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Studies on Variability Parameter and Character Association of Lentil Germplasms in West Bengal Condition

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ABSTRACT

Background: Lentil is the major cultivated pulse crop in the state of West Bengal in terms of total area coverage under cultivation. Selection of high yielding and better quality genotype is the prime vital matter to increase productivity. Investigation and a better understanding of the variability existing in a population base of the crop are pivotal to crop improvement so that the plant breeders can exploit it.

Methods: The current study has been carried out at the experimental farm of the University of Calcutta during 2016-2017 in a plot designed with the randomized block design. It was carried out to estimate the magnitude of genetic variability, heritability and genetic advance of fifty-four lentil germplasms.

Result: Moderate to high heritability, GCV, PCV, GA and GA % of mean was obtained by days to1st flowering, days to 50% flowering, pods per plant and harvest index. The genotypic and phenotypic association of seed yield was significantly positive with traits like plant height, pods/plant, 100 seed weight and harvest index. Characters like days to 50% flowering, plant height, primary branches per plant, pods/plant, pod length, 100 seed weight and harvest index shows a positive direct effect on seed yield in path analysis suggesting select for such traits while exercising selection for seed yield per plant in lentil.

Key words: Correlation, GCV, Lentil, Path analysis, PCV, Variability.

INTRODUCTION

Pulses are the second only to cereals that used to feed the world population, especially in developing countries. Botanically Lentil (*Lens culinaris* ssp. *Culinaris)* is a diploid (2n=2x=14), autogamous species and it is one of amongst oldest cultivated crop in the world, which originated in the Near East or Mediterranean area. Lentil was one of the first domesticated plant species and its remains are as old as that of einkorn, emmer, barley and pea. It is predominantly grown in Asia, which accounts for 80-95% global area and production, respectively. Lentil seeds are relatively higher in protein content (25%), carbohydrates and calories than other legumes. Lentil as legume has a positive impact on soil fertility, like N_2 fixation (Paliya *et al*., 2015).

The lentil or Daal or Masoor dal (*Lens culinaris* Medik) is a bushy annual plant of the legume family, grown for its lens-shaped seeds. With 26% protein, lentils have the third-highest level of protein from any plant-based food after soybeans and hemp and are an essential part of the diet around the world, especially in the Indian subcontinent which has large vegetarian populations. In India, lentil is being grown in 1.56 M ha area with production 1.06 M t and productivity 678 kg/ha. Uttar Pradesh, Madhya Pradesh, Jharkhand, Bihar and West Bengal are the major lentil growing states in India (Pandey *et al*., 2014).

MATERIALS AND METHODS

In this study, fifty-four lentil genotypes were evaluated at Experimental Farm of the University of Calcutta, Baruipur, South 24 Parganas West Bengal during the period of end-October 2016 to end-February 2017. The experiment was carried out in a randomized block design (RBD) using three replications with the experimental plot and cultural practices were performed according to Park (1978). Data were collected from five randomly selected healthy harvested plants in each replication and each genotype. The pre and post-harvesting observations were recorded from five randomly selected plants from each replication on different parameters such as 1st flowering, 50% flowering, plant height, branches/plant, pods/plant, pod length, seeds/pod, 100 seed weight, harvest index, seed yield/plant and these traits were determined according to Moussa *et al.* (2000). Pods of each plant were kept separately in envelop and dried. Path coefficient analysis was done according to Dewey and Lu (1959). Statistical analysis, variability, correlation and path coefficient analysis of yield and yield-attributing traits were calculated using the software SPAR version 2.0.

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RESULTS AND DISCUSSION

Genotypic and phenotypic coefficient of variation, Heritability%, genetic advance and GA% of mean

Among the ten characters, five of them showed significant variation (Table 1). In GCV, PCV and GA the value <10 = Low, 10-20= Moderate and >20 = High in nature. In case of heritability the value >60 = High, 30-59= Moderate and <30= Low (Johnson *et al.,* 1955). According to this scale, the following data were represented.

Traits like pods/plant, 100 seed weight, Harvest index andseed yield/plant showed very high GCV wile pod length shows low GCV and other character shows moderate GCV. High PCV was exhibited by traits like pods/plant, 100 seed weight, Harvest index andseed yield/plant, whereas other character shows moderate PCV (Table 2).

Similarly, very high heritability % was exhibited by traits like 1st flowering, 50% flowering, plant height, pods/plant, seeds/pod and 100 seed weight. On the other hand, moderate heritability % was found in traits like branches/ plant, pod length, harvest index and seed yield/plant. Very high GA was found in traits like pods/ plant while moderate GA was exhibited by 1st flowering and 50% flowering and all other character shows low GA. Traits like pods/plant, seed/ pod, 100 seed weight, harvest index and seed yield showed very high GA% of meanwhile characteristics like pod length showed meagre GA% of mean (Table 2).

