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PROPORTIONAL CONTRIBUTION, TRAIT ASSOCIATION AND PATH COEFFICIENT ANALYSIS FOR AGRONOMIC TRAITS AND ITS COMPONENTS IN MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK) GENOTYPES

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ABSTRACT
A line x tester analysis was carried out to estimate the proportional contribution between lines, testers and their interaction and also to access the association between various traits and direct and indirect effects on yield and other contributing characters in mungbean. The ultimate outcome showed that the interaction of lines contributed the major part of total variance when likened to testers and line x tester interaction and the estimates of correlation revealed that the trait single plant yield had highly significant and positive association with number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length, number of seeds per pod, 100 seed weight and harvest index. Path coefficient analysis indicated the role of number of seeds per pod, 100 seed weight and number of pods per plant had higher effect on single plant yield and so, suggesting that more emphasis should be given on these parameters while executing the selection for genetic enhancement of seed yield in mungbean.

INTRODUCTION

The economically important *Vigna* species are grown in warm temperate and tropical regions globally but are particularly crucial to human nutrition in large parts of tropical Africa and Asia. *Vigna* also furnish important forage crops (Tomooka *et al*., 2005). *Vigna* species including mungbean (*Vigna radiata* (L.) Wilczek), belonging to the subgenus Ceratotropis, have chromosome complements typical of the tribe Phaseolae with 2n = 2x = 22 (Smartt, 1990). They are an important component of cropping systems to maintain soil health because of their ability to fix atmospheric nitrogen, extract water and nutrients from the deeper layer of soil and add organic matter into the soil through leaf drop. It is a self-pollinated crop and it is also known as the crop of sub-continent and up to three crops per year can be grown (Malik, 1994). Several disadvantages of mungbean crops have prevented the widespread distribution of production in tropical and subtropical environments (Lawn, 1995). These include low seed yield potential, photoperiod sensitivity; asynchronous reproductive development and susceptibility to weather damage (Williams *et al*., 1995). In Tamil Nadu, mungbean is cultivated in an area of about 1.34 lakh hectares 2006-07, with the production and productivity of 0.77 lakh tonnes and 577 kg/ha respectively. Likewise, mungbean is under cultivation in an area of 1.59 lakh hectares 2007-08, with the production and productivity of about 0.46 lakh tonnes and 291 kg/ha respectively (Anonymous, 2008). This shows that there is drastic reduction in production and yield, because of the poor management practices and non usage of high yielding varieties. The entire success of plant breeding programme of any crop largely depends on the wide range of variability present in that crop. Genetic variation among genotypes and relationships between major yield contributing characters are important in plant breeding programmes that aim to produce elite cultivars in crops like mungbean. Identification of important yield components and information about the nature and magnitude of their direct and indirect contributions towards the manifestation of plant yield is very essential for devising successful crop breeding strategy in any crop. The correlation and path coefficient analysis provide information about the relative importance of various yield components in the expression of yield and thus, help in formation of appropriate selection strategy. In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Dewey and Lu, 1959). Considering the above points, the objective of this study was formulated to investigate the parents and its offspring through line x tester analysis to estimating the correlation coefficients and direct as well as indirect effects on single plant yield and its components in mungbean.

MATERIALS AND METHODS

Experimental materials and design

The present investigation on mungbean was carried out at the experimental farm of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai, Tamil Nadu, India during kharif 2009-2010. The experimental material comprises of twelve genotypes, of which eight genotypes *viz*., VRM(Gg) 1, Co 6, Co(Gg) 7, VBN(Gg) 1, K 1, KM 2, VBN(Gg) 2 and Pusha vishal were used as 'lines' and four genotypes *viz*., VGG04-028, VGG04-005, CGG 973 and VBN(Gg) 3 were used as 'testers'. The eight lines and four testers were raised in a crossing block during August, 2009 and the genotypes were raised in ridges of four meter length spaced at 30cm apart. The plant to plant spacing was 10cm. Staggered sowing of the parents was carried out to have synchronization in flowering. Each of the eight lines was crossed with four testers individually in a line x tester fashion (Kempthorne, 1957) to obtain 32 cross combinations. The F_1 generation was raised in a Randomized Block Design (RBD) with three replications along with the parents during January, 2010 in ridges of four meter length with the spacing of 30 X 10cm.

