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Genetic Variability and Character Association of Yield and Yield Components in Mungbean [Vigna radiata(L.) Wilczek]

Moushree Sarkar[1], Sanhita Ghosh[2] and S. Kundagrami[3]

[1,2]Research Fellow Dept. of Genetics & Plant Breeding, Institute of Agricultural Science, University of Calcutta, 51/2, Hazra Road, Kolkata-19.
[3]Head Dept. of Genetics & Plant Breeding, Institute of Agricultural Science, University of Calcutta, 51/2, Hazra Road, Kolkata-19
E-mail: [1]moushreesarkar88@gmail.com, [2]sanhitaghosh91@gmail.com, [3]skundagrami@gmail.com

Abstract: *In the present investigation, the genotypic and phenotypic coefficient of variations, heritability, genetic advance, correlation and path coefficient analysis were made for yield and its contributing characters of twenty three mungbean genotypes over two seasons at Experimental Farm of University of Calcutta, Baruipur, South 24 Parganas,West Bengal, India. Phenotypic coefficient of variation was slightly higher than the genotypic coefficient of variation for all the characters suggesting the presence of environmental influence to some extent in the expression of these characters. Therefore, heritability estimates give better idea about possible gain through selection. High heritability along with high genetic advance as per cent of mean was observed for the trait plant height, pods/plant and seed yield/plantindicating that these characters would be amenable for phenotypic selection. From the correlation studies the number of pods per plant, 1st picking and final picking of pods were highly positive and highly significant with seed yield/plant. Based on path coefficient analysis, the 100 seeds weight, seeds/pods, number of pods per plant were the important characters for increasing yield in mungbean. The residual effect of 0.3489 suggested that it was in range of moderate which indicates that there are some more characters which contribute to the grain yield which need to be studied.*

Keywords: *Coefficient of variations, heritability, genetic advance, correlation, path coefficient analysis.*

1. INTRODUCTION

Mungbean [*Vigna radiata*(L.)Wilczek] is an important pulse crop. It is a self pollinated legume originated in South Asia. Historically, India has been the largest global producer and consumer of mungbean. It has wider adaptability and low input requirements and the ability to fix the nitrogen in symbiotic association with rhizobia (58-109 kg/ha), which not only enables it to meet its own nitrogen requirement but also benefits the succeeding crops. It is a short duration crop that can be grown over a range of environments. It is grown extensively in India under varying soil types and climatic conditions. The yield of mungbean depends largely onweather conditions, soil, cultural practices and variety. Our yields are still lower than other mungbean countries. Therefore, to bring about improvement in this crop, a thorough knowledge of breeding behaviour of character is very essential. Seed yield in mungbean is a complex character like other crops, and is determinedby various components.A direct selection for desirable types should not only be restricted to grain yield alone but other components related to grain yield. The knowledge of the interrelationship of grain yield with other important characters is necessary to determine which of these characters could be used for high grain yield. A survey of genetic variability with the help of suitable parameters such as genotypic coefficient of variation, heritability and genetic advance are absolutely necessary to start an efficient breeding program [15]. Heritability with genetic advance helps in understanding the mode of inheritance of quantitative traits.The coefficient of correlation between yield and its contributing traits show a complex relationship. Path coefficient analysis partitions the components of correlation coefficient into direct and indirect effects and visualizes the relationship in more meaningful way. Therefore, the present investigation was undertaken to find out the variability parameter,correlation and path coefficient of mungbean genotypes and identify the promising genotypes.

2. MATERIALS AND METHODS

The experiment for the present investigation was conducted at Experimental Farm of University of Calcutta,Baruipur,South 24 Parganas,West Bengal, India(22^0 N,88.26^0 E and 9.75m above the sea level) in two different growing seasons: August to November 2013 and March to June 2014.Experimental material consisting of 23 genotypes was sown in randomized block design with three replications. Recommended agronomic practices and plant protection measures were adopted over the two seasons to raise a good crop.Observations viz., days to 50 per cent flowering, 1st picking of pods, days to maturity were taken on row basis. For

other characters viz., plant height (cm),no of branch per plant, number of pods per plant, pod length (cm),number of seeds per pod, 100 seed weight (g),seed yield (g) and harvest index (%) were recorded on five randomly selected plants from each row. Genotypic and phenotypic coefficient of variations, heritability and genetic advance were estimated as per Singh and Chowdhury [20] and Johnson et al. [9]. Correlation coefficients were calculated asaccording to Miller et al. [14] and path coefficientanalysis was done following to the method suggested by Dewey and Lu [3].

