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Genetic variability study for yield and its components in black gram [*Vigna mungo* (L.) Hepper]

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Abstract
Black gram is an important Indian pulse crop. The analysis of variance revealed significant differences between genotypes indicating presence of sufficient amount of variability in all the thirteen studied characters. The studied materials revealed wide range of variation by virtue of exhibiting highly significant genotypic differences for all the thirteen traits *viz*., days to 50 % flowering, plant height, branches per plant, clusters per plant, pods per plant, seeds per pod, pod length, 100-seed weight, seed yield per plant, days to maturity, straw yield, harvest index, and protein (%). The disease incidence (%) was calculated for YMV incidence. This suggests that there is ample scope to develop seed yielding genotypes with better processing traits. Heritability estimates along with genetic advance are more useful than heritability alone in predicting the resultant effect on selecting best individuals. In present investigation, high heritability with high genetic advance as per cent of mean was recorded for branches per plant, clusters per plant, plant height, seed yield per plant, harvest index and straw yield which indicates the predominance of additive gene action along with lesser influence of environment, thus infers high scope of further improvement through selection for these traits.

Keywords: Sunnhemp, green manuring, variability

Introduction
Black gram [*Vigna mungo* (L.) Hepper], popularly known as urdbean, urid or mash is an important self-pollinating diploid grain legume and belongs to the family Fabaceae. The somatic chromosome number is 2n = 22. The plant has tap root system, provided with nodules. Stem diffusely branched from the base, furrowed with long dense hairs. Leaves are trifoliate, ovate with large petiole, stipules narrow. Inflorescence is an axillary raceme. Flowers are cleistogamous, bisexual, papilionaceous, small, pale yellow, born in clusters of 4-5 on a short hairy penduncles, diadelphous stamens, monocarpellary, unilocular and superior ovary. Pollination takes place before the opening of the flower bud. Pods are short, brown to black in colour and with short hooked beak, containing 5-6 seeds. Seeds are usually black; hilum is white and concave, seedling with epigeal germination.

It is grown mainly in rainy and/or summer seasons. The total area under black gram was 54.39 lakh hectares with 35.62 lakh tonnes of production in India (Anonymous, 2018) [2]. Total black gram occupied an area of 1.37 lakh hectares with 0.98 lakh tonnes production in the state Gujarat (Anonymous, 2018) [2].

The cultivated black gram has low genetic variability and low harvest index and the productivity of black gram has not increased significantly in the last decade (Souframanien and Gopalakrishna, 2006) [27]. The productivity of black gram in Gujarat as well as in India is very low due to various constraints like non-availability of quality seed of high yielding variety, seeds germinate in mature pod itself if there is rains at maturity time of crop and the crop is highly sensitive to high intensity rains etc., all such factors cause heavy losses in terms of yield. Thus, the crop requires due attention to increase its production and productivity.

Moreover Yellow Mosaic Disease (YMD) is a significant biotic stress causing profound yield loss in black gram. Yield losses caused by the disease depend upon the stage at which crop is infected and may vary from 10-100%. YMD intensity of 25% and above influences pod formation and yield in urdbean (Gurha *et al*. 1982) [9].

The knowledge of nature and magnitude of genetic variability for characters of economic importance and cause and effects relationship of yield and yield components for the available genotypes are of utmost importance which helps in planning the future breeding programme for genetic improvement for yield potential of any crop species. The estimates of heritability alone will not be of much value for selection on phenotypic performance. Genotypic coefficient of variation (GCV) along with heritability estimates would provide a better picture of the genetic gain to be expected by phenotypic selection. Hence, it is suggested that genetic gain should be considered in conjunction with heritability.

Heritability along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. The estimates of heritability help the plant breeder in selection of elite genotypes from genetically diverse populations. Genetic advance refers to the improvement in the mean genotypic value of selected individuals over the parental population and it helps in understanding the type of gene action involved in the expression of various polygenic characters. It also helps in deciding a breeding procedure for the genetic improvement of various polygenic traits by determining the gene action.

Materials and methods

The present investigation was carried out using fifty genotypes of black gram. The fifty genotypes were sown in randomized block design at the College Farm, Navsari Agricultural University, Navsari during late kharif 2018. A spacing of 45 cm between rows and 10 cm between plants within the row was maintained. Data was collected from five randomly selected plants tagged from each accession. Analysis of variance was carried out as per standard procedure (Panse and Sukhatme, 1985) [23]. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) (Burton, 1952) [7], heritability (Allard, 1960) [1], genetic advance (Johnson *et al*., 1955) [10], were estimated.

