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RESEARCH NOTE

Analysis of genetic variability parameters for pod-shattering and yield related traits in F_2 and $F_{2:3}$ populations of mungbean [*Vigna radiata* (L.) Wilczek]

SONAM ANGMO AND SUMANGALA BHAT

Department of Biotechnology
College of Agriculture, Dharwad
University of Agricultural Sciences
Dharwad - 580 005, Karnataka, India
E-mail: sumangalabhat09@gmail.com

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Mungbean is an important pulse crop with multiple benefits such as high protein content, short duration, soil restoring capacity and can be used as catch crop and livestock feed. One of the main reasons for its low productivity is shattering of the pods before or during the harvesting of the crop in the field. Little efforts have been made to study this trait especially in mungbean. In the present study, two generations [(F_2 2015-16), ($F_{2:3}$ and F_2 2016-17)] derived from the cross Chinamung × Pantmung-2 were studied for pod shattering and yield related traits. Screening of two segregating generations at the Main Agricultural Research Station, Dharwad during summer 2015-16 and 2016-17 indicated significant positive correlation between pod shattering and number of twists per pod and between yield related traits. The high heritability coupled with high genetic advance as per cent mean was observed for pod shattering percentage in both F_2 (2015-16) and F_2 (2016-17). Hence, this trait should be taken into account while selecting superior and desirable plants for further improvement of yield parameters and pod shattering resistance in mungbean.

Key words: Genetic advance, Genetic variability, Heritability, Mungbean

Mungbean is an important self-pollinating pulse crop of South-Eastern Asia and occupies a pivotal position in meeting the protein needs of people in developing countries like India (Wani and Khan, 2006). It is a short duration crop with a ability to restore soil fertility which can be used as a catch crop between *rabi* and *kharif* seasons. Pod shattering (dehiscence), the opening of mature pod along the dorsal or ventral sutures followed by seed dispersal when the crop reaches maturity and during harvesting (Bara *et al.,* 2013) is the major production constraint in mungbean and causes considerable yield losses. Therefore, in this study, an attempt was made to study this trait by evaluating segregating population derived from the susceptible (Chinamung) and resistant (Pantmung-2) genotypes for pod shattering. One hundred and eleven F_2 seeds obtained from the cross between pod shattering susceptible parent Chinamung, a local selection of Karnataka and pod shattering resistant parent Pantmung-2 a mutant of ML-26 (developed at GBPUA & T, Pantnagar) were sown during summer 2015-16. The F_3 seeds derived from these F_2 plants were sown during summer 2016-17. Another set of F_2 (130 seeds) derived from the same cross was also sown during summer 2016-17. The plants were sown with row to row and plant to plant spacing of 30 × 20 cm.

Observations for pod shattering were taken from each individual plants when the plants had attained physiological maturity (when 95 % pods in the plot were matured) (Helms, 1994). Shattering percentage was calculated by recording shattered pods per plant and total number of pods per plant by using the formula described by Khan *et al.* (2013).

$$\text{Pod shattering} = \frac{\text{Shattered pods per plant}}{\text{Total pods per plant}} \times 100$$

Statistical analysis was done on the observations recorded on each individual F_2 plant and average value of each $F_{2:3}$ progeny lines for the traits *viz.*, pod shattering percentage, number of twists per pod, number of clusters of pods per plant, pod length, pod weight, pod thickness and 100 seed weight. The data obtained were subjected to the biometrical analysis that included analysis of variance, heritability and genetic advance in per cent mean. Genotypic variance (Vg), phenotypic variance (Vp), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability (H^2 bs) genetic advance (GA) and genetic advance over mean (GAM) were estimated by the formula suggested by Burton and De Vane, (1953); Johnson *et al.* (1955). The heritability was categorized into different categories as suggested by Robinson *et al.* (1949). Again, genetic advance as per cent mean was classified by adopting the method of Johnson *et al.* (1955).

The components of genetic variation *viz.*, Vp, Vg, PCV, GCV, H^2 bs, GA and GAM for different characters studied in segregating generations [F_2 (2015-16), $F_{2:3}$ (2016-17) and F_2 (2016-17)] are given in Tables 1, 2 and 3. Among all the three segregating populations (F_2 2015-16, $F_{2:3}$ 2016-17 and F_2 2016-17) the magnitude of PCV was higher as compared to GCV for all the characters under study, indicating that the variability was not only due to genotype but also due to influence of environment. Similarly lower magnitude of GCV than PCV for various traits except for pods per plant and seed yield per plant in mungbean was reported earlier (Bainade *et al.,* 2014 and Suresh *et al.,* 2010).

