Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 1550-1556

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.910.185

Genetic Variability of Lentil (*Lens culinaris* M.) Genotypes in Acidic Soil of Manipur

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Keywords

Genetic Variability, Heritability, PCV&GCV, Genetic Advance (GA), Lentil

Article Info

Accepted:
12 September 2020
Available Online:
10 October 2020

A B S T R A C T

Yield is the main objective for every plant breeder and the better and stable performance of yield in all environmental conditions is necessary and it can be accessed based on the performance and genetic variability of the varieties. The present investigation was carried out with twenty-one lentil genotypes to study the genetic variability in acidic soils of Manipur for 11 characters during *Rabi,* 2018. The analysis of variance showed significant differences for all the characters under consideration. For all the characters the phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV). All the characters have shown high heritability but high heritability accompanied with high genetic advance was shown by number of seeds per plant, biological yield per plant, seed yield per plant and 100 seed weight indicating the substantial contribution of additive gene action. High heritability with moderate to low genetic advance was recorded for number of pods per plant, plant height, harvest index, number of branches per plant, days to 50% flowering and days to maturity which specify equal influence of additive and non-additive genetic action in the expression.

Introduction

Lentil (*Lens culinaris* Medik.), is bushy, annual, self-pollinated, diploid (2x=2n=14) pulse crop belonging to the genus Lens of the Viceae tribe in the Leguminosae (Fabaceae) family, commonly called as legume family. It is generally grown for its lens shaped seed as rainfed crop during *rabi* season. It is one of the most important grain legume nitrogen fixing crops. According to Ladizinsky (1979) lentil has been originated in Southern Turkey. It is also known as *masura*, which means pillow in Sanskrit. On the basis of seed size, cultivated lentil is divided into two groups i.e. *Lens microsperma* (small seeded) and *Lens macrosperma* (large seeded), two subspecies of cultivated species. It is cultivated in semi-arid regions of the world particularly in the Indian sub- continent and the dry areas of Middle East (Malik, 2005).

Lentil is a major source of protein in diet and is an integral part of daily diet of human beings because of their high protein content and good amino acid balance in several forms worldwide. It is versatile source of nutrients for man, animals and soil. Lentil seeds contain about 28% protein, 59% carbohydrates, 0.5% fat, 2.1% minerals and sufficient number of vitamins, *viz.* vitamin A 16 IU; thiamine 0.23 mg and vitamin C 2.5 mg per gram lentil (Frederick *et al.,* 2006).

There are some Constraints that effect lentil production. They are Terminal Drought, Excess soil moisture and humidity, Temperature, Soil acidity and Uncertainty of rainfall (Singh and Singh 2018). And as we have grown the crop in Manipur valley of India, where 90% of the soil is acidic in nature, we have considered soil acidity as a major constraint and we have done work on it. Soil acidity was a serious constraint to legume introduction into *rabi* season as most pulses are highly sensitive to soil acidity as compared to cereals and other non-pulses crops (Choudhary and Pande, 1986).

In North-Eastern region of India, soil poses a great problem for crop production, particularly in Manipur state where about 90% of soils are acidic.

The soils were found to be of heavy in texture and ranged from clay loam to clay while the pH ranged between 4.86 to 6.19 which were considered as strongly acidic to slightly acidic (Sharma and Indira, 2017).

For the successful breeding programme, the parents should be better and the yield and components effecting yield should have to be better than the existing varieties in the acidic soils of Manipur and the present investigation is done focusing on the performance of the lentil genotypes in the acidic soils of Manipur and their genetic variability in acidic soils and the variability can be assessed based on the genetic parameters and this helped in identifying the better genotypes which can be used in the future breeding programmes according the breeding objective.

