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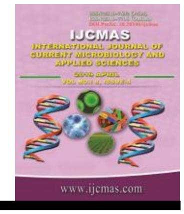

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Genetic Variability, Character Association and Path Analysis Studies in Green Gram (*Vigna radiata* (L.) Wilczek)

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A B S T R A C T

The present study was conducted to evaluate the green gram accessions to assess the magnitude of genetic variability and to understand the heritable component of variation for seed yield and its component traits. Estimation of genetic parameters would be useful in developing appropriate breeding and selection strategies. A field trial was laid under a Randomized Block Design (RBD) with three replications; observation was recorded on ten morphological characters (as detailed in material and methods) among the 100 genotypes collected green gram collections. The phenotypic coefficient of variation (PCV) was greater than that of genotypic coefficient of variation (GCV) for all the characters studied thereby indicating the influence of environmental effect on the characters. The high estimates of GCV, heritability and genetic advance were exhibited by plant height, number of primary branches per plant, number of clusters per plant, number of pods per clusters, number of pods per plant and seed yield per plant. Heritability is a measure of possible genetic advancement under selection. High heritability was observed for all the traits under study. High value of heritability coupled with high genetic advance as per cent of mean were recorded for days to 50% flowering, number of primary branches per plant, number of clusters per plant, number of pods per plant, seed yield per plant and these characters were controlled by additive gene effects. Therefore, selection of genotypes based on these traits could bring about desired improvement in yield of green gram cultivars.

Keywords

Green gram, Germplasm, Genetic variability, Correlation and Path analysis

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Introduction

Green gram (*Vigna radiata* (L.) Wilczek) is one of the important pulse crops because of its short growth duration, adaptation to low water requirement and soil fertility. It is favored for consumption due to its easy digestibility and low production of flatulence (Shil and Bandopadhya, 2007). Pulses are extensively grown in tropical regions of the world as a major protein rich crop bringing considerable improvement in human diet. Average protein content in the seed is around 24 per cent. The protein is comparatively rich in the amino acid lysine but predominantly deficient in cereal grains (Baskaran *et al.*, 2009). Presently, the yield of green gram is well below the optimum level compare to other pulses. The average yield of mungbean is very low not only in India (425 kg/ha) but in entire tropical and sub-tropical Asia. India is the largest producer of green gram in the world and accounts for 65 per cent acreage and 54 per cent production (Pratap *et al.*, 2012). Being the third largest pulse crop in India, it occupies an area of about 3.55 million hectares area with total production of 1.80 million tonnes and productivity of 512 kg/ha (All India Coordinated Research Project, 2012).

Genetic variability studies provide basic information regarding the genetic properties of the population, based on which, breeding methods are formulated for further improvement of the crop. These studies are also helpful to know about the nature and extent of variability attributable to different cases, sensitive nature of the crop to the environmental influences, heritability of the characters and genetic advance that can be realised in practical breeding. The extent of variability and heritability of the characters among the genotypes is the basic source for the exploitation of superior potentiality of genotypes. Heritability gives the information on the magnitude of inheritance of quantitative traits, while genetic advance will be helpful in formulating suitable selection procedures.

Seed yield per plant is a dependent trait, which is influenced by many independent traits. Studies on the correlation of traits and their relative direct and indirect effects on Seed yield are important, as it is helpful in selection of desirable traits. Hence, an attempt was made to study ten biometrical traits, their correlations and effects on genotypes of green gram.

Materials and Methods

The experimental material consisted of 100 germplasm accessions of green gram (*Vigna radiata* (L.) Wilczek) obtained from various countries and maintained at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Killikuam, Tamil Nadu Agricultural University. The accessions were sown in paired rows of 4 metres length, adopting a spacing of 30 x 10 cm in a Randomized Block Design with two replications. All the agronomic practices were followed to maintain the crop stand. Five randomly taken plants were considered to record data for days to 50 per cent flowering, plant height (cm), number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, 100 seed weight (g) and yield per plant (g). The mean values of five plants were taken for the statistical analysis Statistical methods suggested by Burton (1952) for variability, Lush (1940) for heritability, Johnson *et al.*, (1955) for genetic advance as percent of mean were adopted to find out the respective estimates. Further categorization of estimates was made based on the suggestions of Sivasubramanian and Madhavamenon (1973) for variability, Johnson *et al.*, (1955) for heritability and genetic advance as percent of mean. Genotypic and phenotypic correlations were partitioned into path coefficient analysis using the technique outlined by Dewey and Lu (1959). The biometrical observations on grain yield were recorded on single plant basis at the time of harvesting as per descriptors for *Vigna mungo* and *Vigna radiata* (Revised) [IBPGR – Biodiversity International, 1985].

