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# Genetic Association of Characters and Their Effects in Mungbean (*Vigna radiata* L. Wilczek)

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**ABSTRACT**

Genetic variability among mungbean genotypes and character association between different quantitative characters was studied during kharif 2007. The highest GCV and PCV were recorded for harvest index and pods per plant, respectively. High estimates of genetic advance as percent of mean was observed for 100 seed weight and harvest index. High heritability with high genetic advance was observed for harvest index, 100 seed weight and pods per plant. High significant positive correlation was recorded for pods per plant and harvest index at both genotypic and phenotypic levels with seed yield per plant. Plant height, primary branches per plant, clusters per branch and days to maturity had positive direct effect on seed yield, suggesting their potential use in improvement of mungbean.

**Key words :** Correlation, Direct effect, Genetic advance, GCV, Heritability, Mungbean, PCV.

Mungbean (*Vigna radiata* L. Wilczek) syn. *Phaseolus aureus* (Roxb.) is one of the widely grown pulse crops in India. The crop is often preferred to other pulse crops because of its better digestibility and less flatulence problem owing to lower content of raffinose, stachyose and verbacose (Poehlman, 1991). Earlier hybridization did not raise attention in this crop, as native cultivars or selections from native cultivars were grown. Now practically all new varieties are originated by hybridization as a result of favourable characteristics of new lines being identified more fully so that breeder can choose desirable parental combination with greater precision and crossing procedure being improved and standardized.

Genetic improvement of a crop is largely dependent on the magnitude of genetic variability and the extent to which desirable traits are heritable. Genetic variability is of utmost importance as it provides the basis for effective selection. Therefore, an attempt was made in the present study to estimate the extent of variability, heritability, genetic advance, correlation and path analysis in mungbean. Infact, this kind of study is the prerequisite for any crop improvement programme. The correlation and path coefficient analysis provide information about importance of various yield component characters which help in the formulation of appropriate selection strategies. Studies on the above aspects in available germplasm under the environment where it is to be explained are essential for successful utilization of germplasm resources for the development of superior mungbean varieties.

## MATERIAL AND METHODS

The experimental material for the present study comprised 23 mungbean genotypes *viz.*, KM7-173, KM7-174, KM7-178, KM7-179, KM7-180, KM7-181, KM7-182, KM7-184, KM7-187, KM7-189, KM7-190, KM7-191, KM7-192, KM7-193, KM7-194, KM7-198, KM7-200, KM7-202, KM7-203, KM7-207, KM7-211, KM7-212 and KM7-176 received from Indian Institute of Pulses Research, Kanpur. The experiment was carried out at Experimentation Centre, Department of Genetics and Plant Breeding, SHIATS, Allahabad during *kharif,* 2007 in randomized block design in three replications. Each genotype was grown in a plot size of 4 $m^2$ area with 30x10 cm spacing. The recommended cultural practices were adopted for the proper growth and stand of the crop. The observations were recorded on 10 randomly selected plants from each replication from each genotype for plant height (cm), number of pods per plant, number of clusters per plant, number of primary branches per plants, pod length (cm), number of seeds per pod, 100 seeds weight (g), seed yield per plant (g) and seed yield per plant (g). The mean values were used for statistical analysis. Phenotypic coefficient of variation and genotypic coefficient of variation were estimated by the formula given by Burton (1952), heritability in broad sense ($h^2$) by Burton and Devane (1953), and genetic advance *i.e.* the expected genetic gain by using the procedure given by Johnson *et al.,* (1955). Correlation coefficients and direct and indirect effects were worked out as per the method suggested by Al Jibouri *et al.,* (1958) and Dewey and Lu (1959), respectively.

## RESULTS AND DISCUSSION

The highest range of variation was recorded for number of pods per plant, plant height, harvest index and seed yield per plant, indicating presence of sufficient variability for the selection of the desirable genotypes. A perusal of GCV revealed that maximum values were recorded for 100 seed weight (40.67) and harvest index (32.95). The character possessing high genotypic coefficient of variation value has better scope of improvement through selection. Low GCV was observed for number of seeds per pod (5.26) and days to 50% flowering (5.99) (Table 1). Pods per plant (34.90) exhibited high PCV value followed by harvest index (34.79) while estimate of PCV was low for days to 50% flowering (6.10). Maximum difference between phenotypic and genotypic coefficients of variation was recorded for pods per plant, primary branches per plant, clusters per branch and clusters per plant, indicating the environmental influence on expression of these characters (Table 1).