Hence from the above study, it can thus be observed that traits like pods/plant, seed yield, 100 seed weight and harvest index showed very high GCV and PCV values. The traits like pods/plant, harvest index and seed yield per plant have a massive difference between its GCV and PCV; thus, it means high environmental factors take place in those characters.

Similar findings for variability were reported by (Reddy *et al.,* 2016) for 50% flowering, (Pandey *et al.,* 2015) for no of pods per plant, seed yield per plant and 100 seed weight, (Gautam *et al.,* 2014) for days to 50% flowering, days to maturity, pods per plant and seed yield per plant, (Singh *et al.,* 2012) for seed yield per plant, 100 seed weight, number of pods per plant, biological yield and harvest index, (Dugassa *et al.,* 2014) for number of pods per plant, (Kanouni 2016) for Seed yield, number of seed per pod and 100 seed weight, (Choudhary *et al.,* 2016) for plant height.

Correlation coefficient analysis

Genotypic correlation

As displayed in (Table 3), it has been observed that seed yield/plant is negatively correlated with 1st flowering and 50% flowering. While significant and positive correlation with seed yield/plant was attained by plant height, pods/plant, pod length, 100 seed weight and harvest index and positive correlation with seed yield/plant is observed in branches/ plant and seeds/pod. Significant correlation with grain yield also attained by Reddy *et al.,* (2017), Omer *et al.,* (2016), Choudhury *et al.,* (2016), Kumar and Srivastava (2015), Mekonnen *et al.,* (2014), Jahani *et al.,* (2014).

Phenotypic correlation

In phenotypic correlation (Table 4) like genotypic correlation, 1st flowering and 50% flowering shows a negative correlation with seed yield/plant. Characters like branches/plant, pod length and seeds per pod show a positive correlation with seed yield/plant, while the significant positive correlation with seed yield/plant was attained by plant height, pods/plant, 100 seed weight and harvest index. Similar findings were reported by Tadesse *et al.,* (2014), Kumar and Solanki (2014), Jeberson *et al.* (2015).

Environmental correlation

In Table 5, the traits like 1st flowering, 50% flowering, plant height, branches/plant, seeds/pod, 100 seed weight show a positive correlation with seed yield/plant while a significant positive correlation with seed yield/plant was attained by characters like pods/plant and harvest index. A negative correlation with seed yield/plant was observed by pod length. Significant correlation with other characters like 1st flowering with 50% flowering and plant height with pods/plant also

Table 1: Mean sum of square of different character.

Source of variance	1st flowering	50% flowering	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	Seed yield/plant
Replication	18.056**	29.784**	56.570**	1.529	508.571**	0.015	0.005	0.017	72.513**	0.024
Variety	223.795**	222.036**	69.615**	0.673	2558.242**	0.018	0.365	0.343	288.838**	0.740
Error	11.766	13.117	9.846	0.144	412.707	0.007	0.001	0.011	63.131	0.175

*, **: Significant at P= 0.05 and 0.01, respectively.

Table 2: GCV, PCV, heritability%, GA and GA% of mean of different character.

Parameters	1st flowering	50% flowering	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	Seed yield/plant
GCV	12.210	11.123	10.400	13.616	36.336	6.262	19.261	27.931	46.367	39.525
PCV	13.187	12.125	12.713	18.349	45.632	10.619	19.302	29.283	62.881	54.944
Heritability %	85.728	84.150	66.925	55.063	63.409	34.774	99.574	90.983	54.374	51.750
GA	14.847	14.466	6.154	0.476	34.932	0.044	0.715	0.623	9.716	0.462
GA% of mean	21.563	19.282	14.338	15.448	47.463	4.483	39.524	52.335	51.936	42.147

Table 3: Genotypic correlation.

Character	1st flowering	50% flowering	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	Seed yield/plant
1st flowering	1.000	0.996**	-0.461	0.161	-0.421	-0.410	-0.107	-0.374	-0.400	-0.548
50% flowering		1.000	-0.369	0.172	-0.417	-0.446	-0.120	-0.352	-0.441	-0.555
Plant height			1.000	0.045	0.487**	0.022	-0.092	0.255	0.040	0.457**
Branches/plant				1.000	0.253	-0.331	-0.162	-0.250	-0.236	0.030
Pods/plant					1.000	0.178	0.123	0.221	0.316*	0.720**
Pod length						1.000	0.371**	0.681**	0.389**	0.535**
Seeds/pod							1.000	0.320*	0.096	0.142
100 seed weight								1.000	0.353*	0.547**
Harvest index									1.000	0.733**
Seed yield/plant										1.000

*, ** Significant at P= 0.05 and P= 0.01, respectively.

Table 4: Phenotypic correlation.