Results and Discussion

Analysis of variance revealed highly significant differences among the accessions for all the characters under investigation thereby indicating the presence of sufficient magnitude of genetic variability among the experimental material (Table 1), which is very much desirable to the breeder for identification of suitable high yielding genotypes to be used in crop improvement programme to enhance the grain yield of green gram.

The general mean value for each trait and its range among the genotypes and estimates of genetic parameters like phenotypic and genotypic coefficient of variation, heritability and genetic advance are presented in Table 2 and the same depicted in Figure 1a and 1b.

Genetic variability

The phenotypic coefficient of variation (PCV) was slightly higher than the genotypic coefficient of variation (GCV) for all the traits, so it is evident that in expression of the characters mainly governed by the genotypes itself along with meager effect of environment. This finding also get corroborated with Venkateswarlu (2001), Dikshit *et al.,* (2002), Reddy *et al.,* (2003) and Tejbir *et al.,* (2009).

The magnitude of PCV and GCV was the highest for plant height (23.40, 22.18), number of branches per plant (39.02, 36.94), number of clusters per plant (31.48, 30.75), number of pods per cluster (21.30, 20.50), number of pods per plant (42.18, 42.00) and seed yield per plant 36.69, 36.52), respectively. These observations indicated that the variability could be exploited for successful isolation of desirable genotypes for the characters concerned. It is in accordance with the findings of Gadakh *et al.,* (2013) and Byregowada, Chandraprakash, and Jagadeesh (1997). Natarajan, Thiyagarajan and Rathnaswamy (1988) also reported that pods and seeds per plant have the prominent grain yield determinants in green gram. Moderate PCV and GCV values were observed for the traits *viz.,* days to fifty per cent flowering (16.90, 16.28), pod length (15.57, 13.47) and hundred seed weight (18.63, 18.13), respectively. Selection will be effective based on the heritable nature of these traits. Similar finding had been reported by Srivastava and Singh (2012) and Khajudparn and Tantasawat (2011). Low estimates of PCV (9.47) and GCV (8.14) was observed for number of seeds per pod which is highly influenced by the environment and selection would be ineffective. This was in agreement with findings of Malik *et al.,* (1983), Venkateshvarlu (2001b) and Gadakh *et al.,* (2013).

Heritability and genetic advance

The heritability and genetic advance estimates were interpreted as low medium and high as per the classification of Johnson *et al.,* (1955). High heritability coupled with high genetic advance as per cent of mean was observed all the characters under study (except number of seeds per pod) *viz.,* days to 50% flowering (92.82, 33.02), plant height (89.87, 42.89), number of branches per plant (89.64, 70.51), number of cluster per plant (95.44, 61.55), number of pods per clusters 95.29, 40.10), number of pod per plant (99.17, 86.02), pod length (74.81, 23.76), hundred seed weight (94.67, 36.11) and seed yield per plant (98.06, 36.11) respectively, indicating the preponderance of additive and fixable genetic variance; suggesting that this trait may be subjected to any selection scheme to develop the stable genotypes and selection pressure may be exercised in early generation. Similar results were reported by Venkateswarlu (2001b) for days to fifty per cent flowering, plant height, number of cluster per plant, number of pod per plant, pod length, hundred seed weight, seed yield per plant. High heritability with moderate genetic advance was observed for the character number of seeds per pod alone. It is indicative of non-additive gene action. The high heritability is being exhibited due to favourable influence to environment rather than genotype and selection based on such trait may not be rewarded. Similar results were reported by Narasimhulu *et al.,* (2013a) for number of seeds per pod. For this trait improvement can be made opting the two to three cycles of recurrent selection followed by pedigree or single seed descent methods of breeding. These findings were corroborated with Dadepeer *et al.,* (2009), Dhananjay *et al.,* (2009) and Rahim *et al.,* (2010).