On the basis of genotypic coefficient of variation alone, it is not possible to determine the amount of heritable variation. It can be estimated with greater degree of accuracy when heritability in conjunction with genetic advance is studied (Dudley and Moll, 1969). High heritability in broad sense was recorded for 100 seed weight (89.9%), harvest index (89.7%), pod length (88.2%), and days to maturity (83.1%). Moderate heritability was recorded for plant height (75.2%), days to 50% flowering (73.3%), and clusters per plant (61.9%). Low heritability was recorded for clusters per branch (26.4%) (Table 1). The characters which exhibited high heritability, suggested that the selection will be more effective whereas the characters showing low heritability indicate that the selection may be influenced by environmental factors. Similar findings were reported by Choudhary *et al.,* (1988). The heritability estimates were of high magnitude for 100 seed weight, harvest index and days to maturity. The characters with high heritability governed predominantly by additive gene action and could be improved through individual plant selection (Panse, 1958). Anwari and Sochendi (1999) also reported high heritability for 100 seed weigh and harvest index

The estimates of genetic advance expressed as percent of mean showed a wide range for number of seeds per pods (7.37) and for harvest index (64.28). High genetic advance as per cent of mean (64.28) coupled with high heritability (89.7%) was recorded for the harvest index and low genetic advance as per cent of mean (7.75) coupled with low heritability (26.6%) was observed for the number of clusters per branch. Low genetic advance (28.64) coupled with high heritability (89.9%) was observed for 100 seed weight. The high heritability coupled with moderate genetic advance was observed for plant height, and days to maturity. Similar results were reported by Nazir *et al*. (2005).

Seed yield is the result of interaction of a number of interrelated characters with positive and negative effects on yield *per se.* Therefore, selection should be based on those component characters which have positive correlation with seed yield. Character association reveals the mutual relationship between two characters and it is very important parameter for deciding the nature of selection to be

Table 1. Estimates of genetic parameters for 12 quantitative characters in mungbean.

| S.No. | Characters | Genotypic Coefficient Variation | Phenotypic Coefficient Variation | Heritability (bs) (%) | Genetic Advance | GA as percent of mean |
|---|---|---|---|---|---|---|
| 1. | Days to 50% flowering | 5.99 | 06.10 | 73.3 | 03.84 | 10.57 |
| 2. | Plant height | 10.12 | 11.67 | 75.2 | 11.68 | 18.07 |
| 3. | Primary branches per plant | 12.75 | 20.82 | 37.5 | 00.46 | 16.09 |
| 4. | Clusters per branch | 7.32 | 14.26 | 26.4 | 00.28 | 07.75 |
| 5. | Clusters per plant | 14.99 | 19.16 | 61.2 | 02.91 | 24.16 |
| 6. | Pods per plant | 13.90 | 34.90 | 78.4 | 15.02 | 56.35 |
| 7. | Pod length | 13.32 | 14.19 | 88.2 | 02.08 | 25.76 |
| 8. | No. of seeds per pod | 5.26 | 07.71 | 46.4 | 00.83 | 07.37 |
| 9. | Days to maturity | 9.04 | 09.91 | 83.1 | 12.45 | 16.98 |
| 10. | 100 seed weight | 40.67 | 15.47 | 89.9 | 01.25 | 28.64 |
| 11. | Harvest index | 32.95 | 34.79 | 89.7 | 24.07 | 64.28 |
| 12. | Seed yield per plant | 12.73 | 17.41 | 53.5 | 02.06 | 09.18 |

Table 2. Estimates of correlation coefficient of 11 component characters on seed yield in mungbean at genotypic and phenotypic levels.

