	**0.310***	**-0.164**	**0.114**	**0.157**
	P					**0.504****	**0.665****	**0.391****	**0.15**	**0.139**	**-0.096**	**0.322***
	E					**0.227**	**0.290***	**-0.032**	**0.022**	**-0.04**	**-0.09**	**0.088**
Secondary branches plant-1	**G**						**0.576****	**0.166**	**0.234**	**0.147**	**0.388****	**0.126**
	P						**0.550****	**0.084**	**0.231**	**-0.129**	**0.159**	**0.048**
	E						**0.273***	**-0.187**	**0.23**	**-0.113**	**0.485****	**0.485****
Pods plant-1	**G**							**0.517****	**0.614****	**0.041**	**0.182**	**-0.295***
	P							**0.392****	**0.548****	**0.048**	**0.18**	**0.273***
	E							**-0.12**	**0.203**	**0.169**	**0.035**	**0.182**

Pod length cm	**G**								**0.451****	**0.237**	**0.248**	**-0.017**
	P								**0.356****	**0.097**	**0.205**	**-0.003**
	E								**0.146**	**-0.109**	**0.152**	**0.061**
Number of seeds pod-1	**G**									**0.500****	**0.421****	**-0.327***
	P									**0.288***	**0.375****	**-0.272***
	E									**-0.136**	**0.14**	**0.039**
100 seed weight (g)	**G**										**0.280***	**0.234**
	P										**0.044**	**0.046**
	E										**0.213**	**0.162**
Seed yield (Kg/ha)	**G**											**0.128**
	P											**0.124**
	E											**0.035**
**** Significant at 1% probability; * Significant at 5% probability**												

Table.3 Genotypic path coefficients of various characters for seed yield (Kg/ha) in *rabi* pigeonpea

Characters	Days to flower initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches plant^{-1}	Secondary branches plant^{-}1	Pods plant^{-} ^{1}	Pod length (cm)	Seeds pod^{-1}	100 seed weight (g)	Protein content %	Genotyp e 'r' with seed yield (Kg/ha)
Days to flower initiatio	**0.101**	0.282	-0.093	-0.163	-0.389	-0.725	0.785	-0.047	0.004	0.053	0.083	-0.216
Days to 50% flowering	0.100	**0.282**	-0.524	0.429	0.541	1.062	-1.392	0.318	-0.007	0.747	-0.261	0.133
Days to maturity	0.017	0.081	**-0.523**	0.100	-0.070	0.004	0.232	-0.005	0.001	-0.025	0.008	-0.047
Plant height (cm)	-0.038	-0.023	-0.122	**0.428**	0.157	0.391	-0.801	0.037	-0.003	-0.085	0.041	0.306*
Primary branches plant^{-1}	-0.073	-0.149	0.068	0.125	**0.541**	0.588	-1.009	0.178	-0.002	-0.168	-0.044	0.132
Secondary branches plant^{-1}	-0.069	-0.154	-0.002	0.158	0.300	**1.059**	-0.802	0.052	-0.001	-0.109	-0.033	0.388**
Pods plant^{-1}	-0.056	-0.003	0.877	0.247	0.392	0.611	**-1.391**	0.164	-0.004	0.031	0.077	0.182
Pod length (cm)	-0.015	0.019	0.009	0.050	0.304	0.175	-0.718	**0.318**	-0.003	0.177	0.004	0.248
Seeds pod^{-1}	-0.056	0.037	0.131	0.203	0.209	0.248	-0.854	0.143	**-0.007**	0.373	0.085	0.421**
100 seed weight	0.007	0.125	-0.017	0.049	-0.121	-0.155	-0.057	0.075	-0.003	**0.746**	0.061	0.280*
Protein content %	-0.032	-0.261	-0.017	-0.067	0.091	0.133	0.410	-0.005	0.002	-0.175	**-0.261**	0.128

Diagonal values indicate direct effects Residual effect= 0.05487

Significant mean squares due to seed yield and attributing characters revealed the existence of considerable variability in the material studied for the improvement of various traits. Similar results were reported by Venkateshwarlu (2001) and Chetukuri *et al.*, 2013.Results of correlation analysis were presented in Table 2. Association studies revealed that seed yield showed the highest significant positive correlation with the number of seeds per pod followed by the number of secondary branches per plant, plant height, and 100 seed weight. Moreover, days to flower initiation were found to a significant positive correlation with days to 50 % flowering. Plant height showed a significant positive correlation with the number of pods per plant. A number of primary branches per plant showed a significant positive correlation with the number of pods per plant followed by pod length and the number of secondary branches per plant. The number of secondary branches per plant showed a significant positive correlation with the number of pods per plant. The number of pods per plant showed a significant positive correlation with the number of seeds per pod followed by pod length. Pod length showed a significant positive correlation with the number of seeds per pod. The number of seeds per pod showed a significant positive correlation with 100 seed weight. Hence, direct selection for seed yield per plant, number of secondary branches per plant, number of primary branches per plant, number of pods per plant, days to 50% flowering, and days to maturity may be advantageous for selecting the high yielding genotypes in rabi pigeonpea from the available genotypes. The experimental findings on correlation coefficient analysis are corroborated with the results reported earlier by Munoz and Abrams (1971), Joshi (1973), Mukewar and Muley (1975), Brar (1993), Sarma *et al.*, (1994), Chandana *et al.*, (2014) and Singh and Singh (2016).

The path coefficient analysis showed that the number of secondary branches per plant had the highest direct effect on seed yield followed by 100 seed weight (g), the number of primary branches per plant, and plant height cm (Table 3). It also had a significant positive association with seed yield with high heritability and genetic advance. Hence, this character seems to be an important contributor to seed yield and must be considered in the selection for high seed yield. The indirect effect of the number of primary branches per plant on seed yield via., a number of pods per plant and days to 50% flowering. Similarly, the number of pods per plant had an indirect effect on seed yield via., days to maturity, the number of secondary branches per plant, and the number of primary branches per plant. Hence, indirect selection of these traits may increase more number of primary and secondary branches per plant and seed yield per plant which ultimately leads to being the development of high-yielding genotypes in rabi pegeonpea. Similar findings were reported by Veeraswamy *et al.*, (1975), Brar (1993), Jahagirdar *et al.*, (1994), Sarma *et al.*, (1994), Gowda *et al.*, (1996), Musaana and Nahdy (1998), Basavarajaiah *et al.*, (1999), Sinha and Singh (2005), Chandana *et al.*, (2014) and Kothimbire *et al.*, (2016).

In conclusions the overall observations on correlation and path coefficients for seed yield and its attributes in rabi pigeonpea genotypes indicated that the presence of plenty of variability for most of the characters. Correlation studies revealed that seed yield showed the highest significant positive correlation with the number of seeds per pod followed by the number of secondary branches per plant. Moreover, the number of seeds per plant was found to be correlated positively with the number of pods per plant and 46 primary branches per plant. Hence, direct selection for the number of pods per plant, number of primary and secondary

branches per plant is advantageous for selecting the high yielding genotypes in rabi pigeon pea. The path coefficient analysis showed that the number of secondary branches per plant had the highest direct effect on seed yield. Hence, this character must be considered in the selection for high seed yield. Moreover, other important characters having considerable direct effects were the number of seeds per pod, 100 seed weight (g), number of primary branches per plant, and days to 50% flowering may lead to the development of high yielding genotypes from rabi pigeonpea genotypes. Whereas, indirect selection of the traits like days to maturity, plant height, pod length ultimately lead to being the development of high-yielding genotypes.

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