Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2400-2403
Received: 14-03-2019
Accepted: 18-04-2019

Shobiya S
Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

K Shoba Thingalmainyan
Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

PR Kamalkumaran
Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

V Thiruvengadam
Department of Plant Genetic Resources, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Correspondence
K Shoba Thingalmainyan
Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Assessment of genetic variability for yield and galactomannan content in M_3 generation of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) cv. MDU 1

Shobiya S, K Shoba Thingalmainyan, PR Kamalkumaran and V Thiruvengadam

Abstract
An attempt for induced mutagenesis was done in Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) cv. MDU 1 using the chemical mutagen EMS to create genetic variability for getting novel trait such as increased galactomannan. The present study revealed high heritability coupled with high genetic advance as percent of mean for plant height, days to first flowering, number of pods per plant, number of seeds per pod, galactomannan and crude fiber content which are controlled by additive genes favoring for selection but pod length, pod girth and seed yield per plant showed greater variability due to the environmental influence and non-additive gene action for these parameters in M_3 generation of cluster bean. Significant correlation was observed between the galactomannan content and other traits facilitating for morphological screening of mutants for this biochemical trait. It is concluded that selection could be done in M_3 generation for forwarding higher galactomannan content to the proceeding generations of M_4, M_5 and M_6 in the breeding programme.

Keywords: cluster bean, induced mutation, EMS, genetic variability, galactomannan

Introduction
Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) is a traditionally grown vegetable as well as fodder crop along the tracts of South India. Recently guar gum is gaining much industrial importance for its unique galactomannan content in Northern parts of India especially in Rajasthan, Haryana, Gujarat, Uttar Pradesh and Madhya Pradesh. Biosynthesis of galactomannan takes place during the seed developmental stages which occupies upto 30% of the endospermic region. The guar gum extracted from the beans is used as natural polysaccharide, viscosity builder in fracking process of petroleum extraction, paper, mining, textile, cosmetics, pharmaceuticals and food industries as thickener and stabilizer (Punia *et al.*, 2009) [21]. Apart from its industrial use, guar gum is also used for pain relieving, to get rid of gastric ulcers, reduced hyperglycemia, hypertension, cholesterol, weight loss and reduced obesity with fulfillment of diet (Sharma *et al.*, 2011) [25]. Despite its importance, breeding technique to enhance any trait in this crop is scarce, because of its small delicate flower structure and self-pollination behavior (Gottschalk, 1971) [6]. To overcome this bottleneck, mutation breeding opens the way for improving our trait of interest. The present investigation deals with screening of cluster beans for higher galactomannan content in M_3 generation.

Materials and Methods
The experiment was conducted at the college orchard, Department of Vegetable crop, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore (Latitude of 11º00' N, Longitude of 77º00'E and an Elevation of 412m above MSL). The seeds of cluster bean cv. MDU 1 were mutagenized using Ethyl Methane Sulfonate (EMS) to raise M_1 and M_2 generations during 2016-17 and 50 best performing mutant lines based on agronomic traits and galactomannan content were taken for the proceeding generation of M_3 in 2018-19. The varietal description of MDU 1 is given in Table 1.

Raising of M_3 progenies
The fifty best performing lines from M_2 generation were selected and sown in the progeny rows of at the spacing of 60x30cm and raised as separate families and selection is done for various quantitative traits like plant height (cm), days to first flowering, pod length (cm), pod width (cm), number of Pods per plant, number of seeds per pod, seed yield (g/plant)

and qualitative characters like galactomannan content (%) based on the principle formulated by Mccleary (1981) in megazyme enzymatic kit and the crude fiber content (%) has been analyzed as per the standard procedure given by Maynard (1970) [17].

