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Variability and path coefficient analysis for yield attributing traits of mungbean (*Vigna radiata* L.)

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ABSTRACT

Seven mungbean genotypes were studied to estimate the genetic variability and path coefficient analysis for yield attributing traits at Agronomy farm of Institute of Agriculture and Animal Science (IAAS), Paklihawa Campus, Rupandehi, Nepal during summer season of 2017. The experiment was conducted with four replications in a randomized complete block design. Pant-5 and Maya were found high yielding genotypes. High genotypic coefficient of variation was exhibited by secondary branches and seed yield per plant. The low genotypic coefficient of variation was given by pod length, number of grains per pod and days to 50% flowering. High heritability was shown by test weight, secondary branches and seed yield per plant. Yield was correlated positively with days to flowering, pod length, primary branches per plant, test weight, biological, seed yield per plant and number of pods per plant. Biological yield, pod length, days to 50% flowering and no. of grains per pod contributed maximum positive and direct effect on yield indicating these three traits should be given emphasis while selecting high yielding mungbean cultivar for irrigated condition.

INTRODUCTION

Mung bean (*Vigna radiata* (L.) Wilczek), also known as green gram or moong is one of the most important pulse crops extensively grown in tropical, subtropical and temperate zones of Asia (Amanullah et al. 2016). Its input requirement is low, and its drought tolerance enables it to withstand adverse environmental conditions, allowing it to be successfully grown in rainfed areas (Anjum et al. 2006). In terms of average land area, grain legumes rank fourth and in production they rank fifth. At the farm level, more than 600 newly adopting farmers were involved in mungbean grain production covering more than 100 ha and producing 85 MT of grains (MOAD 2014). Mungbean is commonly grown in mid-hills, inner terai and terai region on Nepal.While conducting Principal Component Analysis of local and exotic genotypes of mungbean, the genotypes almost similar in cluster exhibit much closeness in them as compared to mixed group of genotypes (Basnet 2014).

Path coefficient analysis, heritability and genetic advance can be estimated for developing appropriate breeding and selection strategies. The relationship between yield and its component traits provide the information that can be useful for the selection to improve the yield. Path coefficient analysis can be used to estimate seed yield, which is directly contributed by pod per plant, biological Seed yield per plant and harvest index (Rao et al. 2006).

The knowledge regarding relative contribution of individual trait to yield is very important and this can be achieved by dividing the correlation coefficient into direct and indirect effects. The direct and indirect cause of association can be determined by path coefficient analysis (Dewey and Lu 1959).The main purpose of the study was to find out correlation between yield attributing traits as direct and indirect contribution of these individual traits in yield. Thus, the result obtain from the study could be further used for the breeding strategies and developing new mungbean varieties of higher productivity.

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Table 1. List of genotypes and their collection centers

SN/ Entry	Name of genotypes	Origin
1	Pant -5	Foreign germplasm
2	Bari mung	Foreign germplasm
3	Pratikshya	National Grain Legumes Research Center, Khajura
4	SML-668	Foreign germplasm
5	Hum-16	Foreign germplasm
6	Kalyan	National Grain Legumes Research Center, Khajura
7	Maya	Local

MATERIALS AND METHODS

The experiment was carried out during spring season at Institute of Agriculture and Animal Science, Tribhuvan University, Paklihawa Campus, Agronomy Farm. It located in Western development region having humid subtropical climate with annual rainfall of 1500 mm. The research site was located 27°29'2" N latitude and 83° 27'13" E longitude and at an altitude of 84 meters above sea levelhaving humid subtropical climate with annual rainfall of 1500 mm. The experiment was conducted from 20th March 2017 to 7th July 2017. Seven genotypes of Mungbean were used as an experimental material. The collection centers of genotypes of mungbean are shown in Table 1.

The experiment was conducted with four replications in a Randomized Complete Block Design (RCBD). There were total 28 plots and each plot size was 3m×2m=6m². There were 5 rows per plot, row to row spacing was 30cm and plant to plant spacing was 15 cm. The spacing between two plots was 50cm and inter spacing between the replication was 1m.

Five plants sample per rowand altogether 25 plants sample per plot were taken for collection of data and study of different parameters of mungbean. The data from the sample plants were collected in such a way that first 5 plants from first line, last 5 plants from second line, again middle 5 plants from third line and so on. The data on days to 50% flowering, plant height, primary branch /plant, secondary branch/plant, number of pods/plant, pod length, number of grains/pod, biological yield/plant, test weight and seed yield/plant were recorded. These data were analyzed to estimate genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV), heritability and genetic advance (GA) following the outlines by (Burton, 1952), (Burton and Devane 1953) and (Johnson et al. 1955) respectively. Similarly, the outlines of Deweyand Lu (1959) were followed for path analysis.