Biometrical approaches

Observations *viz*., days to 50 per cent flowering and days to maturity were taken on row basis. Remaining traits namely plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length, number of seeds per pod, 100 seed weight, harvest index, protein content (estimated by Kjeldhal method) and single plant yield were recorded on five randomly selected plants from each replication. The biometrical data were analyzed using TNAUSTAT computer software. The correlation coefficients were calculated according to Singh and Chaudhary (1985) and path coefficient analysis was done as per method suggested by Dewey and Lu (1959).

Proportional contribution of Lines, Testers and their interaction to total variance

Contribution of lines = {ss (l) / ss (crosses)} x 100

Contribution of testers = {ss (t) / ss (crosses)} x 100

Contribution of ($l$xt) = {ss ($l$xt) / ss (crosses)} × 100

RESULTS AND DISCUSSION

The percentage contribution of lines, testers and line x tester interactions to total variance is presented in Table 1 and Fig. 1. The interaction of lines contributed the major part of total variance for the traits *viz*., days to 50 per cent flowering, days to maturity, plant height, number of branches per plant, number of clusters per plant and number of pods per plant. The interaction of testers contributed for the attributes *viz*., number of pods per clusters, pod length, number of seeds per pod and single plant yield more than the lines and line x tester. The traits 100 seed weight, harvest index and protein content, the line x tester interaction was higher than the lines and testers.

Relationship between yield and yield contributing traits

The association among yield and yield contributing characters provide reliable information on nature, extent and direction of selection. Grafius (1959) suggested that the knowledge on inter relationship of plant characters with seed yield and among themselves is of paramount importance to the breeder for making importance in complex characters like seed yield, for which direct selection is not much effective. Hence, the association analysis was undertaken to determine the direction of selection and number of characters to be considered in improving the seed yield. The estimates of correlation coefficients between different characters of mungbean genotypes are presented in Table 2. In the existent investigation, single plant yield expressed highly significant and positive association with number of branches per plant, number of clusters per plant, number of pods per cluster,

Table 1: Proportional contribution of lines, testers and their interaction to total variance (per cent) in mungbean

Characters	Days to 50 per cent flowering	Days to maturity	Plant height	No. of branches per plant	No. of clusters per plant	No. of pods per cluster	No. of pods per plant	Pod length	No. of seeds per pod	100 seed weight	Harvest index	Protein content	Single plant yield
Lines	47.38	61.08	54.48	44.95	58.51	18.31	49.13	32.58	24.03	41.52	18.78	18.39	35.20
Testers	6.15	3.20	12.92	28.13	14.77	58.67	33.71	40.96	38.40	10.94	18.92	3.22	36.95
Line x Tester	46.47	35.72	32.60	26.92	26.72	23.02	17.16	26.46	37.58	47.54	62.30	78.39	27.85

Table 2: Genotypic correlation coefficients between single plant yield and component characters in mungbean

	Days to 50 per cent flowering	Days to maturity	Plant height	No. of branches per plant	No. of clusters per plant	No. of pods per cluster	No. of pods per plant	Pod length	No. of seeds perpod	100 seed weight	Harvest index	Protein content	Single plant yield
Days to 50 per cent flowering	1.000	0.981**	0.225	0.321*	0.441**	0.243	0.231	-0.365**	-0.088	-0.172	-0.322*	-0.298*	0.168
Days to maturity		1.000	0.281*	0.307*	0.470**	0.169	0.267*	-0.236	-0.100	-0.223	-0.237	-0.181	0.173
Plant height			1.000	0.462**	0.733**	0.219	0.438**	0.196	0.502**	-0.303*	-0.147	0.345*	0.327*
No. of branches per plant				1.000	0.654**	0.542**	0.606**	0.076	0.560**	-0.303*	0.013	0.243	0.544**
No. of clusters per plant					1.000	0.428**	0.740**	0.186	0.439**	-0.344*	-0.092	0.351**	0.485**
No. of pods per cluster						1.000	0.736**	0.407**	0.516**	0.142	0.440**	0.030	0.793**
No. of pods per plant							1.000	0.478**	0.387**	-0.206	0.326*	0.278*	0.629**
Pod length								1.000	0.477**	0.284*	0.526**	0.188	0.529**
No. of seeds per pod									1.000	0.001	0.273*	0.155	0.676**
100 seed weight										1.000	0.486**	-0.339*	0.429**
Harvest index											1.000	-0.008	0.546**
Protein content												1.000	0.005

* Significant at 5% level, ** Significant at 1% level

Table 3: Direct and indirect effects of single plant yield and its components in mungbean