High heritability and high GAM was observed in pod shattering and number of twists per pod in F_2 populations of both the years of study which indicated that these traits are highly heritable and the selection is effective as variation is mainly due to genetic variance. High heritability for pod shattering was also reported in mungbean by Isemura *et al.* (2012). However, decline in heritability and GAM from F_2 to $F_{2:3}$ populations were observed for these traits. Decrease in heritability in next generation was due to decrease in segregation and increase in the homogeneity as reported by

Table 1. The genetic parameters estimated for pod shattering and other yield related traits studied in F_2 during summer 2015-16

Traits	Range		Mean	Ve	Vp	Vg	PCV	GCV	H^2 (bs)	GA	GAM
	Max.	Min.					(%)	(%)	(%)		
Pod shattering											
a. Field	33.3	0.0	1.4	0.4	1.3	0.9	79.9	66.6	69.3	1.7	114.2
b. Incubation at room temperature	80.0	0.0	1.9	1.2	3.5	2.3	98.9	80.4	66.1	2.5	134.7
Number of twists per pod											
a. Field	3.0	0.0	0.4	0.0	0.1	0.1	27.1	25.6	89.2	0.6	49.8
b. Incubation at room temperature	3.0	0.0	0.2	0.0	0.0	0.0	20.0	17.0	72.4	0.3	29.8
Clusters per plant	14.0	1.0	3.9	3.3	1.2	0.1	51.9	23.3	20.2	0.9	21.6
Pod length (cm)	7.3	3.8	6.2	0.7	0.8	0.1	14.3	5.0	12.1	0.2	3.6
Pod weight (g)	0.7	0.1	0.4	0.0	0.0	0.0	33.9	13.3	15.3	0.0	10.7
Pod thickness (mm)	6.2	1.2	5.4	0.4	0.0	0.1	12.3	4.7	14.7	0.2	3.7
100 seed weight (g)	8.2	1.5	5.1	0.6	1.4	0.8	23.4	18.0	59.2	1.4	28.6
Plant height (cm)	68.8	9.8	26.1	23.9	94.0	70.1	37.2	32.1	74.5	14.9	57.2

Table 2. The genetic parameters estimated for pod shattering and other yield related traits studied in F_2: F_3 during summer 2016-17

Traits	Range		Mean	Ve	Vp	Vg	PCV	GCV	H^2 (bs)	GA	GAM
	Max.	Min.					(%)	(%)	(%)		
Pod shattering											
a. Field	25.6	0.0	3.3	0.5	0.7	0.2	52.0	25.1	23.3	0.4	25.0
b. Incubation at room temperature	18.0	0.0	3.5	0.6	0.7	0.2	51.1	23.5	21.2	0.4	22.3
Number of twists per pod											
a. Field	1.0	0.0	0.5	0.0	0.0	0.0	38.8	20.4	27.8	0.1	22.2
b. Incubation at room temperature	1.0	0.0	0.4	0.0	0.0	0.0	51.5	34.3	44.2	0.2	46.9
Clusters per plant	10.2	5.0	6.9	0.5	0.7	0.1	11.8	5.3	20.3	0.3	4.9
Pod length (cm)	6.7	5.5	6.3	0.0	0.0	0.0	2.7	0.8	7.9	0.0	0.4
Pod weight (g)	1.5	0.6	0.9	0.0	0.0	0.0	14.1	5.1	12.8	0.0	3.7
Pod thickness (mm)	9.6	5.3	6.8	0.3	0.4	0.0	9.1	3.0	10.8	0.1	2.0
100 seed weight (g)	5.8	4.0	4.8	0.1	0.1	0.0	5.7	3.1	30.7	0.2	3.6
Plant height (cm)	51.4	27.9	38.0	3.9	10.1	6.2	8.4	6.6	61.3	4.0	10.6

Table 3. The genetic parameters estimated for pod shattering and other yield related traits studied in F_2 during summer 2016-17

Traits	Range		Mean	Ve	Vp	Vg	PCV	GCV	H^2 (bs)	GA	GAM
	Max.	Min.					(%)	(%)	(%)		
Pod shattering											
a. Field	41.7	0.0	2.8	0.5	1.6	1.0	83.2	67.4	65.6	1.7	112.4
b. Incubation at room temperature	60.0	0.0	8.7	0.8	4.1	3.4	86.9	78.2	81.0	3.4	145.1
Number of twists per pod											
a. Field	3.0	0.0	0.2	0.0	0.1	0.0	21.1	14.4	46.7	0.2	20.3
b. Incubation at room temperature	3.0	0.0	0.3	0.0	0.1	0.0	21.3	16.5	59.8	0.3	26.2
Clusters per plant	10.0	1.0	4.7	2.7	2.8	0.1	35.5	5.6	24.5	0.1	1.8
Pod length (cm)	7.3	2.6	6.0	0.5	0.6	0.1	13.2	4.9	13.9	0.2	3.8
Pod weight (g)	0.8	0.1	0.5	0.0	0.0	0.0	28.3	4.6	2.7	0.0	1.6
Pod thickness (mm)	6.1	3.7	4.9	0.2	0.2	0.0	9.0	3.6	16.4	0.2	3.0
100 seed weight (g)	8.3	1.0	5.1	0.1	1.6	1.5	24.9	24.5	96.6	2.5	49.5
Plant height (cm)	52.0	11.0	33.8	26.3	66.1	39.8	24.1	18.7	60.3	10.1	29.9