RESULTS AND DISCUSSIONS

Performance of genotypes

A thorough probe into mean data (Table 2) revealed that plant height ranged from 49.76 to 63.78cm with maximum contribution from Kalyan while minimum contribution by Pant -5. Days to 50% flowering was ranged from 37.25 days (Pratikshya) to 41.50 days (Maya). Maximum number of primary branches per plant was produced by Maya (4.89) followed by Pratikshya (3.96) and SML-668 (3.91), whereas minimum value was observed for Pant-5 (3.56). Similarly,

Table 2. Mean values for yield and its components in mungbean genotypes

SN	Genotype	Days to 50% flowering	Plant height cm	Primary branches / plant	Secondary branches/ plant	Number of pods/plant	Pod length (cm)	Number of grains/ pod	Biological yield/ plant	Seed yield per plant (g)	Test weight (g)
1	Pant -5	38.75	49.76	3.56	11.91	36.81	9.18	9.63	68.87	1.21	56.10
2	Bari mung	38.00	54.67	3.82	16.70	54.93	8.81	10.35	83.73	0.90	55.32
3	Pratikshya	37.25	53.10	3.96	16.45	41.07	8.64	9.74	71.80	0.78	48.23
4	SML-668	37.75	51.10	3.91	16.65	46.25	8.71	9.64	80.40	0.82	48.25
5	Hum-16	38.00	57.60	3.67	17.36	37.83	8.70	9.88	79.59	0.65	47.98
6	Kalyan	37.50	63.79	3.66	18.06	46.59	8.38	10.45	82.95	0.93	59.60
7	Maya	41.50	61.82	4.89	23.90	54.25	8.60	9.76	109.14	1.09	43.64
	Mean	38.39	55.98	3.92	17.29	45.39	8.72	9.92	82.35	0.91	51.30
	CV (%)	3.42	10.59	13.16	11.40	15.09	2.75	4.03	13.10	15.74	0.77
	SE	0.65	2.96	0.26	0.99	3.42	0.12	0.20	5.39	0.07	0.20

CV=Coefficient of variation, SE= standard error

Table 3. Parameters of genetic variability for yield and yield contributing characters of 7 genotypes of Mungbean

SN	Characters	Range	Mean	PCV (%)	GCV (%)	Heritability (%)	Genetic advance (% of mean)
1	Days to 50% flowering	37.25-41.50	38.4	4.8	3.36	0.49	4.85
2	Plant height(cm)	49.77-6379	55.98	13.21	7.91	0.36	9.75
3	Primary branches/Plant	3.56-4.89	3.92	16.16	9.38	0.34	11.21
4	Secondary branches/ Plant	11.91-23.90	17.29	22.67	19.59	0.75	34.89
5	Number of pod /plant	36.81-54.93	45.39	20.75	14.24	0.47	20.14
6	Pod length (cm)	8.38-9.19	8.71	3.68	2.45	0.44	3.36
7	Number of grains /pod	9.63-10.45	9.92	4.88	2.75	0.32	3.2
8	Biological yield /plant(g)	68.88-109.14	82.35	19.5	14.45	0.55	22.06
9	Test weight (g)	43.64-59.60	51.3	11.17	11.15	1	22.91
10	Seed yield /plant (g)	0.66-1.21	0.91	24.68	19.01	0.59	30.16

maximum number of secondary branches per plant was produced by Maya (23.90) followed by Kalyan (18.06) and Hum-16 (17.36), whereas minimum value was observed for Pant-5 (11.91). The number of pods per plant ranged from 36.81 (pant-5) to 54.93 (Bari mung). Maximum number of grains per pod was recorded as 10.45 by Kalyan and minimum by Pant-5 (9.63). Pod length ranged from 9.18cm (Pant-5) to 8.38cm (Kalyan). Plant height ranged from 49.76 cm to 63.78 cm with maximum contribution from Kalyan while minimum contribution by Pant. The biological yield per plant ranged from 109.14 to 68.87 g with maximum contribution from Maya while minimum contribution by Pant -5. The Seed yield per plant was highest in Pant-5 (1.21g) followed by Maya (1.09 g) and Kalyan (0.93 g). The test weight ranged from 43.64g to 59.60g with minimum contribution from Maya and maximum form Kalyan.

PCV and GCV

Rahim et al. (2010) which stated that maximum range for variability was observed for number of pods per plant. The differences in number of pod per plant may be due to different genetic back ground among these tested genotypes. Results are supported by Tabsum et al. (2010).

The analysis revealed that for all the characters phenotypic coefficient of variation (PCV) was slightly higher than the genotypic coefficient of variation (GCV), so it is evident that in expression of the characters mainly governed by the genotypes itself along with meagre effect of environment. This finding also gets corroborated with Venkateswarlu (2001), Dikshitet al. (2002), Reddy et al. (2003), Siddique et al. (2006) and Makeen et al. (2007). The phenotypic coefficient of

Table 4. Genotypic path coefficient analysis showing direct and indirect effects among their characters towards yield in mungbean