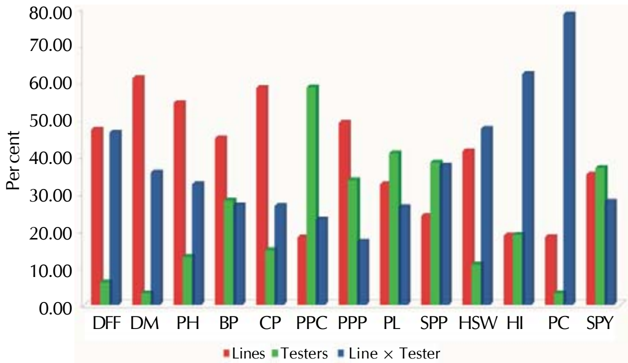
Characters	Days to 50 per cent flowering	Days to maturity	Plant height	No. of branches per plant	No. of clusters per plant	No. of pods per cluster	No. of pods per plant	Pod length	No. of seeds per pod	100 seed weight	Harvest index	Protein content	Single plant yield
Days to 50 per cent flowering	0.80078	-0.50691	0.00501	0.06028	0.01567	-0.00195	0.05545	-0.04865	-0.02932	-0.08009	-0.07248	-0.02971	0.168
Days to maturity	0.78578	-0.51658	0.00627	0.05773	0.01671	-0.00135	0.06427	-0.03148	-0.03327	-0.10365	-0.05328	-0.01809	0.173
Plant height	0.17985	-0.14502	0.02232	0.08669	0.02608	-0.00176	0.10532	0.02613	0.16737	-0.14082	-0.03306	0.03440	0.327
No. of branches per plant	0.25707	-0.15883	0.01031	0.18776	0.02325	-0.00436	0.14568	0.01018	0.18668	-0.14104	0.00297	0.02426	0.544
No. of clusters per plant	0.35286	-0.24272	0.01637	0.12276	0.03556	-0.00344	0.17790	0.02479	0.14662	-0.15971	-0.02073	0.03495	0.485
No. of pods per cluster	0.19485	-0.08714	0.00488	0.10182	0.01523	-0.00803	0.17687	0.05437	0.17224	0.06620	0.09902	0.00297	0.793
No. of pods per plant	0.18468	-0.13809	0.00978	0.11375	0.02631	-0.00591	0.24045	0.06379	0.12907	-0.09584	0.07328	0.02771	0.629
Pod length	-0.29195	0.12184	0.00437	0.01432	0.00660	-0.00327	0.11493	0.13345	0.15920	0.13219	0.11829	0.01871	0.529
No. of seeds per pod	-0.07038	0.05152	0.01120	0.10506	0.01563	-0.00415	0.09302	0.06368	0.33363	0.00032	0.06145	0.01546	0.676
100 seed weight	-0.13801	0.11522	-0.00676	-0.05698	-0.01222	-0.00114	-0.04959	0.03796	0.00023	0.46471	0.10926	-0.03378	0.429
Harvest index	-0.25799	0.12233	-0.00328	0.00248	-0.00328	-0.00354	0.07833	0.07017	0.09113	0.22569	0.22497	-0.00077	0.546
Protein content	-0.23862	0.09372	0.00770	0.04569	0.01247	-0.00024	0.06683	0.02505	0.05174	-0.15745	-0.00175	0.09969	0.005