Correlation and path analysis

In the present investigation, the correlation coefficients were estimated among different characters are presented in Table 3. Seed yield per plant was highly significant and positively associated with plant height, number of branches per plant, number of clusters per plant, number of pods per plant, number of pods per cluster and number of pods per plant indicating that selection based on these characters may result in high seed yield, which was in close agreement with early findings of Prasanna *et al.,* (2013) for number of primary branches per plant, number of cluster per plant, number of pods per cluster and number of pods per plant. Highly significant and positive association of seed yield per plant was observed with plant height and number of pods per plant by Kumar *et al.,* (2005) in green gram. Interestingly, there were significant correlation exist among the above characters as well as seed yield which, suggested that these characters may be considered for improvement of grain yield. Further, based on these relationships, presumed that for improving grain yield in green grass, a model plant type would be that increased plant height, number of branches, clusters, pods per plant and pods per cluster.

Path analysis partitions the total correlation coefficient into direct and indirect effects and measures the relative importance of the causal factor individually (Dewey and Lu, 1959). In the present study, seed yield was considered as dependent character and other characters were taken as independent characters. The results of path analysis are presented in Table 4 and the same depicted in Figure 2. Number of pods per plant and hundred seed weight had positive direct effects on seed yield indicating that there is always scope for enhancement of grain yield by selecting this trait. The present results are in agreement with findings of Mishra and Singh (2012) and Prasanna *et al.,* (2013). The trait, number of branches per plant had a negative influence on seed yield per plant. Therefore, selection of these traits could be ineffective for increasing grain yield.

The number of clusters per plant and number of pods per clusters exhibited positive and high indirect effects through number of pod per plant on seed yield per plant. These results were accordance with the findings of (Gadakh *et al.,* 2013; Degefa *et al.,* 2014). The number of primary branches per plant had exhibited positive contribution to the seed yield per plant with the trait number of pods per plant high indirect effects on seed yield per plant. Selection based on the number of cluster per plant and number of pods per clusters would increase the seed yield indirectly through the number of pods per plant.

In conclusion, in the present study, genetic analysis showed that high heritability coupled with high genetic advance as per cent of mean was recorded by all the characters except pod length and number of seeds per pod which implies that these characters were under the control of additive type of gene action. Therefore, selection of these traits would offer scope for improvement of both seed yield in green gram.

Table.1 ANOVA showing values of mean squares for different characters in green gram

Source of variation	Days to 50 % flowering	Plant height (cm)	No. of primary branches per plant	No. of clusters per plant	No. of pods per cluster	No. of pods per plant	Pod length (cm)	No. of seeds per pod	100 seed weight (g)	Seed yield per plant (g)
Treatment	117.78**	348.006**	1.617**	23.609**	1.547**	501.912**	3.713**	2.491**	1.846**	67.619**
Error	2.961	12.591	0.060	0.370	0.040	1.460	0.375	0.264	0.034	0.412

** Significant at 1% level; * Significant at 5% level

Table.2 Estimates of variability parameters for different biometrical traits in green gram

S. No.	Characters	General Mean	Range	PCV (%)	GCV (%)	Heritability (h^2)	GA as per cent of mean
1.	Days to 50 % flowering	37.99	25.67 - 52.00	16.90	16.28	92.82	33.02
2.	Plant height (cm)	47.67	24.85 -109.15	23.40	22.18	89.87	42.89
3.	No. of branches per plant	1.95	1.00 - 4.47	39.02	36.94	89.64	70.51
4.	No. of clusters per plant	9.05	5.07- 18.07	31.48	30.75	95.44	61.55
5.	No. of pods per clusters	3.45	2.62- 6.11	21.30	20.50	92.59	40.10
6.	No. of pods per plant	30.72	13.53- 77.93	42.18	42.00	99.17	86.02
7.	Pod length (cm)	7.83	5.84- 12.27	15.57	13.47	74.81	23.76
8.	No. of seeds per pod	10.59	8.24- 12.21	9.47	8.14	73.75	14.64
9.	100 seed weight (g)	4.29	2.89-6.74	18.63	18.13	94.67	36.11
10.	Seed yield per plant (g)	13.02	4.82- 28.78	36.69	36.52	98.06	74.05