Table 1: The salient features of the genotype MDU 1 are furnished below

Particulars	Details
Variety	MDU 1
Parentage	Selection from IC 432117
Year of release	2015
Leaf	Trifoliate
Inflorescence	Axillary raceme
Flower	White to purplish color, small size
Plant height (cm)	100 – 150 cm
Days to 50% flowering	30 - 40th day of sowing
Pod length (cm)	10-13
Seeds per pod	9-12
Maturity duration (days)	90-100
Pod yield	250- 300g/plant
Galactomannan content	28-30%
100 grain weight (g)	4.8
Special Features	Tolerance to powdery mildew

Statistical analysis

The Genetic variability parameters like per se performance, frequency distribution, Genotypic Coefficient of Variation (GCV), Phenotypic Coefficient of Variation (PCV) were estimated according to Burton (1952), heritability h^2 (Lush, 1940), genetic advance (GA), genetic advance as percentage of mean by Johnson *et al.* (1955) [11], correlation between the traits using SPSS software and skewness, kurtosis have been estimated as per the statistical procedure given by Panse and Sukhatme (1967) [19].

Results and Discussion

Genetic variability for yield components in Cluster bean

From the table 2, it was observed that phenotypic co-efficient of variation and genotypic coefficient of variation for plant height were 16.7% and 13.74% respectively. The trait showing higher heritability 67.66% and genetic advance as percent of mean 205.88% indicates the character was governed by additive gene action hence selection would be beneficial for this trait to forward to next generation. This result corroborate with the findings of Gill *et al.* (2000) [5] and Islam *et al.* (1999) [10]. The values of plant height are negatively skewed with platykurtic nature of frequency distribution. This indicates absence of gene interaction for plant height (Kotch *et al.*, 1992) [14].

PCV and GCV for the days to first flowering were 10.43% and 6.08% which shows greater environmental influence in this character. Heritability was moderate 33.92% and genetic advance as percent of mean was high 31.79% indicating the governance of additive gene action favoring selection technique. Flat distribution of values in the curve combined with absence of skewness shows the values are evenly distributed throughout the entire range.

Number of pods ranged from 29 to 75 per plant showing higher variation. Phenotypic and genotypic coefficient of variation were 17.43% and 14.24% respectively with moderate environmental influence. Selection would be a profitable strategy for this trait because of higher heritability and genetic advance as percent of mean 66.78% and 101.53% due to additive gene action in its background. The results were on par with the findings of Ahsan *et al.* (2013) [2], Ali *et al.* (2012) [1], Hussain *et al.* (2013) [8], Ahmad *et al.* (2012) [1]. Moderate skewness is observed towards the positive direction and the curve is platykurtic in nature for this character.

Pod girth ranges from 1.6 to 2.2 cm with the mean value of 1.99 cm expressing the clear variability. The variability traits like PCV, GCV are found to be 8.38% and 4.27% showing moderate heritability about 25.98% with very less genetic advance as percent of mean about 0.14%. This may be due to higher environmental influence and non-additive gene action. The values are skewed towards the negative direction and the curve is highly peaked showing platykurtic nature due to the presence of dominance and dominance based gene action (Roy, 2000) [23].

Length of the pod varies from 8.70 to 12.50 cm with more diversity in its character. Variability parameters like PCV, GCV were estimated about 6.17% and 4.97% with lesser impact of environment. The heritability 64.85% with 2.54% genetic advance as percent of mean which was disagreement with the results of Ali *et al*, (2012a,b) [1], Gul *et al.* (2007) [7] and Venkatesan *et al.* (2005) [29]. This indicates that selection does not favour for this trait due to non- additive gene action and suitable breeding strategies have to be implemented to select this trait effectively. The curve is platykurtic for this morphological character and it is controlled by only fewer genes.

Seeds in each pod varies from 7 to 9 numbers. Phenotypic coefficient of variation was found to be higher than the genotypic coefficient of variation. Moderate heritability 41.75% coupled with high genetic advance as percent of mean 22.49% indicates selection would be rewarding. It coincides with the results of Khan *et al.* (2005) [12], Idress *et al.* (2006) [9] and Singh (2009) [26] who reported higher heritability with higher genetic advance as percent of mean. The values of skewness are almost symmetrically distributed and kurtosis is platykurtic pointing the presence of less variability in this character.