Residual effect: 0.25

number of pods per plant, pod length, number of seeds per pod, 100 seed weight and harvest index. Significant and positive associations with plant height were positive and non-significant association with the traits, days to 50 per cent flowering, days to maturity and protein content. This result was in close agreement with those obtained by earlier workers *viz.*, Haritha and Reddy Sekhar (2002), Mallikarjuna Rao *et al.* (2006), Chauhan *et al.* (2007), Rahim *et al.* (2010) and Kumar *et al.* (2013). The inter correlation between yield contributing characters may affect the selection for component traits either in favorable or unfavorable direction. Hence, the knowledge on inter-relationship between yield component traits may facilitate breeders to decide upon the intensity and direction of selection pressure to be given on related traits for the simultaneous improvement of these traits. The results showed that there was a positive and significant correlation between plant height and all the other characters except for days to maturity, number of pods per cluster, 100 seed weight and harvest index. This was in confirmation with the findings of Khattak *et al.* (1995). The number of branches per plant had highly significant and positive correlation with number of clusters per plant, number of pods per cluster, number of pods per plant and number of seeds per pod. This was supported by Natarajan and Rathinasamy (1999) and Mallikarjuna Rao *et al.* (2006). The trait number of clusters per plant expressed significantly positive correlation with number of pods per cluster, number of pods per plant, number of seeds per pod and protein content. These results were in close agreement with the findings of Kasundra *et al.* (1997) and Sunil Kumar *et al.* (2003). The number of pods per cluster had significantly positive correlation with number of pods per plant, plant height, number of seeds per pod and harvest index. Similar findings were reported by Singh *et al.* (2009). The attribute number of pods per plant showed significantly positive association with plant height, number of seeds per pod, harvest index and protein content. This was supported by Sunil Kumar *et al.* (2003) and Konda *et al.* (2008). Pod length had significantly positive association with number of seeds per pod, harvest index and 100 seed weight. This was earlier found by Gayen and Chattopadhayay (2002). The character number of seeds per pod and 100 seed weight had registered significant and positive association with harvest index. Harvest index expressed negative and non-significant association with protein content. From the aforesaid facts, it is clear that all the yield component traits *viz.*, plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, pod length and number of seeds per pod were inter correlated among themselves. Therefore, these traits are to be given priority during selection to increase the seed yield in mungbean.

Direct and indirect effects on yield and its components

The estimates of correlation coefficients revealed only the relationship between yield components, but did not show the direct and indirect effects of different traits on yield *per se*. This is because; the attributes which are in association do not exist by themselves, but are linked to other components. The path coefficient analysis suggested by Dewey and Lu (1959) specifies the effective measure of the direct and indirect causes of association and depicts the relative importance of each



DFF - Days to 50 per cent flowering, DM - Days to maturity, PH - Plant height, BP - Number of branches per plant, CP - Number of clusters per plant, PPC - Number of pods per cluster, PPP - Number of pods per plant, PL - Pod length, SPP - Number of seeds per pod, HSW - Hundred seed weight, HI - Harvest index, PC - Protein content, SPY - Single plant yield

Figure 1: Proportional contribution of lines, testers and their interaction to total variance (per cent) of various traits in mungbean

factor involved in contributing to the final product *viz*., yield. The direct and indirect effects of yield and yield components are presented in the Table 3. In the current study, number of seeds per pod and 100 seed weight had high direct effect on seed yield. This was in accordance with earlier findings of Venkateshwaralu (2001), Haritha and Sekhar (2002), Motiar Rohman *et al*. (2003) and Sahu *et al*. (2014). Moderate direct effect on seed yield was noticed for number of pods per plant. It was suggested by Konda *et al*. (2008). Number of branches per plant and pod length showed low positive direct effect on yield. Luman Hakim (2008) found similar results with regard to number of branches per plant. Remaining traits noticed negligible effect on single plant yield. The indirect effect of number of clusters per plant on seed yield was positive through days to 50 per cent flowering. The indirect effect of number of seeds per pod was positive on all the characters except for days to maturity and number of pods per cluster. Similar findings were also reported by Veeramani *et al*. (2005). The remaining traits had negligible effects on seed yield. The observed residual factor was 0.25, indicating that factors which have been considered here are sufficient to account variation in yield. On the basis of path analysis, the parameters like number of seeds per pod followed by 100 seed weight and number of pods per plant may be given due weightage during selection to increase the plant yield in mungbean.

REFERENCES

Anonymous. 2008. Department of Economics and Statistics, Chennai. pp. 71-72.

Chauhan, M. P., Mishra, A. C. and Ashok Kumar Singh. 2007. Correlation and path analysis in urdbean. *Legume Res*. **30(3):** 205-208.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path analysis of components of crested wheat grass seed production. *Agron. J.* **51:** 515-518.

Gayen, P. and Chattopadhayay, P. 2002. Variability and association of pod and seed characters in urdbean. *Ann. Agric. Res*. **21(4):** 575-576.

Grafius, J. E. 1959. Heterosis in barley. *Agron. J*. **51:** 515-518.

Haritha, S. and Reddy Sekhar, M. 2002. Correlation and path coefficient analysis in mungbean (*Vigna radiata* (L.) Wilczek). *Legume Res*. **25(3):** 180-183.

Kasundra, J. K., Pethani, K. V. and Kathiria, K. B. 1997. Studies on genetic variability, correlation and path analysis in urdbean. *Indian J. Pulses Res*. **8(2):** 113-118.