Table.3 Correlation coefficients of yield and its components

Characters	Days to 50 % flowering	Plant height (cm)	No. of branches per plant	No. of clusters per plant	No. of pods per cluster	No. of pods per plant	Pod length (cm)	No. seeds per pod	100 - seed weight (g)	seed yield per plant (g)
Days 50% flowering	**1.000**	0.533**	0.272**	0.291**	0.176*	0.242**	-0.272**	0.046	-0.265**	0.181*
Plant height (cm)		**1.000**	0.336**	0.326**	0.161	0.260**	-0.205*	0.195*	-0.164*	0.254**
No. of branches per plant			**1.000**	0.937**	0.730**	0.918**	-0.290**	0.142	-0.456**	0.806**
No. of clusters per plant				**1.000**	0.744**	0.948**	-0.307**	0.079	-0.427**	0.858**
No. of pods per cluster					**1.000**	0.895**	-0.210*	-0.098	-0.309**	0.836**
No. of pods per plant						**1.000**	-0.301**	0.022	-0.427**	0.908**
Pod length (cm)							**1.000**	0.057	0.691**	-0.063
No. of seeds per pod								**1.000**	-0.148	0.149
100 - seed weight (g)									**1.000**	-0.111
Seed yield per plant (g)										**1.000**

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

Table.4 Path coefficient analysis of different characters with seed yield per plant

S. No.	Characters	Days to 50 % flowering	Plant height (cm)	Number of branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Pod length (cm)	Number seeds per pod	100 - seed weight (g)	seed yield per plant (g)
1.	Days to 50 % flowering	**0.010**	0.004	-0.057	0.048	0.018	0.240	0.003	0.009	-0.096	0.181*
2.	Plant height (cm)	0.005	**0.008**	-0.071	0.054	0.017	0.258	0.002	0.040	-0.059	0.254**
3.	No. of branches per plant	0.003	0.003	**-0.210**	0.156	0.076	0.911	0.003	0.029	-0.165	0.806**
4.	No. of clusters per plant	0.003	0.003	-0.197	**0.166**	0.078	0.940	0.003	0.016	-0.154	0.858**
5.	No. of pods per clusters	0.001	0.001	-0.154	0.124	**0.104**	0.889	0.002	-0.020	-0.111	0.836**
6.	No. of pods per plant	0.002	0.002	-0.193	0.158	0.093	**0.992**	0.003	0.005	-0.154	0.908**
7.	Pod length (cm)	-0.003	-0.002	0.061	-0.051	-0.022	-0.299	**-0.010**	0.012	0.250	-0.063
8.	No. of seeds per pod	0.000	0.001	-0.030	0.013	-0.010	0.021	0.000	**0.207**	-0.054	0.149
9.	100 seed weight (g)	-0.003	-0.001	0.096	-0.071	-0.032	-0.424	-0.007	-0.031	**0.361**	-0.111

Residual effect = 0.207 *, ** Significant at 5 and 1 percent level respectively Diagonal values (bold) are direct effects

Fig.1a Phenotypic and Genotypic coefficients of variation for ten characters in green gram