3. RESULTS AND DISCUSSIONS

Development of high yielding varieties requires a deep knowledge of the existing genetic variation for yield and its component characters. A thorough probe into pooled mean data over the two seasonspresented in Table 1 revealed that plant height ranged from 49.83 to 85 cmwith maximum contribution from PS 16 while minimum contribution by Shona mung 2. Pods per plant ranged from 68.45 to 33.83 where Pusabaisakhi as well as APDM-84 was seen to attain the maximum and minimum value respectively. Number of branches and pods per plant are considered as the most important yield component and are directly concerned with final yield in pulse crop. Both these characters showed a great deal of variation in their mean values for these twenty three genotypes. M. Farshadfar and E. Farshadfar [4] observed similar variation in several genotypes of Chickpea.Deliberation of mean values for seed yield per plant demonstrated that cultivar Shona mung 1 proved its superiority by contributing maximum towards the trait. Final harvesting ranged from64.06-72.75 days where Shona Mung 1 took minimum time in final picking followed by the genotypes B1, UPM-99-3, Pusa 9632, Shona mung 2, Baruipur local 2.

3.1 Variability Parameter Study

In the present study, the estimation of genotypic and phenotypic coefficients of variation, heritability and genetic advance of various characters of mungbean genotypes over the two seasons are presented in Table 2. Data revealed that the phenotypic coefficient of variation (PCV) was slightly higher than the genotypic coefficient of variation (GCV) for all the characters suggesting the presence of environmental influence to some extent in the expression of these characters.The heritable portion of this variation is determined by the estimation of heritability. Therefore, heritability estimates give better idea about possible gain through selection. High Heritability (H%) were observed for the characters seed yield/plant, plant height, 1st picking, 50% flowering indicated the scope of their improvement through selection for these traits [19]. High genetic advance along with high heritability was noticed in Plant height, pods/plant and seed yield/plant. According to Gafoor et al. [5],Ali et al. [1] high heritability coupled high Genetic Advance (GA) revealed the presence of additive gene effects; hence crop improvement through these traits could be possible through simple selection. However, heritability estimates should be considered with Genetic Advance because heritability alone is not a good indicator of the amount of usable genetic variability [6,13].

3.2 Character Association

Correlation studies: The correlation coefficient provides a measure of the relationship between traits and serves to assess the chance for mutual improvement of two traits by common selection. The estimates of genotypic and phenotypic correlation coefficients between different characters of mungbean genotypes over the two seasons are presented in Table 3 and Table 4 respectively.

Genotypic correlation of the trait with other parameters revealed that plant height at maturity was significantly and positively correlated with branches/plant, pods/plant,pod length, seeds per pod, 100 seeds weight, final picking, and seed yield/plant. Likewise pods/plant, harvest index, final picking, and seed yield/plant were positively correlated with no. of branch/plant. Similar results were reported by Sharma [18] and Gill et al. [7].Similar results were also reported by Kingshlin and Vannirajan [10]. The traits seeds/pod, harvest index were positively correlated with pods/plant and seeds/pod showed high level of significance. 100 seeds weight, 50% flowering, 1st picking were positively correlated with pod length. At the same time phenotypic correlation revealed that no. of branches/ plant, pod length, seeds/pod, 100 seed weight and final picking were positively correlated with plant height. Likewise no. of branches/plant was positively correlated with pods/plant, and harvest index. Traits like pods/plant showed positive correlation with harvest index and seed yield/plant. The results depicted positive significant phenotypic correlations of pods per plant and harvest index with seed yield. This indicates that selection based on these traits may result in improved yield. According to Madhur & Jinks [11], positive correlations occur due to the changes of genes supplying precursors. On the other hand negative correlations arise due to competition among traits for common precursors which is restricted supply.

Path analysis: The phenotypic and genotypic correlations were further analyzed by path coefficient analysis, which involves partitioning of the correlation coefficients into direct and indirect effects through alternate characters or pathways. Such analysis leads to identification of important component traits useful in indirect selection complex traits like yield. Since a character like seed yield is dependent on several mutually associated component characters and change in any one of the components is likely to affect the whole network of cause and effect relationship. Table 5 deals with the partitioning of correlation coefficient into direct and indirect effects of casual factors on grain yield.100 seeds weight (1.56), seeds/pods (1.25), 50% flowering (1.03) had positive direct effect on seed yield per plant. Plant height showed negative direct effect and positive indirect effect via no. of branch/plant, pods/plant, pod length, seeds/pod, 100 seeds weight,50% flowering,1st picking.