Khattak, G. S. S., Peerasal Srinivas and Kim, D. H. 1995. Yield partitioning in high yielding greengram. *Kasetsart J. (Nat. Sci.)*. **29:** 494-497.

Kempthorne, O. 1957. An introduction to genetic statistics. *John Wiley and Sons Inc*., New york. pp. 458-471.

Konda, C. R., Salimath, P. H. and Mishra, M. N. 2008. Correlation and path coefficient analysis in blackgram (*Vigna mungo* (L.) Hepper). *Legume Res*. **31(3):** 202-205.

Kumar, K., Prasad, Y., Mishra, S. B., Pandey, S. S. and Ravi, K. 2013. Study on genetic variability, correlation and path analysis with grain yield and yield attributing traits in greengram (*Vigna radiata* (L.) Wilczek). *The Bioscan*. **8(4):** 1551-55.

Lawn, R. J. 1995. The Asiatic *Vigna* species. *Vigna* spp. (*Vigna radiata*, *Vigna mungo*, *Vigna angularis*, *Vigna umbellata* and *Vigna acontifolia*) (Leguminosae-Papilionoideae). In: Smartt, J., Simmonds, N.W. (eds) Evolution of Crop Plants, *2nd edn. Longman*, London, pp. 321-326.

Luman Hakim. 2008. Variability and correlation of agronomic characters of mungbean germplasm and their utilization for variety improvement program. *Int. J. Agric Sci*. **9(1):** 24-28.

Malik, B. A. 1994. In: Bashir E, Bantel R (Eds.). Crop production. National Book Foundation, Islamabad, Pakistan. *Grain legume*. pp. 277-328.

Mallikarjuna Rao, C. H., Koteswara Rao, Y. and Reddy, M. V. 2006. Evaluation of mungbean germplasm for yield and yield components. *Legume Res*. **29(1):** 73-75.

Motiar Rohman, A. S. M. Iqbal Hussain, Saykhul Arifin, Zerin Akhter and Mirza Hasanazzaman. 2003. Genetic variability correlation and path analysis in mungbean. *Asian J. Plant Sciences*. **2(7-24):** 1209-1211.

Natarajan, C. and Rathinasamy, R. 1999. Genetic variability, correlation and path analysis in blackgram. *Madras Agric. J.* **86(4-6):** 228-231.

Rahim, M. A., Mia, A. A., Mahmud, F., Zeba, N. and Afrin, K. S. 2010. Genetic variability, character association and genetic divergence in mungbean (*Vigna radiata* (L.) Wilczek). *POJ*. **3(1):** 1-6.

Sahu, H., Amadabade, J., Kumar, P., Sao, A. and Patel, R. K. 2014. Assessment of segregating generations for genetic variability and yield regulating traits in mungbean (*Vigna radiata* (L.) Wilczek). *The Bioscan*. **9(4):** 1701-1706.

Smartt, J. 1990. Grain Legumes. Evolution and Genetic Resources. *Cambridge University Press*, Cambridge. p. 371.

Singh, R. K. and Chaudhary, B. D. 1985. Biometrical methods in quantitative genetic analysis. *Kalyani Publishers*, New Delhi, India, pp. 57-78.

Singh, S. K., Singh, I. P., Singh, B. B. and Onkar Singh. 2009. Correlation and path coefficient studies for yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). *Legume Res*. **32(3):** 180-185.

Sunil Kumar, B., Padmavathi, S., Prakash, M. and Ganesan, J. 2003. Correlation and path analysis in blackgram (*Vigna mungo* (L.) Hepper). *Legume Res*. **26(1):** 75-76.

Tomooka, N., Vaughan, D. A. and Kaga, A. 2005. Mungbean. In: Singh R. J., Jauhar P.P. (eds) Genetic resources, chromosome engineering and crop improvement. II. *Grain legumes. CRC, Boca Rogue, FL*. pp. 319-339.

Veeramani, N., Venkatesan, M., Thangavel, P. and Ganesan, J. 2005.

Genetic variability, heritability and genetic advance analysis in segregating generation of blackgram (*Vigna mungo* (L.) Hepper). *Legume Res*. **28(1):** 49-51.

Venkateswarlu, O. 2001. Correlation and path analysis in greengram. *Legume Res*. **24(2):** 115-117.

Williams, R. W., Lawn, R. J., Imrie, B. C. and Byth, D. E. 1995. Studies on water damage in mungbean. I. Effect of weathering on seed quality and viability. *Aust. J. Agric. Res*. **46:** 887-899.