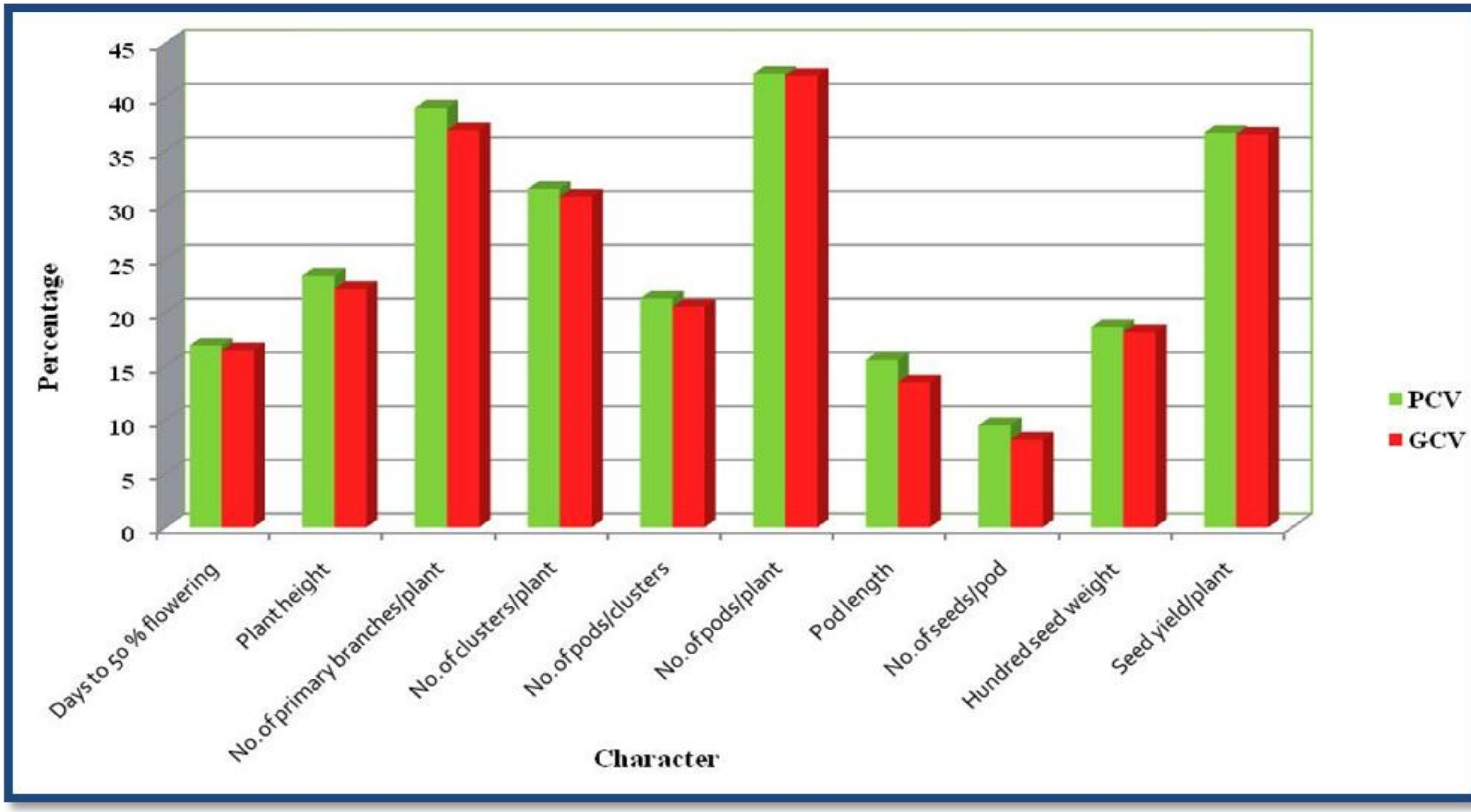


Fig.1b Heritability (Broad sense) and genetic advance as per cent of mean for ten characters in green gram