Table 1: Mean values of different agro-morphological characters in Mungbean genotypes

Var	Plant height (cm)	Branch	Pods/pt	Pod L (cm)	Seeds/P	100 seeds wt (gm)	Harvest Index	Seed Yield/pt (gm)	Days to 50% maturity	1st picking (days)	Final picking (days)
APDM-84	53.16	5.8	33.8	7.61	10.5	3.8	16.695	15.03	35.25	58.9	69.2
MH-98-1	63.16	6.115	37.65	7.63	11	3.95	16.985	17.28	30.7	54.9	66.85
B1	77.5	9.45	42	7.43	11.5	3	17.275	17.14	29	54.05	65.25
PS-16	85	9.345	65	6.96	12	3.66	18.005	22.46	30.85	55.4	67.265
PTM-11	73.83	8.295	50.665	7.36	11.165	4.06	17.005	16.19	34.1	59.3	70.75
SML-302	53.83	6.915	45.83	7.36	10	4.38	16.53	17.98	32.1	56.85	68.1
ML-5	73.5	6.43	47.665	6.95	10.5	4.23	16.115	13.88	37.65	61.85	72.59
APDM-116	55.48	8.75	54.165	6.93	10.5	3.88	16.895	22.85	36.9	58.85	70.545
UPM-99-3	81.16	7	58.165	7.26	12	4.31	15.98	20.15	30.45	54.3	65.85
24 pargana local	76.83	6.58	66.665	7.43	12.3	3.6	15.855	19.34	34.55	58.925	69.35
Pusa baishakhi	82.33	5.51	68.45	7.73	13	2.8	14.785	21.72	30.2	55.85	66.545
Pusa 9632	62.66	6.75	44.5	7.23	10.33	3.3	14.785	16.47	31	54.55	65.7
K-851	82	4.955	52.5	7.56	11	4.21	17.87	24.55	33.85	59.2	70.85
Shona mung 1	77.16	6.86	61.48	7.15	11.5	3.71	16.865	23.61	29.4	53.73	64.06
PM-2	76.16	7.7	53.5	7.88	11	2.965	18.83	20.12	30.75	56.195	67.35
Baruipur Local 1	65.33	7.175	49.3	8.2	11.165	3.895	15.695	16.0	31.35	55	66.935
BL3	78.33	7.915	59.665	8.2	11.5	4.00	15.305	22.9	35.5	59.875	70.2
Shona Mung 2	49.83	6.115	54.815	7.715	13.13	3.215	17.77	20.97	31.0	55.45	66.14
Panna	71.0	6.915	53.45	6.765	11.415	3.615	16.24	20.86	33.6	59.7	70.7
Baruipur Local 2	79.115	7.065	59.8	8.765	9.93	6.615	15.41	23.14	30.0	55.405	66.35
Howrah Local	71.29	7.03	50.25	8.83	10.9	2.95	17.8	13.23	37	61.35	72.75
Purulia Local	65.5	7.115	45	7.765	9.33	2.7	17.105	15.97	33.4	59.75	70.37
Bankura local	67.93	8.13	55.15	7.7	10.8	3.45	19.085	18.07	33.65	59.585	69.5
Mean	70.52	8.13	52.15	7.58	11.05	3.75	16.73	20.00	32.71	57.34	68.05
CD	8.07	1.52	15.85	1.018	1.772	1.309	1.906	5.69	3.114	2.164	3.04

Table 2: GCV, PCV, H% & GA and GA% of Mean of different characters of Mungbean

SOV	Plant height	Branch/plant	Pods/plant	Pod length	Seeds /pod	100 seeds wt	Harvest index	Seed yield /plant	Days to 50% maturity	1st picking	Final picking
GCV	13.98	14.05	3.0	5.19	6.06	17.29	5.69	68.41	7.11	4.20	4.80
PCV	15.13	17.70	20.02	8.54	10.1	24.64	8.09	71.74	8.59	4.62	5.06
H%	85	62	42	36	36	49	49	90	68	82	5,06
GA	17.35	1.29	5.93	0.29	0.50	0.65	0.96	17.08	3.2	4.11	5.63
GA% of mean	24.60	18.11	11.27	3.82	4.48	17.33	5.73	128.1	9.78	7.16	8.86

Table 3: Genotypic correlation matrix of different agro morphological characters of Mungbean

	Plant height	Branch/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	50% maturity	1st picking	Final picking	Seed yield/plant
Plant height	1.000	0.175	0.007	0.145	0.394*	0.097	-0.007	-0.243	-0.080	0.037	0.516**