SN	Characters	Days to 50% flowering	Plant height cm	Primary branches/ plant	Secondary branches/ plant	Pod/ plant	Pod length (cm)	Grains/ panicle	Biological yield/ plant	Test weight
1	Days to 50% flowering	0.5660	0.2520	0.6245	0.4012	0.3129	0.0821	-0.1604	0.5839	-0.3083
2	Plant height cm	0.0081	0.0181	0.0059	0.0168	0.0092	-0.0205	0.0169	0.0136	0.0005
3	Primary branches/ plant	-0.6088	-0.1791	-0.5518	-0.5612	-0.4337	0.1552	0.1487	-0.5894	0.4774
4	Secondary branches/ plant	-0.2075	-0.2719	-0.2977	-0.2927	-0.2082	0.2182	-0.0779	-0.2994	0.1703
5	Pod/ plant	-0.1869	-0.1712	-0.2658	-0.2404	-0.3381	0.1463	-0.2120	-0.2745	0.0395
6	Pod length cm	0.1208	-0.9442	-0.2342	-0.6205	-0.3602	0.8326	-0.5728	-0.4239	0.1124
7	Grains/ panicle	-0.1127	0.3717	-0.1071	0.1059	0.2493	-0.2735	0.3976	0.0967	0.3119
8	Biological yield/ plant	1.1372	0.8261	1.1777	1.1277	0.8951	-0.5613	0.2682	1.1025	-0.5722
9	Test weight	-0.0315	0.0015	-0.0501	-0.0337	-0.0068	0.0078	0.0454	-0.0301	0.0579
10	Yield/ plant	0.6846	-0.0970	0.3014	-0.0970	0.1195	0.5869	-0.1463	0.1793	0.2892
	Partial R^2	0.3875	-0.0018	-0.1663	0.0284	-0.0404	0.4886	-0.0582	0.1977	0.0167

R square = 0.8524, Residual effect = 0.3842 variation was highest for grains weight per plant followed by yield per plant, secondary branch, pod per plant and biological yield exhibited moderate high phenotypic coefficient. This result is in accordance with the result of Kumar et al. (2010) which stated that highest PCV were observed for pods per plant. Slight change in the result might be due to the environmental and some other factors. Genotypic coefficient of variation was also high for grain weight per plant followed by secondary branch, yield per plant, biological yield and pod per plant. Similarly, lowest phenotypic coefficient of variation was exhibited by pod length. Lower value of coefficient of variation was exhibited by pod length and grain per pod. The difference between the values of PCV and GCV was comparatively smallest in case of Plant height, pod length and grain pod. Coefficient of variation with high heritability and genetic advance as percent mean was observed for grains weight per plant, secondary branch, and Seed yield per plant which indicates additive gene action and good scope for selection followed by test weight and grain yield per plant.

Heritability and Genetic Advance

The development of high-yield varieties requires deep knowledge of the existing genetic variation for yield and its component characters. The high heritability plays an important role in the selection suitable types according to their phenotypic performance. Genetic advance is indicative of the expected genetic progress for a particular trait under the appropriate selection procedure (Kaul and Garg 1982). In the present study, estimates of genotypic and phenotypic coefficients of variation, heritability and genetics advance of several characters of mungbean genotypes are presented in the Table 3. High genetic advance (as percent mean) were observed for seed yield per plant (50.82). Similar findings of high genetic advance were reported by Byregowda et al. (1997). Lowest heritability was exhibited by number primary branches per plant. The variation observed in values different characters is primarily due to genetic causes and very less by environmental effects (Saravanan and Senthi 1997). Similarly, the genetic advance was highest for grain weight per plant and was lowest for grain per pod.

Path Analysis

The path coefficient analysis of yield attributing traits divided into their corresponding direct and indirect effects on yield is shown in Table 4. Plant height and total number of tillers per plant showed direct negative effect on grain yield.

The evaluation of path coefficient for agronomic traits indicated that days to flowering, pod length, primary branches per plant, test weight, biological Seed yield per plant and pods per plant had the direct and positive effect on seed yield per plant (Table 4). Similar results were also reported by Rao et al. (2006) for biological yield per plant, test weight, Gadhak et al. (2013) for number of primary branches per plant. The positive direct effect (0.6846) of days to flowering on seed yield was also observed (Table 4). Rahman (1982) after studied 9 mungbean varieties found that days to 50% flowering also had direct contribution on yield in mungbean. From the result (Table 4) it was revealed that pod length had positive direct effect (0.5869) on seed yield/plant. It indicated that increased pod length made large amount of photosynthetic available for storage in seed. In 1982, Rahman, after studied 9 varieties of mungbean observed that pod length had direct effect on yield. The pods/plant had direct positive effect (0.1195) on seed yield/plant (Table 4). Rahman (1982) studied 9 mungbean varieties observed that pods/plant had direct contribution on yield. The residual effect (0.3842) indicates that the component characters under study were responsible for about 62% of variability in seed yield per plant.

CONCLUSIONS

The mungbean genotype namely Pant-5 and Maya were high yielding genotypes. The magnitude of all the phenotypic variances was higher than genotypic variances showing the pronounced effects of environment. Higher heritability showed additive effects and more gain of selection in next generations when coupled with high genetic advance. The seed yield is an important parameter among all the morphological as well as yield traits. Improvement in seed yield in mungbean could be brought through selection of component characters like days to flowering, pod length, primary branches per plant, test weight, biological Seed yield per plant and pods per plant which showed positive direct effects on seed yield per plant.

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