PCV 19.18% was greater than GCV 18.21% with the interference of environment. This result was linear with the recordings of Tabasum *et al.* (2010) [28] in green gram and Rami Reddy *et al.* (2011) [22] in black gram. High heritability 90.15% along with less genetic advance as percent of mean was 5.29% observed for seed yield per plant (g) character. In this case, selection has to be postponed to the future generations agreeing with the observations of Loganatha *et al.* (2001) [15]. Skewness is attributed towards the positive direction and the curve is highly peaked resulting selection would be disadvantageous method for forwarding this character to further generation due to complementary epistatic gene interaction (Snape and Riggs, 1975) [27]. This may be due to negative influence of mutagen over this character (Sambandamurthi, 1983) [24].

Variability studies for biochemical content in cluster bean

Biochemical composition of the cluster bean seeds varies within the range of 20% to 31%. The estimates of PCV and GCV were 8.03% and 5.32% respectively indicating an environmental influence in this trait. Heritability was moderate 43.93% coupling with higher genetic advance as percent of mean 25.14% and selection can be made for this trait rather than other breeding methods. The values of the galactomannan are highly skewed towards positive direction. Kurtosis is highly positively peaked over the normal distribution curve i,e leptokurtic due to cumulative gene action (Kiran, 2012) [13].

The content of crude fiber in the beans valued from 2.23% to 3.57%. PCV was higher than GCV and the heritability was high coupling with greater genetic advance as percent of mean about 22.49%. Hence selection can be adopted to transform this character to future generations. The curve is skewed toward the positive direction. Positive kurtosis is observed for this quantitative character indicating the peaked distribution of values indicating this trait is under the control of cumulative genes (Kiran, 2012) [13].

Correlation studies for yield and biochemical traits in M_3 generation of cluster bean

In this segregating generation of cluster beans, plant height was not correlated with any other traits of cluster bean. Highly significant and positive correlation was observed between pod length and number of pods per plant and also pod length is negatively and significantly correlated with days to first flowering. Seed yield per plant also had a negative correlation with days to first flowering and positive correlation with number of seeds per pod. Seed yield per plant is highly positively correlated with pod yield. Galactomannan and crude fiber are highly positively correlated with number of pods per plant, pod length and seed yield per plant. Crude fiber content of the pod was also in significant positive correlation with galactomannan of the dried seeds. Crude fiber content of the pod was also in significant positive correlation with galactomannan of the dried seeds (Pathak, 2015) [20], since galactomannan is the form of dietary fibre. Hence the plants showing any one of these traits could be selected for next generation.

Conclusion

In the present variability studies, phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the physical as well as biochemical parameters expressing that variation is not purely due to genotype but also the external factors of environment. The traits which are controlled by additive gene action were plant height, days to first flowering, number of pods per plant, number of seeds per pod, galactomannan and crude fiber. The effective selection would give gain to the breeder for these characters. Hence the selection for increased galactomannan content could be done in M_3 generation for transforming the character to following generations of M_4, M_5 and M_6. Pod length, pod girth, seed yield per plant were governed by non- additive gene action in their background. In such case, selection technique has to be postponed to later generations for these characters in the mutant progeny lines.

Acknowledgement

I would like to deliver my gratitude towards my chairperson and members of advisory committee from Department of Vegetable Crops and Department of Plant Genetic Resources for sharing their valuable resources and providing me timely help. I acknowledge the assistance rendered by my seniors and batch mates for their untiring efforts for my research. I would also like show my gratefulness to Tamil Nadu Agricultural University, Coimbatore.