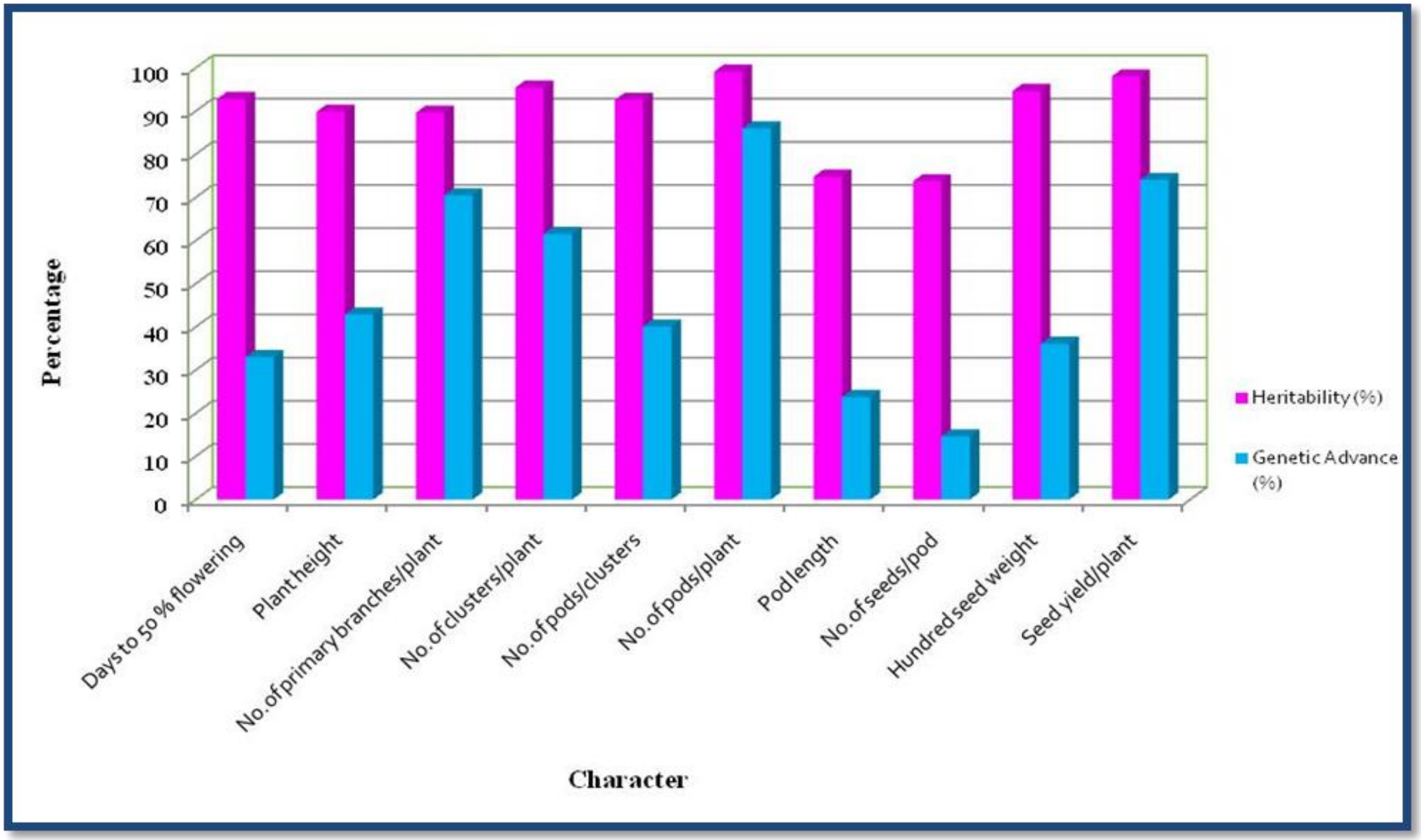
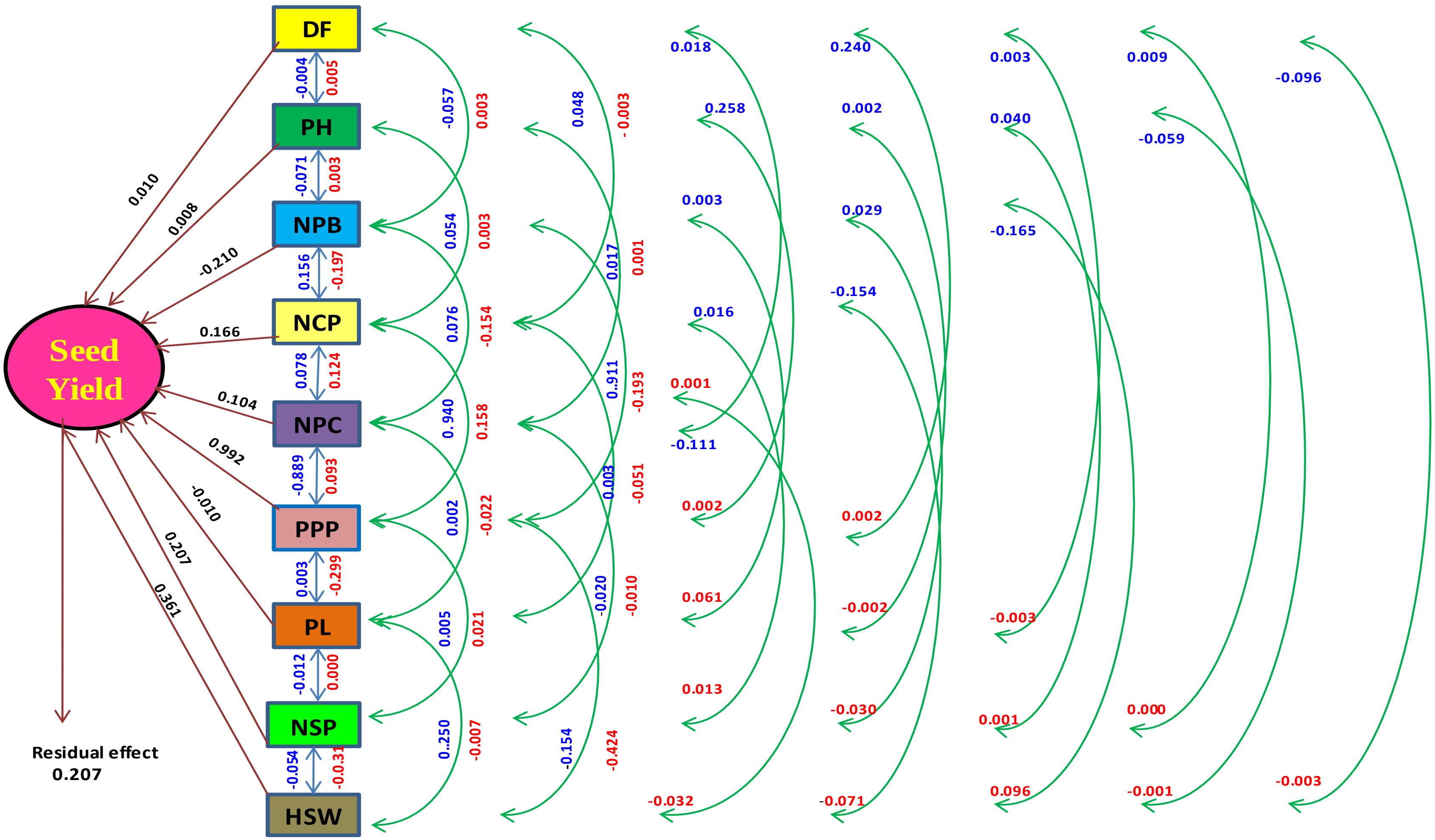


