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Estimation of genetic variability, heritability and genetic advance in mungbean [*Vigna radiata* (L.) Wilczek] in *summer* season under late sown condition

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Abstract
The present investigation entitled "Estimation of genetic variability, heritability and genetic advance in mungbean [*Vigna radiata* (L.) Wilczek] in *summer* season under late sown condition" were undertaken to work out genetic variability, heritability and genetic advance in per cent of mean. These carried out during timely sown condition in *summer* seasons of 2020 at Genetics and Plant Breeding Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya. The experimental materials comprised of 26 genetically diverse varieties/strains and their 88 crosses. The experimental material was evaluated under summer seasons in timely sown condition. The observations were recorded on ten characters. The high estimates of phenotypic and genotypic coefficient of variation (>20%) were found for number of branches per plant, non-reducing sugar, grain yield per plant, harvest index and 100-seeds weight under late sown condition. The characters which exhibited moderate estimates (10-20%) of PCV and GCV were recorded for pod per plant, reducing sugar, seed per pods, TSS, plant height, pod length, biological yield per plant under late sown condition late sown condition. The estimates of heritability in broad sense were high recorded for the all characters and days to maturity moderate in late sown condition. High heritability coupled with high estimate of genetic advance in per cent of mean was not found in late sown condition.

Keywords: Genetic variability, Heritability and Genetic Advance

Introduction
Mungbean [*Vigna radiata* (L.) Wilczek] (2n=22) is an ancient pulse crop widely cultivated in India and there family Leguminaceae, subfamily Papillionaceae; most important pulse crop in India after chickpea and pigeonpea. Mungbean constitute an important ingredient of the vegetarian diet in the Indian sub-continent and play a significant role in Indian farming because of their value in providing quality food to teeming million and restoring soil fertility through biological nitrogen fixation. The major portion is utilized in making dal, curries, soup, sweets and snacks. Moreover, its food values lie in high and easily digestible protein. The grains contain approximately 25-28 per cent protein, 1.0-1.5 per cent oil, 3.5-4.5 per cent fiber, 4.5-5.5 per cent ash and 62-65 per cent carbohydrates on dry weight basis (Bhavani *et al.* 2017) [5]. In India, mungbean is 3rd important crop group, was sown over an area of 4.26 Mha in (*kharif* + *rabi*) and recorded a production of 2.01 Mt at and yield level of 472 kg/ha. There have been the major states of mungbean production like Rajasthan, Madhya Pradesh, Maharashtra, Karnataka, Bihar, Andhra Pradesh, Odisha, Tamil Nadu, Gujarat and Telangana (Min. of Agri. & FW (DAC&FW), GOI, 2017-18) [3]. Pulses share in total food grain production occupy 65 per cent of total gross cropped area comprising cereals in 50% and pulses in about 15%. Within pulses, gram occupies 2% area mung. Other pulses cover about 13% of gross cropped area.

Globally, it has acreage under pulses is about 85.40 (Mha) with production of 87.40 (Mt) at 1023 kg/ha yields level. In India, with >29 Mha pulses cultivation area, is the largest pulse producing country in the world. It ranks first in area and production with 34 per cent and 26 per cent respectively. During 2017-18 the country's productivity at 835 kg/ha, is a significant increase over Eleventh (662 kg/ha) and Twelfth plans (745 kg/ha) (Min. of Agri. & FW (DAC&FW), GOI, 2017-18) [3].

The entire success of plant breeding programme of any crop largely depends on the wide range

of variability present in that crop. It is the range of genetic variability in respect of important economic characters present in the population upon which is based on the effectiveness of selection. Environment has a profound influence upon the economically important characters, which are quantitatively inherited. Hence, it is difficult to decide upon whether the observed variability is heritable or due to environment and it is therefore, necessary to partition the same into its heritable and non-heritable components with suitable parameters like genetic coefficient, heritability estimates and genetic advance. Correlation studies measure only mutual association between two traits and it does not imply the cause and effect of relationship. Path coefficient analysis has been found useful direct and indirect causes of association and allows a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each causal factor (Kumar *et al.*, 2013) [4].

Materials and Methods

The present investigation was carried out at the Genetics and Plant Breeding research form of A.N.D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya. The crosses were made during *summer* in 2019. Further, the germplasm lines, hybrids along with parental lines and check varieties were evaluated during the *summer* in 2020. Geographically, experimental site is located between 24^0 47´ and 26^0 56´ N latitude, 82^0 12´ and 83^0 98´ E longitude and at an altitude of 113 m above mean sea level. This area falls in sub-tropical climatic zone. The soil type is sandy loam. The experimental material comprised 26 diverse genotypes (22 lines and 4 testers) of mungbean obtained from Indian Institute of Pulses Research in Kanpur, (Uttar Pradesh). Quite good number of crosses were attempted to produce sufficient F_1 seed in each cross.

Results and Discussion

The phenotypic, genotypic and environmental coefficients of variability for all the seventeen characters under late sown condition in *summer* season have been given in Table 1. In general, the magnitude of phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the traits in late sown condition.