| Characters | | Plant height | Primary branches per plant | Clusters per branch | Clusters per plant | Pods per plant | Pod length | No .of seeds per pod | Days to maturity | 100 seed weight | Harvest index | Seeds yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | rg | -0.0778 | -0.4833** | 0.4504* | 0.0665 | -0.1998 | -0.2608 | 0.5538** | 0.1243 | -0.1431 | -0.1431 | -0.5186** |
| | rp | -0.2530 | -0.1847 | 0.2310 | 0.0985 | -0.0650 | 0.1554 | -0.1413 | 0.4201** | 0.0860 | -0.0732 | 0.2827 |
| Plant height | rg | | 0.4441* | -0.2121 | 0.1899 | -0.6907** | -0.1836 | -0.1690 | 0.1085 | -0.3019 | -0.4408* | -0.3479* |
| | rp | | 0.3569** | -0.0022 | 0.2718 | -0.4694** | -0.1378 | -0.1495 | 0.1352 | 0.2113 | -0.3519* | -0.2725 |
| Primary branches per | rg | | | 0.4192* | 0.8184** | -0.1482 | -0.4685** | -0.0432 | -0.3542* | -0.0806 | -0.0713 | 0.0256 |
| plant | rp | | | 0.1837 | 0.6446** | -0.0830 | -0.2872 | 0.0405 | -0.2291 | 0.0043 | -0.0350 | 0.0399 |
| Clusters per branch | rg | | | | 0.7546** | 0.4612* | 0.3231 | 0.2999 | 0.2308 | 0.2790 | 0.2654 | 0.1611 |
| | rp | | | | 0.5712** | 0.2568 | 0.1794 | 0.1951 | 0.1622 | 2.1793 | 0.0636 | 0.1568 |
| Clusters per plant | rg | | | | | 0.0982 | -0.1748 | 0.2119 | 0.0703 | -0.1503 | -0.0784 | -0.0446 |
| | rp | | | | | 0.1070 | -0.1365 | 0.0973 | 0.0555 | -0.0618 | -0.0725 | 0.0096 |
| Pods per plant | rg | | | | | | 0.0646 | 0.2464 | -0.1863 | 0.2025 | 0.4979** | 0.8606** |
| | rp | | | | | | 0.0902 | 0.1931 | -0.1749 | 0.1815 | 0.4455* | 0.5419** |
| Pod length | rg | | | | | | | 0.5303** | 0.1994 | 0.6970** | 0.1572 | 0.1459 |
| | rp | | | | | | | 0.4742** | 0.1816 | 0.6247** | 0.1343 | 0.1222 |
| No. of seeds per pod | rg | | | | | | | | -0.3775 | 0.5351** | 0.1076 | 0.3556 |
| | rp | | | | | | | | -0.2404 | 0.3684* | 0.0736 | 0.2855 |
| Days to maturity | rg | | | | | | | | | -0.1241 | -0.1684 | -0.3217 |
| | rp | | | | | | | | | -0.1092 | -0.1759 | -0.2234 |
| 100 seed weight | rg | | | | | | | | | | 0.1015 | 0.2161 |
| | rp | | | | | | | | | | 0.1948 | 0.1214 |
| Harvest index | rg | | | | | | | | | | | 0.7635** |
| | rp | | | | | | | | | | | 0.5553** |

** and * significant at 1% and 5% lavel, respectively

Table 3. Direct and indirect effects of yield component characters on seed yield in mungbean at genotypic and phenotypic level

