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Character association and path analysis studies on seed yield and its yield attributing traits in mungbean (*Vigna radiata* (L.) Wilczek)

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Abstract
Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop of India. It is an excellent source of dietary protein. Inter-relationship among various quantitative characters *i.e* days to 50% Flowering, days to Maturity, plant height (cm), primary Branches /plant, secondary Branches /plant, pods per plant, Seeds per pod, 100 seed weight (gms) were analysed with seed yield. Eight genotypes being studied at station trial at Barrister Thakur Chhedilal college of Agriculture and Research Station, Sarkanda Bilaspur, Chhattisgarh in Kharif 2014-15. Correlation analysis revealed that days to 50 % flowering has positive significant correlation with days to maturity, plant height and pods per plant. Pods per plant have positive significant correlation with plant height, secondary branches per plant and days to maturity. Plant height has positive significant correlation with days to maturity and secondary branches per plant. The path coefficient analysis revealed that days to 50% flowering, primary branches/plant, secondary branches/plant, 100 seed weight and no of seeds per pod had positive direct effect on seed yield, while plant height, days to maturity and pods per plant had negative direct effects on seed yield. Late flowering with numerous primary and secondary branches with more seed weight and more no of seeds per pod directly lead to increase in seed yield. Less pods per plant with high seeds/pods is more desirable trait for high seed yield.

Keywords: mungbean, correlation, path analysis

Introduction
Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop of India and plays an important role in the food and nutritional security of India. It is a short duration legume crop cultivated mainly for their dry seeds. It can be grown successfully in extreme environments (e.g., high temperatures, low rain fall, and poor soils) with few economic inputs (Das *et al.*, 2014) [3]. It has an ability to fix atmospheric nitrogen (N2) in symbiosis with the soil bacteria *Rhizobium* spp. The crops are utilized in several ways, where seeds, sprouts and young pods are consumed as sources of protein, amino acids, vitamins and minerals, and plant parts are used as fodder and green manure. Mungbean protein is easily digested without flatulence. Amino acid analysis confirms that it has Lysine amino acid more than urdbean hence its protein is an excellent complement to rice in terms of balanced human nutrition. State data of Chhattisharh tells that mungbean crop has been grown in 10040 hectares with the total production of 4580 Metric tons with an average productivity of 456 kg/ha for the year 2015, (Anonymous., 2015) [2]. Yield is one such character that results due to the actions and interactions of various component characters (Grafius, 1960) [6]. It is also widely recognised that genetic architecture of yield can be resolved better by studying its component characters correlations. This enables the plant breeder to breed for high yielding genotypes with desired combinations of traits. Linear correlation between yield and several of its components can present a confusing picture due to inter-relationships between component characters themselves. The objective of this study was to establish the inter-relationship and direct and indirect effects of various Mungbean genotypes among themselves and with seed yield.

Materials and Methods
Eight mungbean entries along with two check varieties were used in this study. This is the Station trial grown at the Research Farm of B.T.C. College of Agriculture and Research station, Sarkanda, Bilaspur, Chhattisgarh, India during *kharif* season of 2014-15.These entries were sown in a randomised block design with three replications along with the check entries. In each replication, 08 treatments were grown in 4 m long rows of 4 rows with 30 cm interrow spacing. Initially, extra seed was planted which was later thinned to maintain an optimum

population density. Five randomly selected plants from each treatment were tagged for recording the observations on the following characters, viz., days to 50% flowering, days to maturity , plant height (cm),primary branches per plant, Secondary branches per plant, pods per plant, seeds per pod,100 seed weight (gms) and Seed yield per plot. The data were analysed by OPSTAT open data analysis software (Sheoran *et al*., 1998) [13] for the estimation of correlation and path values. Genotypic correlations were computed using variance and co-variances as suggested by (Johnson *et al.*, 1955) [7]. Path coefficient analysis was performed as suggested by (Dewey and Lu, 1959) [4].

Results and Discussion

In the present study of correlation analysis showed Table 1. seed yield recorded negative non significant correlation with days to 50 % flowering while negative significant correlation with days to maturity and plant height. These results are in close agreement with earlier workers (Khan *et al.*, 2001), (Ahmad *et al.*, 2012) [1] and (Kritika and Yadav, 2017) [9] for maturity and. (Khan *et al.*, 2001), (Rohman *et al.*, 2003) [10] for plant height. (Rohman *et al.*, 2003) [10] reported negative significant correlation with seed yield with flowering and their results are in agreement with our negative but non significant range. Correlation analysis revealed that days to 50 % flowering has positive significant correlation with days to maturity, plant height and pods per plant. The results are in tune with (Kritika and Yadav, 2017) [9], (Dhoot *et al*., 2017) for maturity and (Rohman *et al.*, 2003) [10], (Kritika and Yadav, 2017) [9], (Dhoot *et al*., 2017) for plant height.Plant height has positive significant correlation with days to maturity and secondary branches per plant. The results are in tune with (Rozina Gul *et al.*, 2008) [11], (Kritika and Yadav, 2017) [9], (Dhoot *et al*., 2017) for days to maturity and (Kritika and Yadav, 2017) [9] for secondary branches per plant. Pods per plant have positive significant correlation with days to flowering days to maturity, plant height and secondary branches per plant. The results are in tune with (Rohman *et al.*, 2003) [10], (Kritika and Yadav, 2017) [9] for plant height, (Kritika and Yadav, 2017) [9], (Dhoot *et al*., 2017) for secondary branches per plant. Seeds per pods have positive significant correlation with primary branches per plant.100 seed weight has negative non significant correlation with maturity, plant height while significant correlation for pods per plant. The results are in tune with (Rohman *et al.*, 2003) [10], (Rozina Gul *et al.*, 2008) [11] for maturity and plant height for negative significant correlations while (Rozina Gul *et al.*, 2008) [11], (Kritika and Yadav, 2017) [9] for pods per plant.