Result and discussion

The present experimental material showed a wide range of variation by virtue of exhibiting highly significant genotypic differences for all the studied thirteen traits *viz*., days to 50 % flowering, plant height, branches per plant, clusters per plant, pods per plant, seeds per pod, pod length, 100-seed weight, seed yield per plant, straw yield, harvest index and protein (%) indicating a considerable amount of genetic variability among the genotypes evaluated. This suggests that there is ample scope to identify high seed yielding genotypes. Wide variability has also been reported by Konda *et al*. (2009) [13], Neelavathi and Govindarasu (2010) [19], Reni *et al*. (2013) [25], Kumar *et al*. (2014a) [15], Kumar *et al*. (2014b) [16], Mandal and Majumder (2014) [18], Panigrahi and Baisakh (2014b) [22], Punia *et al*. (2014) [24], Kumar *et al*. (2015) [14], Gowsalya *et al*. (2016) [8], Jyothsna *et al*. (2016) [11], Bishnoi *et al*. (2017) [6], Kondagari *et al*. (2017) [12], Mahesha and Gabriel (2017) [17], Panda *et al*. (2017) [20], Rolaniya *et al*. (2017) [26], Bana and Devi (2018) [3] and Bandi *et al*. (2018) [4]. The mean, range, genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability and genetic advance as per cent of mean for all the characters are presented in Table 1. All the studied genotypes showed highly significant mean sum of squares indicating that there is generous amount of diversity present among the considered genotypes. Hence, the genotypes can be used for further improvement.

Table 1: Mean, range, variability parameter, heritability and genetic advance for different traits in black gram

Parameters	Mean	Range	σ^2p	σ^2g	σ^2e	GCV%	PCV%	Heritability (%)	Genetic Advance (% Mean)
Days to 50 % flowering	49.03	43.67 -66.00	15.18	13.55	1.63	7.51	7.95	89	14.61
Plant height (cm)	45.73	31.20-79.73	117.66	115.77	1.89	23.53	23.72	98	48.08
Branches per plant	2.86	1.40-3.93	0.36	0.27	0.09	18.18	20.85	76	32.65
Clusters per plant	3.84	1.33-6.77	1.27	1.13	0.14	27.71	29.34	89	53.92
Pods per plant	18.73	5.73-30.67	30.40	27.26	3.13	27.88	29.43	89	54.38
Seeds per pod	6.09	3.67-7.20	0.47	0.21	0.26	7.56	11.22	45	10.48
Pod length (cm)	3.88	3.07-4.63	0.11	0.05	0.06	5.98	8.73	47	8.44
100- seed weight (g)	4.27	3.33-5.07	0.13	0.11	0.02	7.79	8.46	84	14.78
Seed yield per plant (g)	4.03	1.37-6.15	1.32	1.22	0.10	27.37	28.49	92	54.15
Days to maturity	80.31	72.00-95.67	27.09	24.80	2.29	6.20	6.48	92	12.22
Straw yield (g)	7.76	3.39-14.60	7.23	7.15	0.08	34.46	34.65	99	70.59
Harvest index (%)	34.76	25.37-50.29	39.39	35.27	4.12	17.09	18.05	90	33.31
Protein (%)	24.60	19.24-28.50	5.82	5.74	0.07	9.74	9.81	99	19.94

Heritability estimates along with genetic advance are more useful than heritability alone in predicting the resultant effect on selecting best individuals. In present investigation, high heritability coupled with high genetic advance as per cent of mean was recorded for plant height, branches per plant, clusters per plant, pods per plant, seed yield per plant, straw yield and harvest index indicated that these characters were governed by additive gene action. Hence, there are good chances of improvement of these traits through direct phenotypic selection in the present materials. The results are in conformation of results recorded by Konda *et al*. (2009) [13] and Gowsalya *et al*. (2016) [8] for plant height. Neelavathi and Govindarasu (2010) [19] for branches per plant, clusters per plant, pods per plant, seed yield per plant and harvest index. Reni *et al*. (2013) [25] for plant height, pods per plant and seed yield per plant. Kumar *et al*. (2014b) [16] for plant height, branches per plant, clusters per plant, pods per plant, seed yield per plant and harvest index. Panigrahi and Baisakh (2014b) [22] for plant height, branches per plant, clusters per plant and pods per plant. It indicates the predominance of additive gene action and scope of further improvement through phenotypic selection.

Conclusion

In conclusion the analysis of variance revealed significant differences between genotypes indicating presence of sufficient amount of variability in all the studied characters. This suggests that there is ample scope to develop seed yielding genotypes with better processing traits. The value of phenotypic coefficient of variation (PCV) was recorded higher and closer to the respective genotypic coefficient of variation (GCV) for majority of traits under study indicates less influence of environment. The higher magnitude of genotypic coefficient of variation was observed for plant height, clusters per plant, 100-seed weight, seed yield per plant and straw yield indicated the inherent connection between genotypic and phenotypic expression of these traits, hence offers a better opportunity for improvement through selection. The high estimates of heritability coupled with high genetic advance expressed as percentage of mean was observed for branches per plant, clusters per plant, plant height, seed yield per plant, harvest index and straw yield which indicates the predominance of additive gene action along with lesser influence of environment, thus infers high scope of further improvement through selection for these traits.

Application of research: This research is very important as it provides basic information regarding the selection of genotypes for further breeding programme.

Research Category: Basic research of Genetics and Plant Breeding.

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Author agree to submit ethical clearance certificate from the concerned ethical committee or institutional biosafety committee, if the project involves field trails / experiments / exchange of specimens, human & animal materials etc.

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