Table 2: Genetic variability parameters for yield and galactomannan content in M_3 generation

Characters	Mean	SD	Range		Co-efficient of variation		Heritability (h^2)	Genetic advance (GA)	GA (% of mean)	Skew ness	Kurto sis
			min	max	PCV (%)	GCV (%)					
Plant height (cm)	77.88	13.01	45.00	112.0	16.70	13.74	67.66	18.13	205.88	-0.36	-0.52
Days to 1st flowering	27.85	2.91	20.00	35.00	10.43	6.08	33.92	2.03	31.79	0.47**	0.02
Number of Pods/plant	44.27	7.71	29.00	75.00	17.43	14.24	66.78	10.61	101.53	0.70**	1.51**
Pod girth (cm)	1.99	0.17	1.60	2.20	8.38	4.27	25.98	0.09	0.14	-0.20	-1.32**
Pod length (cm)	9.46	0.58	8.70	12.50	6.17	4.97	64.85	0.78	2.54	1.84**	6.21**
Number of Seeds/pod	7.87	0.57	7.00	9.00	7.31	4.72	41.75	0.49	22.49	0.00	-0.10
Seed yield/ plant (g)	13.79	2.65	9.20	29.00	19.18	18.21	90.15	4.91	5.29	1.81**	7.15**
Galacto Mannan (%)	24.25	1.95	20.00	31.20	8.03	5.32	43.93	1.76	25.14	1.03**	2.11**
Crude fiber (%)	2.49	0.21	2.23	3.57	8.47	13.38	249.24	1.08	22.49	2.45**	7.75**

Table 3: Correlation studies in M_3 generation of cluster beans:

Characters	Plant height (cm)	Days to 1st flowering	Number of Pods/plant	Pod girth (cm)	Pod length (cm)	Number of Seeds/pod	Seed yield/ plant (g)	Crude fiber (%)	Galacto Mannan (%)
Plant height (cm)	1	.103	.058	-.067	-.002	.046	-.069	-.096	-.047
Days to 1st flowering		1	-.120	-.037	-.154*	-.076	-.131*	-.073	-.110
Number of Pods/plant			1	-.116	.394**	-.108	.685**	.510**	.391**
Pod girth (cm)				1	.039	.010	-.057	.050	.017
Pod length (cm)					1	.010	.457**	.529**	.455**
Number of Seeds/pod						1	.153*	-.083	-.028
Seed yield/ plant (g)							1	.450**	.424**
Crude fiber (%)								1	.514**
Galacto Mannan (%)									1

References

1. Ahmad HM, Ahsan M, Ali Q, Javed I. Genetic variability, heritability and correlation studies of various quantitative traits of mungbean (*Vigna radiate* L.) at different radiation levels. Int. Res. J. Microbiol, 2012; 3:352-362.
2. Ahsan M, Farooq A, Khaliq I, Ali Q, Aslam M. Kashif M. Inheritance of various yield contributing traits in maize (*Zea mays* L.) at low moisture condition. African Journal of Agricultural Research. 2013; 8:413-420.
3. Ali Q, Elahi M, Ahsan M, Tahir MHN, Khaliq I, Kashif M *et al.* Genetic analysis of Morpho-Physiological and quality traits in chickpea genotypes (*Cicer arietinum* L.). African Journal of Agricultural Research. 2012; 7:3403-3412.
4. Burton GW. Quantitative inheritance in grasses. Pro VI Int Grassl Cong, 1952, 277-283.