Table 1: Correlations of yield related traits with seed yield of Mungbean Genotypes grown in kharif 2014-15 (Pearson Correlation Matrix**)**

Characters	Days to 50% Flowering	Days to Maturity	Plant height (cm)	Primary Branches/plant	Secondary Branches/plant	Pods per plant	Seeds per pod	100 seed weight (gms)	Seed yield (kg/plot)
Days to 50% Flowering	1.000								
Days to Maturity	0.824^{**}	1.000							
Plant height (cm)	0.489^{*}	0.667^{**}	1.000						
Primary Branches /plant	0.001^{NS}	0.122^{NS}	0.227^{NS}	1.000					
Secondary Branches /plant	0.202^{NS}	0.331^{NS}	0.468^{*}	0.302^{NS}	1.000				
Pods per plant	0.481^{*}	0.406^{*}	0.542^{**}	0.275^{NS}	0.533^{**}	1.000			
Seeds per pod	0.036^{NS}	0.039^{NS}	0.114^{NS}	0.452^{*}	0.256^{NS}	-0.040^{NS}	1.000		
100 seed weight (gms)	-0.264^{NS}	-0.308^{NS}	-0.059^{NS}	0.304^{NS}	0.177^{NS}	0.433^{*}	0.174^{NS}	1.000	
Seed yield (kg/plot)	-0.316^{NS}	-0.467^{*}	-0.513^{*}	0.151^{NS}	-0.084^{NS}	-0.205^{NS}	0.197^{NS}	0.236^{NS}	1.000

*** Correlation significant at the 0.01 probability level; * Correlation significant at the 0.05 probability level.*

Table 2. Directs effects (bold), indirect effects and genotypic correlations of yield related traits with seed yield of Mungbean genotypes grown in kharif 2014-15

Characters	Corr.with seed yield	Days to 50% Flowering	Days to Maturity	Plant height (cm)	Primary Branches /plant	Secondary Branches /plant	Pods per plant	Seeds per pod	100 seed weight (gms)
Days to 50% Flowering	-0.316^{NS}	0.292	-0.342	-0.215	0.000	0.032	-0.060	0.003	-0.027
Days to Maturity	-0.467^{*}	0.240	-0.415	-0.293	0.026	0.053	-0.050	0.004	-0.032
Plant height (cm)	-0.513^{*}	0.143	-0.277	-0.439	0.049	0.075	-0.067	0.011	-0.006
Primary Branches /plant	0.151^{NS}	0.000	-0.051	-0.100	0.214	0.048	-0.034	0.042	0.032
Secondary Branches /plant	-0.084^{NS}	0.059	-0.137	-0.206	0.065	0.159	-0.066	0.024	0.018
Pods per plant	-0.205^{NS}	0.140	-0.168	-0.238	0.059	0.085	-0.124	-0.004	0.045
Seeds per pod	0.197^{NS}	0.010	-0.016	-0.050	0.097	0.041	0.005	0.092	0.018
100 seed weight (gms)	0.236^{NS}	-0.077	0.128	0.026	0.065	0.028	-0.054	0.016	0.104

Residual are 0.587

Path coefficient analysis accommodates assistance for categorizing the total correlation into direct and indirect effects. The results of path analysis showed in Table 2 confirms that characters *viz*. days to 50% flowering, primary branches/plant, secondary branches/plant ,100 seed weight and no of seeds per pod had positive direct effect on seed yield, while plant height, days to maturity and pods per plant had negative direct effects on seed yield. The results are in tune with (Dhoot *et al*., 2017) for flowering and maturity, (Rohman *et al.*, 2003) [10], for plant height, (Sharma *et al.*, 2003) for primary branches per plant, (Dhoot *et al*., 2017) and (Rohman *et al.*, 2003) [10], for seeds per pod and (Dhoot *et al*., 2017), (Sharma *et al.*, 2003) and (Rohman *et al.*, 2003) [10] for 100 seed weight. Late flowering with numerous primary and secondary branches with more seed weight and more no of seeds per pod directly lead to increase in seed yield. Less pods per plant with high seeds/pods is more desirable trait for high seed yield.

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