Fig.2 Genotypical path diagram for seed yield per plant



Correlation and path analysis showed that due importance should be given for number of pods per plant because of its significant correlation and high direct effects. This indicates that there is always scope for enhancement of grain yield by selection of this trait.

References

All India Coordinated Research Project on MULLaRP (green gram and urdbean). 2012. *Indian Institute of Pulses Research,* Kanpur, India. p 29.

Baskaran, L., P. Sundararmoorthy, A.L.A. Chidambaram and K.S. Ganesh. 2009. Growth and physiological activity of green gram (*Vigna radiata* (L.) Wilczek) under effluent stress. *Bot. Res. Int.,* 2: 107-114.

Burton, G.W. 1952. Quantitative inheritance in grasses. Proc. 6th Int. Grassland Cong., 1: 24-84.

Byregowada, M., J. Chandraprakash, and C.S. Jagadeesh. (1997). Genetic variability and interrelationships among yield and yield components in green gram (Vigna radiata (L.) Wilezek). Crop Research, 13, 361-368.

Dadepeer, Peerajade, Ravi Kumar, R. L. and Salimath, P.M. 2009. Genetic variability and character association in local green gram genotypes. *Environment and Ecology*. 27(1): 165-169.

Degefa, I., Y. Petros and M. Andargie. 2014. Correlation and path coefficient analysis among seed yield traits of mungbean (*Vigna radiata* (L.) Wilczek) accessions in Ethiopia. *Ann. Res. & Rev. in Biol.,* 4(1): 269-284.

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

Dhananjay, Ramakant, Singh, B. N. and Singh, G. 2009. Studies on genetic variability, correlations and path coefficients analysis in mung bean. *Crop Res. Hisar*. 38(1/3): 176-178.