Character	1st flowering	50% flowering	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	Seed yield/plant
1st flowering	1.000	0.957**	-0.382	0.118	-0.305	-0.217	-0.101	-0.318	-0.278	-0.360
50% flowering		1.000	-0.308	0.099	-0.307	-0.229	-0.109	-0.312	-0.266	-0.347
Plant height			1.000	0.057	0.414**	0.009	-0.068	0.181	-0.020	0.332*
Branches/plant				1.000	0.214	-0.102	-0.120	-0.165	-0.150	0.049
Pods/plant					1.000	0.114	0.108	0.185	0.238	0.602**
Pod length						1.000	0.220	0.407**	0.275*	0.225
Seeds/pod							1.000	0.301*	0.073	0.104
100 seed weight								1.000	0.267	0.396**
Harvest index									1.000	0.705**
Seed yield/plant										1.000

*, ** Significant at P= 0.05 and P= 0.01, respectively.

Table 5: Environmental correlation.

Character	1st flowering	50% flowering	Plant height	Branches/ plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index	Seed yield/plant
1st flowering	1.000	0.738**	-0.151	0.028	0.023	0.021	-0.094	0.107	-0.019	0.018
50% flowering		1.000	-0.137	-0.068	-0.011	0.038	0.031	-0.034	0.121	0.070
Plant height			1.000	0.078	0.278*	-0.003	0.201	-0.107	-0.113	0.158
Branches/plant				1.000	0.160	0.079	-0.005	0.060	-0.047	0.070
Pods/plant					1.000	0.063	0.253	0.096	0.128	0.451**
Pod length						1.000	0.024	0.101	0.194	-0.004
Seeds/pod							1.000	-0.170	0.057	0.047
100 seed weight								1.000	0.092	0.097
Harvest index									1.000	0.674**
Seed yield/plant										1.000

*, ** Significant at P= 0.05 and P= 0.01, respectively.

observed. Same things were previously reported by Omer *et al.,* 2016, Choudhury *et al.,* 2016, Pandey *et al.,* 2015, Kumar and Srivastava 2015.

By studying the genotypic, phenotypic and environmental correlation it has been observed that in all the case pods/plant and harvest index were a significantly positive correlation with seed yield, hence the above study those traits can be chosen for the selection of desired genotypes. In the case of genotypic and phenotypic correlation, the traits like Plant height and 100 seed weight have a significant positive correlation with seed yield; thus, those characters are idle to select desired genotypes.

Path coefficient analysis

The residual effect is 0.268 (Table 6) suggests that it is in the range of moderate, which indicates that some more characters contribute to grain yield that needs to be studied.

Table 6: Path coefficient analysis.

	50% flowering	Plant height	Branches plant	Pods/ plant	Pod length	Seeds/ pod	100 seed weight	Harvest index
50% flowering	0.038	-0.090	0.028	-0.143	-0.125	0.004	-0.034	-0.234
Plant height	-0.014	0.243	0.007	0.167	0.006	0.003	0.025	0.021
Branches/plant	0.007	0.011	0.163	0.087	-0.092	0.005	-0.024	-0.125
Pods/plant	-0.016	0.118	0.041	0.342	0.050	-0.004	0.021	0.168
Pod length	-0.017	0.005	-0.054	0.061	0.279	-0.012	0.065	0.207
Seeds/pod	-0.005	-0.022	-0.026	0.042	0.104	-0.032	0.031	0.051
100 seed weight	-0.013	0.062	-0.041	0.076	0.190	-0.010	0.096	0.187
Harvest index	-0.017	0.010	-0.038	0.108	0.109	-0.003	0.034	0.531

The data revealed (Table 6) that 50% flowering (0.038), plant height (0.243), branches/plant (0.163), pods/plant (0.342), pod length (0.279), 100 seed weight (0.096) and harvest index (0.531) have positive direct effect on seed yield per plant which indicates that they are the main contributors to yield. These characters also produce positive effects of different magnitude when the correlations of most characteristics with seed yield. Similar direct and indirect effects were reported by Mekonnen *et al.* (2014), Nath *et al.* (2014), Singh and Srivastava (2013), Nimbalkar *et al.* (2017), Tadesse *et al.* (2016), Rajkumar *et al.* (2014).

By studying the above statement, it can say that the traits 50% flowering, plant height, branches/plant, pods/ plant, pod length, 100 seed weight and harvest index have a positive direct effect on seed yield; thus those traits can be used for selection of desired genotypes.

SUMMARY AND CONCLUSION

This study concerned the mean performance, variability, heritability and character associations and path analysis of different agro-morphological characters of lentil. High heritability was observed in 1st flowering, 50% flowering, plant height, pods/plant, seeds/pod and 100 seed weight while it was moderate for branches/plant, pod length, harvest index and seed yield/plant. GA % of mean was high for pods/plant, seed/pod, 100 seed weight. When the correlation coefficient was considered, it was observed that the pods/plant and harvest index exhibited a significant positive association with seed yield per plant. When interrelationships at the genotypic level were checked pods/ plant was positively, significantly correlated with harvest index. Traits like 50% flowering, plant height, branches/plant, pods/plant, pod length, 100 seed weight and harvest index have a positive direct effect on seed yield per plant.

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