In *summer* season, the high estimates of phenotypic and genotypic coefficient of variation (>20%) were found for methionine content (30.52), number of branches per plant (29.26), chlorophyll (28.11), non-reducing sugar (26.98), grain yield per plant (23.39), harvest index (21.35) and 100-seeds weight (20.02) under late sown condition. The characters which exhibited moderate estimates (10-20%) of PCV and GCV were recorded for pods per plant (19.34, 19.33), reducing sugar (17.49), seeds per pods (17.49), TSS (17.46), plant height (16.22), pod length (16.11), biological yield per plant (15.94) under late sown condition. Low estimates (< 10%) of PCV and GCV under days to 50% flowering, protein content and days to maturity under late sown condition.

Heritability in broad sense, genetic advance and genetic advance in per cent of mean under both timely and late sown condition in *summer* season were estimated for all the characters are presented in Table 1.

In *summer* season, High estimates of broad sense heritability (> 75%) were recorded for the all characters under late sown condition except days to maturity is moderate in late sown condition (Table 1).

In *summer* season, high genetic advance in per cent of mean (>20%) was recorded for plant height (33.34), number of branches per plant (60.25), pod length (33.18), pods per plant (39.82), chlorophyll (57.89), seeds per pod (36.02), biological yield per plant (32.82), harvest index (43.76), 100-seeds weight (41.22), methionine content (62.79), TSS (35.95), reducing sugar (35.90), non-reducing sugar (55.47) and grain yield per plant (47.98) whereas, days to 50% flowering (14.17) and protein content (15.30) showed moderate estimates of genetic advance in per cent of mean (10-20%) and other showed low estimates of genetic advance in per cent of mean (<10%) under late sown conditions.

In *summer* season, high heritability coupled with high genetic advance in per cent of mean was recorded for plant height, number of branches per plant, pod length (cm), Pods per plant, chlorophyll, seeds per pod, biological yield per plant, harvest index, 100-seeds weight, methionine content in protein, TSS, reducing sugar, non-reducing sugar and grain yield per plant while, high heritability coupled with moderate genetic advance in per cent of mean was recorded for days to 50% flowering and protein content. low heritability coupled with high genetic advance in per cent of mean and low heritability coupled with low genetic advance in per cent of mean were not found for any characters under late sown condition.

Table 1: Estimate of range coefficient of variation (ECV, GCV and PCV), heritability, genetic advance and genetic advance in percent of mean for all characters under summer season late sown condition in mung bean

Characters Parameters	Days to 50% Flowering	Days to Maturity	Plant height (cm)	Number of branches plant	Pod length (cm.)	Pod per plant	Seeds per pod	Biological Yield per plant (g)	Harvest index (%)	100- seed weight (gm.)	Grain yield per Plant (g)
Range	27.30-36.98	67.58-75.34	34.51-72.99	1.66-6.14	2.65-6.80	4.78-28.70	3.98-9.12	21.05-47.17	13.64-36.88	2.04-5.59	3.58-11.28
ECV	0.61	1.388	1.057	0.83	0.47	0.54	0.49	0.44	2.13	0.56	2.21
GCV	6.90	2.36	16.22	29.26	16.11	19.33	17.49	15.94	21.35	20.02	23.39
PCV	6.93	2.73	16.25	29.27	16.12	19.34	17.50	15.94	21.45	20.02	23.50
h^2 (Broad Sense)	99.20	74.30	99.60	99.90	99.90	99.90	99.90	99.90	99.90	99.90	99.10
Genetic Advancement 5%	4.55	2.94	16.84	2.10	1.61	8.22	2.29	10.31	9.46	1.37	3.23
Genetic Advancement 1%	5.83	3.77	21.59	2.69	2.07	10.53	2.93	13.21	12.13	1.76	4.14
Gen. Adv as % of Mean 5%	14.17	4.19	33.34	60.25	33.18	39.82	36.02	32.82	43.76	41.22	47.98
Gen. Adv as % of Mean 1%	18.16	5.37	42.73	77.22	42.52	51.03	46.17	42.06	56.08	52.83	61.48
General Mean	32.09	70.34	50.51	3.49	4.87	20.65	6.36	31.42	21.63	3.33	6.73
Exp Mean next Generation	36.64	73.29	67.36	5.60	6.48	28.87	8.65	41.74	31.10	4.71	9.97

Summery and Conclusion

The present investigation entitled "Estimation of genetic variability, heritability and genetic advance in mungbean [*Vigna radiata* (L.) Wilczek] in summer season under late sown condition" were undertaken to work out genetic variability, heritability and genetic advance in per cent of mean. The high estimates of phenotypic and genotypic coefficient of variation (>20%) were found for methionine content, number of branches per plant, chlorophyll, non-reducing sugar, grain yield per plant, harvest index, 100-seeds weight and protein content under late sown condition. High estimates of broad sense heritability (> 75%) were recorded for the all characters under late sown condition except days to maturity is moderate in late sown condition. High genetic advance in per cent of mean (>20%) was recorded for plant height, number of branches per plant, pod length, pods per plant, chlorophyll, seeds per pod, biological yield per plant, harvest index, 100-seeds weight, methionine content, TSS, reducing sugar, non-reducing sugar and grain yield per plant whereas, days to 50% flowering and protein content. High heritability coupled with high genetic advance in per cent of mean was recorded for days to 50% flowering and protein content. Low heritability coupled with high genetic advance in per cent of mean and low heritability coupled with low genetic advance in per cent of mean were not found for any characters under late sown conditions.

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