5. Gill J, Gumber R, Verma M, Pankaj R. Genetic estimates of advanced mungbean lines derived through different selection methods. Crop Improvement, 2000; 27:88-98.
6. Gottschalk W. Problems and results in improvement of grain legumes through mutation breeding. Proc. of Intern. Symposium on Use of Isotopes and Radiation in Agriculture and Animal Husbandry Research. New Delhi, 1971, 116-136.
7. Gul R, Ali S, Khan H, Ali F, Ali I. Variability among mungbean (*Vigna radiata*) genotypes for yield and yield components grown in peshawar valley. Journal of agricultural and biological science, 2007.
8. Hussain B, Khan MA, Ali Q. Shaukat S. Double haploid production in wheat through microspore culture and wheat x maize crossing system: an overview. IJAVMS, 2013; 6:332-344.
9. Idress A, Sadiq M, Hanif M, Abbas G, Haider S. Genetic parameters and path coefficient analysis in mutated generation of mungbean (*Vigna radiata* L. Wilczek). J. Agric. Res, 2006; 44:181-191.
10. Islam M, Haque M, Islam M, Malek M, Hoque M. Genetic Variability, Correlation and Path Analysis in Mungbean (*Vigna radiata* L. Wilezek). Bangladesh Journal of Scientific and Industrial Research. 1999; 34:103-107.
11. Johnson HW, Robinson H, Comstock R. Estimates of genetic and environmental variability in soybeans 1. Agronomy journal, 1955; 47:314-318.
12. Khan MR, Qureshi AS, Hussain SA, Ibrahim M. Genetic variability induced by gamma irradiation and its modulation with gibberellic acid in M~ 2 generation of chickpea (*Cicer arietinum* L.). Pakistan Journal of Botany, 2005; 37:285.
13. Kiran K. Genetic variabilityfor grain yield, its components and inheritance of resistance to BPH in two F2 populations of rice (*Oryza sativa* L.) University of Agricultural Sciences GKVK, Bangalore, 2012.
14. Kotch GP, Ortiz R, Peloquin S. Genetic analysis by use of potato haploid populations. Genome, 1992; 35:103-108.
15. Loganatha K, Saravanan A, Ganesan J. Genetic variability in green gram (*Vigna radiata* L. Wilczek). Res. on Crops, 2001; 2:396-397.
16. Lush JL, Intra-sire correlations or regressions of offspring on dam as a method of estimating heritability of characteristics. Journal of Animal Science, 1940; 1940:293-301.
17. Maynard A. Methods in food analysis. New York: Academic, 1970, 176.
18. Mccleary B. Galactomannan quantitation in guar varieties and seed fractions. Lebensm.-Wiss. Technol, 1981; 14:188-191.
19. Panse V, Sukhatme P. Statistical methods for agricultural workers 2nd edn. *ICAR*, New Delhi, 1967, 381.
20. Pathak R. Clusterbean: Physiology, Genetics and Cultivation, Springer, 2015.
21. Punia A, Arora P, Yadav R, Chaudhury A. Optimization and inference of PCR conditions for genetic variability studies of commercially important cluster bean varieties by RAPD analysis. Asia Pacific J. Mol. Biol. Biotechnol, 2009; 17:33-38.
22. Rami Reddy DK, Venkateswarlu O, Jyothi G, Obaiah M. Genetic parameters and inter-relationship analysis in blackgram [*Vigna mungo.* (L.) Hepper]. Legume Research: An International Journal, 2011, 34.
23. Roy D. Plant breeding: Analysis and exploitation of variation, Alpha Science Int'l Ltd, 2000.
24. Sambandamurthi S. Studies on induceed mutations in tuberose (*Polyanthes tuberosa* L.), 1983.
25. Sharma P, Dubey G, Kaushik S. Chemical and medico-biological profile of *Cyamopsis tetragonoloba* (L) Taub: an overview. Journal of Applied Pharmaceutical Science, 2011; 1:32-37.
26. Singh AK. Induced genetic variability in M3 generation of mungbean. Journal of Food Legumes, 2009; 22:162-165.
27. Snape J, Riggs T. Genetical consequences of single seed descent in the breeding of self-pollinating crops. Heredity, 1975, 35:211.
28. Tabasum A, Saleem M, Aziz I. Genetic variability, trait association and path analysis of yield and yield components in mungbean (*Vigna radiata* (L.) Wilczek). Pak. J. Bot, 2010; 42:3915-3924.
29. Venkatesan N, Thangavel P, Ganesan J. Genetic variability, heritability and genetic advance analysis in segregating generation of blackgram {*Vigna mungo* (L.) hepper}. Legume Research-An International Journal. 2005; 28:49-51.