Ve - Environmental variance, Vp - Phenotypic variance, Vg- Genotypic variance, PCV- Phenotypic covariance, GCV- Genotypic covariance, H^2 (bs) – Heritability (Broad Sense), GA- Genetic advance, GAM – Genetic advance overmean

Wallace *et al.* (1972). Decrease in the heritability from F_2 to F_3 generation was also reported in *faba* bean (Mohamed and Abd-El-Haleem, 2011) and pigeon pea (Ajay *et al.,* 2014). For pod length, heritability and GAM was observed to be low in all three segregating generations (F_2, $F_{2:3}$ and F_2). However, Bains *et al.* (2007) have reported moderate heritability for pod length in mungbean sown during summer/spring. Heritability and GAM for pod thickness were found to be low in all the three segregating generations. For 100 seed weight, moderate heritability and high GAM were observed in F_2 while moderate heritability and low GAM were observed in $F_{2:3}$. However, high heritability and high GAM were observed in F_2 for this trait. Ganguly and Bhat (2012) reported 100 seed weight as a variable character in mungbean.

Conclusion

Phenotypic screening of segregating generations (F_2 2015-16 , $F_{2:3}$ and F_2 2016-17) derived from the cross Chinamung × Pantmung-2 showed significant variation among them for various traits such as pod shattering and number of twists per pod, cluster per plant, pod length, pod weight, pod thickness, 100 seed weight and plant height at field level. The trait pod shattering percentage exhibited high variability coupled with high heritability and high genetic advance as percent of mean in both F_2 (2015-16) and F_2 (2016-17). Therefore, this trait should be taken into account while selecting superior and desirable plants for further improvement of yield parameters and pod shattering resistance in developing high yielding and shattering resistant genotype in mungbean.

References

Ajay, B. C., Byregowda, M., PrashanthBabu, H., Veera, Kumar, G. N. and Reena, M., 2014, Variability and transgressive segregation for yield and yield contributing traits in pigeon pea crosses, *E. J. Plant. Breed.,* 5(4): 786-791.

Bainade, P. S., Manjare, M. R., Deshmukh, S. G. and Kumbhar, S. D., 2014, Genetic analysis in green gram [*Vigna radiata* (L.) Wilczek] subjected to North Carolina Mating Design-I, *The Bioscan.,* 9(2): 875-878.

Bains, T. S., Singh, S., Singh, I. and Gill, R. K., 2007, Breeding for ideal plant type in spring/summer mungbean. *Acta Hort.,* 752: 417-422.

Bara, N., Khare, D. and Srivastava, A. N., 2013, Studies on factor affecting pod shattering in soybean. *Indian J. Genet.,* 73(3): 270-277.

Burton, G. W. and De Vane, E. M., 1953, Estimating heritability in tall fescue (*Festuca circunclinaceae*) from replicated clonal material. *Agron. J.,* 45: 478-481.

Ganguly, P. R. and Bhat, K. V., 2012, Analysis of agronomically important morphological traits diversity in *Vigna radiata, DHR Int. J. Biomed. Life Sci.,* 3(1): 84-91.

Helms, T. C., 1994, Greenhouse and field evaluation of pod dehiscence in soybean, *Canadian J. Pl. Sci.,* 74: 699-701.

Isemura, T., Kaga, A., Tabata, S., Somata, P., Shrinives, P., Shimizu, T., Vaughan, D. A. and Tomooka, N., 2012, Construction of genetic linkage map and genetic analysis of yield related traits in mungbean (*Vigna radiata*). *Plos one,* 7(8): 1-14.

Johnson, H. W., Robison, H. F. and Comstock, R. E., 1955, Genotypic and phenotypic correlation in soybean and their implication in selection. *Agric. J.*, 47: 477-483.

Khan, M. H., Tyagi, S. D. and Dar, Z. A., 2013, Screening of soybean [*Glycine max* (L.) Merr.] genotypes for resistance to rust, yellow mosaic and pod shattering. *Intech.,* 173-184.

Mohamed, G. I. A. and Abd-El-Haleem, 2011, Pedigree selection in two segregating populations of faba bean (*Vicia faba*) I-agro-morphological traits, *World J. Agric. Sc.,* 7(6): 785-791.

Robinson, H. F., Comstock, R. E. and Harvey, P. H., 1949, Estimation of heritability and degree of dominance in corn. *Agric.*, 41: 353-359.

Suresh, S., Jebaraj, S., Hepziba, S. J. and Theradimani, M., 2010, Genetic studies in mungbean [*Vigna radiata* (L.) Wilczek]. *Electronic J. Pl. Breed,* 1(6): 1480-82.

Wallace, D. H., Ozbun, J. L. and Munger, H. M., 1972, Advances in agronomy. American society of agronomy, Academic press, New York.

Wani, M. R. and Khan, S., 2006, Estimates of genetic variability in mutated populations and the scope of selection for yield attributes in *Vigna radiata* (L.) Wilczek. *Egyptian J. Biol.,* 8: 1-6.