Branch/plant		1.000	0.143	-0.33	-0.148	-0.13	0.268	-0.014	-0.164	0.023	0.207
Pods/plant			1.000	-0.371	0.704**	-1.02	0.186	-0.16	-0.104	-0.09	-0.309
Pod length				1.000	-0.15	0.213	0.016	0.041	0.100	-0.07	-0.136
Seeds/pod					1.000	-0.37	0.161	-0.47	-0.458	-0.28	0.784**
100 seed wt						1.000	0.495**	0.002	-0.072	-0.12	0.514**
Harvest index							1.000	0.012	0.129	0.283	0.157
50% maturity								1.000	1.045**	0.977**	-0.578
1st picking									1.000	1.040**	-0.386
Final picking										1.000	-0.387
Seed yield/plant											1.000

** denotes 1% level of significance and * denotes 5% level of significance

Table 4: Phenotypic correlation matrix of different agro morphological characters of Mungbean

	Plant height	Branch/ plant	Pods/ plant	Pod length	Seeds/pod	100 seed wt	Harvest index	50% maturity	1st picking	Final picking	Seed yield/plant
Plant height	1.000	0.134	-0.02	0.012	0.28	0.134	0.121	-0.195	-0.065	0.009	0.292*
Branch/plant		1.000	0.022	-0.04	-0.12	-0.04	0.294*	-0.08	-0.027	-0.011	-0.089
Pods/plant			1.000	-0.19	0.180	-0.45	0.013	0.021	0.0002	-0.049	0.020
Pod length				1.000	-0.13	0.162	0.010	-0.05	0.025	-0.012	-0.128
Seeds/pod					1.000	-0.24	0.096	-0.18	-0.191	-0.226	0.248*
100 seed wt						1.000	0.205*	-0.05	-0.083	-0.089	0.193
Harvest index							1.000	0.088	0.177	0.222*	-0.104
50% maturity								1.000	0.836**	0.799**	-0.189
1st picking									1.000	0.882**	-0.259
Final picking										1.000	-0.164
Seed yield/plant											1.000

** denotes 1% level of significance and * denotes 5% level of significance

Table 5: Path coefficient analysis of different agro morphological characters of Mungbean

	Plant height	Branch/plant	Pods/plant	Pod Lenght	Seeds/Pod	100 seeds weight	Harvest Index	Days to 50% muturity	1st picking	Final picking
Plant height	-0.21	0.18	0.002	0.0002	0.49	0.23	-0.008	0.04	0.07	-0.06
Branch/plant	0.12	0.45	0.04	-0.0006	-0.19	-0.21	0.15	-0.02	0.14	-0.04
Pods/plant	0.01	0.45	0.25	-0.0006	0.88	-1.61	0.11	-0.36	0.09	0.15
Pod Length	-0.03	0.06	0.09	0.02	-0.14	0.34	-0.008	0.04	-0.21	-0.07
Seeds/Pod	-0.08	-0.15	0.18	-0.0003	1.25	-0.59	0.09	-0.48	0.95	-0.28
100 seeds weight	-0.02	-0.07	0.25	0.004	-0.33	1.56	-0.25	0.003	0.15	-0.12
Harvest Index	0.02	-0.06	0.50	-0.0003	0.20	-0.52	0.58	0.012	-0.27	0.28
Days to 50% maturity	-0.25	0.12	0.03	0.0008	-0.42	0.003	0.07	1.03	-2.17	0.98
1st picking	-0.08	0.0003	0.02	0.099	-0.41	-0.08	0.07	1.08	-2.08	1.04
Final picking	0.04	-0.0005	0.02	-0.0012	-0.25	0.12	0.14	1.01	-2.16	1.0

*Residual effect is0.3489.

These findings are partly in accordance with findings of Rohman & Hussain [17].Pods/plant showed positive direct effect and positive indirect effect via no. of branch/plant, seeds/pod, harvest index, 1st picking, final picking. These findings are also partly in accordance with previous reports [2,8,12,16,17] proving the effectiveness of direct selection through pods per plant for yield improvement. Harvest index showed positive direct effect and positive indirect effect via plant height, no. of branch/plant, pods/plant, seeds/pod, 50% flowering and final picking.The residual effect of 0.3489

suggested that it was in range of moderate which indicates that there are some more characters which contribute to the grain yield which need to be studied. It was concluded that characters with positive effects should be significantly considered in selection criteria for yield improvement in mungbean breeding programs.

4. CONCLUSION

In forgoing discussion it can be concluded that the high magnitude of all the phenotypic variances than genotypic variances showing the pronounced effects ofenvironment. Higher heritability coupled with high genetic advance showed additive effects and more gain of selection in next generations. The seed yield is an importantparameter among all the yield contributing as well as morphological traits. Improvement in seed yield in mungbean could be brought through selection of component characters directly concerned with final yield like branches, pods per plant, pod length, seeds/pod, 100 seed weight, harvest index, 50% maturity and final picking which showed positive direct effects.

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