Dikshit, H. K., Singh, B. B. and Dua, R. R. 2002. Genetic variation in mungbean. *Indian J. Pulses Res.* 15(2): 125-127.

Gadakh, S. S., Dethe, A. M., & Kathale, M. N. (2013). Genetic variability, correlations and path analysis studies on yield and its components in mungbean (Vigna radiata (L.) Wilczek) Bioinfolet, 10 (2a), 441-447.

Gadakh, S.S., A.M. Dethe and H.N. Kathale. 2013. Genetic variability and correlation and path analysis studies on yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). *Bioinfolet*, 10 (2A): 441-447.

Gadakh, S.S., A.M. Dethe and H.N. Kathale. 2013. Genetic variability and correlation and path analysis studies on yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). *Bioinfolet*, 10(2A): 441-447.

IBPGR Descriptors for *Vigna Mungo* and *V. Radiata* (Revised). 1985. International Board for Plant Genetic Resources, Rome.

Johnson, H.W., H.F. Robinson and R.E. Comstock. 1955. Estimation of genetic variability and environmental variability in soybean. Agron. J., 47: 314-318.

Khajudparn, P and P. Tantasawat. 2011. Relationships and variability of agronomic and physiological characters in mungbean. *Afr. J. Biotechnol.,* 10(49): 9992-10000.

Kumar, U., S.P. Singh and Vikas. 2005. Variability and character association in mungbean. (*Vigna radiata* (L.) Wilczek). *New Agriculturist,* 16(1, 2): 23-28.

Lush, J.L. 1940. Intra-sire correlation and regression of offspring on dams as a method of estimating heritability of characters. Proc. Amer. Soc. Anim.

Prod., 33: 293-301.

Malik, A.B., S.A. Hussain, A.M. Haqqani and A.H. Chaudhary. 1983. Genetic variability in mungbean *(Vigna radiata). Pakistan J. Agric. Res.,* 4 (3): 171-173.

Narasimhulu, R., N.V. Naidu, M.S. Priya, V. Rajarajeswari and K.H.P. Reddy. 2013a. Genetic variability and association studies for yield attributes in mungbean (*Vigna radiata* (L.) Wilczek). *Indian J. Plant Sci.,* 2(3): 82-86.

Natarajan, C., K. Thiyagarajan and R. Rathnaswamy. 1988. Association and genetic diversity studies in green gram (Vigna radiata (L.) Wilczek). The Madras Agricultural Journal, 75, 238-245.

Prasanna, L. B., P.J.M. Rao, K.G.K. Murthy and K. Kiran Prakash. 2013. Genetic variability, correlation and path coefficient analysis in mungbean. *Enviro. and Ecolo.,* 31(4): 1782- 1788.

Pratap, A., D.S. Gupta. and N. Rajan. 2012. Breeding Indian Field Crops. *Agro bios Publishers*, New Delhi, India. p 208-227.

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). *Plant Omics.* 3(1): 1-6.

Reddy, V. L. N., Reddi Sekhar, M., Reddy, K. R. and Reddy, K. H. 2003. Genetic variability for yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). *Legume Res.* 26(4): 300-302.

Shil, S and P.K. Bandopadhya. 2007. Retaining seed vigor and viability of mungbean by dry dressing treatments. *J. Food Legumes.,* 20: 173-175.

Sivasubramanian, S. and P. Madhava Menon. 1973. Genotypic and phenotypic variability in rice. Madras Agric. J., 60: 1093-1096.

Srivastava, R.L and G. Singh. 2012. Genetic variability, correlation and path analysis in mungbean (*Vigna radiata* (L.) Wilczek). *Indian J. Life Sci.,* 2(1): 61-65.

Tejbir, Singh., Amitesh, Sharma. and Alie, F. A. 2009. Impact of environment on heritability and genetic gain for yield and its component traits in mung bean. *Legume Res*. 32(1): 55 58.

Venkateswarlu, O. 2001. Genetic variability in green gram (*Vigna radiata* (L.) Wilczek]. *Legume Res.* 24(1): 69-70.

Venkateswarlu, O. 2001b. Genetic variability in green gram (*Vigna radiata* (L.) Wilczek). *Legume Res.,* 24(1): 69-70.

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