| Characters | | Days to50% flowering | Plant height | Primary branchesper plant | Clusters per branch | Clusters per plant | Pods perplant | Pod length | Seeds per pod | Days to maturity | 100 seed weight | Harvest index | Correlation Coefficient with Seed yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50% | g | **-0.9734** | 0.0758 | 0.4704 | -0.4384 | -0.0647 | 0.1303 | -0.1945 | 0.2538 | -0.5391 | -0.1210 | 0.1392 | -0.5186** |
| flowering | p | **-0.2133** | 0.0054 | 0.0400 | -0.0493 | -0.210 | 0.0139 | -0.0331 | 0.0301 | -0.0896 | -0.183 | 0.0156 | -0.2827 |
| Plant height | g | -0.0071 | **0.0915** | 0.0406 | -0.0194 | 0.0174 | -0.0632 | -0.0168 | -0.0155 | 0.0099 | -0.0276 | -0.0403 | -0.3479* |
| | p | -0.0008 | **0.0335** | 0.0120 | -0.0001 | 0.0091 | -0.0157 | -0.0046 | -0.0050 | 0.0045 | -0.0071 | -0.0118 | -0.2725 |
| Primary branches | g | -0.7483 | 0.6877 | **1.5483** | 0.6491 | 1.2671 | -0.2295 | -0.7255 | 0.0668 | -0.5484 | -0.1248 | -0.1104 | 0.0256 |
| per plant | p | -0.203 | 0.0387 | **0.1085** | 0.0199 | 0.0699 | -0.0090 | -0.0312 | 0.0044 | -0.00249 | 0.0005 | -0.0038 | 0.0399 |
| Clusters per | g | 1.9052 | -0.8973 | 1.7734 | **4.2303** | 3.1922 | 1.9509 | 1.3670 | 1.2688 | 0.9763 | 1.1805 | 1.1229 | 0.1611 |
| branch | p | 0.0294 | -0.0003 | 0.0234 | **0.1271** | 0.0726 | 0.0326 | 0.0228 | 0.0248 | 0.0206 | 0.0228 | 0.0081 | 0.1568 |
| Clusters per plant | g | -0.3513 | -1.0032 | -4.3230 | -3.9862 | **-5.2826** | -0.5188 | 0.9233 | -1.1195 | -0.3713 | 0.7942 | 0.4140 | -0.0446 |
| | p | -0.0150 | -0.0414 | -0.0982 | -0.0870 | **-0.1524** | -0.0163 | 0.0208 | -0.0148 | -0.0084 | 0.0094 | 0.0110 | 0.0096 |
| Pods per plant | g | 0.0127 | 0.0656 | 0.0141 | -0.0438 | -0.0093 | **-0.0950** | -0.0061 | -0.0234 | 0.0177 | -0.0192 | -0.0473 | 0.8606** |
| | p | -0.0227 | -0.1639 | -0.0290 | 0.0896 | 0.0373 | **0.3491** | 0.0315 | 0.0674 | -0.0611 | 0.0634 | 0.1555 | 0.5419** |
| Pod length | g | -0.2335 | 0.2146 | 0.5475 | -0.3776 | 0.2042 | -0.0755 | **-1.1684** | -0.6197 | -0.2330 | -0.8144 | -0.1837 | 0.1459 |
| | p | 0.0010 | 0.0009 | -0.0018 | 0.0011 | -0.0008 | 0.0006 | **0.0062** | 0.0029 | 0.0011 | 0.0039 | 0.00008 | 0.1222 |
| No. of seeds per | g | -0.4173 | -0.2704 | 0.0691 | 0.4800 | 0.3391 | 0.3943 | 0.8487 | **1.6003** | -0.6042- | 0.8562 | 0.1723 | 0.3556* |
| pod | p | -0.0247 | -0.0262 | 0.0071 | 0.0342 | 0.0170 | 0.0338 | 0.0830 | **0.1751** | 0.0421 | 0.0645 | 0.0129 | 0.2855 |
| Days to maturity | g | 0.4017 | 0.0787 | -0.2569 | 0.1674 | 0.0510 | -0.1352 | 0.1447 | -0.2739 | **0.7254** | -0.0901 | -0.1222 | -0.3217 |
| | p | 0.0158 | 0.0051 | -0.0086 | 0.0061 | 0.0021 | -0.0066 | 0.0068 | -0.0091 | **0.03376** | -0.0041 | -0.0066 | -0.2234 |
| 100 seed weight | g | -0.1706 | 0.4145 | 0.1106 | -0.3831 | 0.2064 | -0.2780 | -0.9569 | -0.7346 | 0.1704 | **-1.3729** | -0.1393 | 0.2161 |
| | p | 0.0042 | 0.0104 | -0.0002 | -0.0088 | 0.0030 | -0.0089 | -0.0308 | -0.0182 | 0.0054 | **-0.0493** | -0.0047 | 0.1214 |
| Harvest index | g | 0.0632 | 0.1947 | 0.0315 | -0.1172 | 0.0346 | -0.2199 | -0.0694 | -0.0475 | 0.0744 | -0.0448 | **-0.4416** | 0.7635** |
| | p | 0.0277 | -0.1331 | -0.0132 | 0.0241 | -0.0274 | 0.1685 | 0.0508 | 0.0278 | -0.0665 | 0.0358 | **0.3781** | 0.5553** |

followed in the crop under investigation. In the present study the seed yield per plant was significantly and positively associated with pods per plant (0.8606** and 0.5419**) and harvest index (0.7635** and 0.5553**) at both genotypic and phenotypic levels, respectively (Table 2). Thus selection for higher yield on the basis of above two characters would be reliable. The findings are in concordance with Zabet *et al.,* (2004). But Mittal *et al.,* (2007) reported that the seed yield per plant was positively correlated with pods per plant and 100 seed weight. Primary branches per plant was significantly and positively associated with plant height (0.4441** and 0.3569**) and clusters/ plant (0.8184** and 0.6446**) at both genotypic and phenotypic levels, respectively. Pod length was significantly and positively associated with number of seeds/ pod (0.5303** and 0.4742**) and 100 seed weight (0.6970** and 0.6247**) at both genotypic and phenotypic levels, respectively. Besides, 100 seed weight was significantly and positively associated with number of seeds/ pod (0.5351** and 0.3684**) (Table 2). These findings are in agreement with results of Sridevi and Sekhar (2004).

As the correlation coefficient is insufficient to explain true relationship for an effective manipulation of the character, path coefficient was worked out. Path coefficients at phenotypic level revealed that harvest index (0.3781) and pods per plant (0.3491) had high positive direct effect on seed yield per plant, indicating that they are main contributors to yield (Table 3). Number of clusters/ branch (4.2303), primary branches per plant (1.5483) and seeds per pod (1.6003) had direct positive effect on seed yield at genotypic level. The findings are in agreement with the reports of Kumar *et al.,* (2004).

Seed yield per plant registered positive and significant association with number of pods per plant, harvest index at phenotypic and genotypic levels, indicating that seed yield per plant can be improved by considering these characters as selection indices in mungbean.

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