Materials and Methods

For the present study, twenty-one lentil genotypes were collected from IARI, New Delhi (Table 1). The genotypes were laid in randomized block design (RBD) with three replications at Andro Research Farm, Central Agricultural University, Imphal during *rabi* 2018-2019. The research farm is located at 24^0 46´ N and 94^0 03´ E. Each plot was sown in 3 rows of 3 m length with a spacing of 22.5cm X 7.5cm between and within rows. All the other recommended package of practices was followed during the crop growth to raise good crop. The genotypes were harvested as and when pods matured. Five plants from each replication were randomly selected for recording observations on various characters such as days to 50% flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, number of seeds per plant, biological yield per plant, seed yield per plant, harvest index, 100 seeds weight, plot yield. The data obtained were subjected to standard statistical procedures.

Results and Discussion

The findings of the present investigation have been interpreted and discussed in this chapter. The present study was carried out to study the genetic architecture and information on different growth, yield and its traits on 21 different genotypes of lentil. Bright knowledge of genetic information with regard to extent of genetic variability for seed yield per plant and its components, helps in understanding the characters influencing the yield (Table 2).

Discussion pertaining to the result of the present study has been shown under the following genetic parameters PCV & GCV, heritability and Genetic Advance.

Table.1 Name of the lentil genotypes utilized in this study and its source

S. No.	GENOTYPES	SOURCE
1.	VL-507	IARI, NEW DELHI
2.	PAL-5	IARI, NEW DELHI
3.	PAL-7	IARI, NEW DELHI
4.	L-4602	IARI, NEW DELHI
5.	PAL-6	IARI, NEW DELHI
6.	PDL-1	IARI, NEW DELHI
7.	HUL-57	IARI, NEW DELHI
8.	KLS-218	IARI, NEW DELHI
9.	DPL-62	IARI, NEW DELHI
10.	WBL-77	IARI, NEW DELHI
11.	VL-126	IARI, NEW DELHI
12.	L-7903	IARI, NEW DELHI
13.	PAL-4	IARI, NEW DELHI
14.	PAL-3	IARI, NEW DELHI
15.	BM-4	IARI, NEW DELHI
16.	L-4147	IARI, NEW DELHI
17.	PDL-5	IARI, NEW DELHI
18.	PAL-1	IARI, NEW DELHI
19.	CH-84-8	IARI, NEW DELHI
20.	L-4076	IARI, NEW DELHI
21.	PAL-8	IARI, NEW DELHI

Table.2 Analysis of variance for 11 different characters in 21 genotypes of lentil

Source of variations	Degrees of freedom	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of seeds per plant	Biological yield (g)	Seed yield per plant (g)	Harvest index (%)	100 seed weight (g)	Plot yield (g)
Replications	2	5.90	5.02	3.24*	1.01	113.89**	148.01	0.01	0.07	168.78*	0.01	1172.75
Genotypes	20	29.24**	70.43**	25.31**	1.37**	101.38**	990.01**	1.32**	0.50**	126.74**	1.63**	11641.40**
Error	40	1.90	1.77	0.76	0.50	15.64	123.12	0.06	0.04	37.45	0.10	475.12
CV (%)	-	1.95	1.15	3.25	14.95	11.02	17.89	10.78	15.52	10.77	10.24	14.98

1% Level of significance
5% Level of significance

Table.3 Genetic variability parameters for 11 different traits in 21 lentil genotypes

S.No.	Characters	Mean	Minimum	Maximum	GCV	PCV	Heritability (h^2bs)	Genetic advance	GA (%)
1	**Days to fifty percent flowering**	70.71	64.67	77.00	4.27	4.69	90.95	5.66	8.00
2	**Days to maturity**	115.41	105.67	127.33	4.15	4.30	96.35	9.50	8.23
3	**Plant height**	26.83	22.94	30.97	10.66	11.15	95.65	5.64	21.01
4	**Number of branches per plant**	4.73	3.47	6.40	11.40	18.80	60.64	0.67	14.24
5	**Number of pods per plant**	35.89	24.53	47.07	14.89	18.53	80.39	8.85	24.67
6	**Number of seeds per plant**	62.02	24.53	94.13	27.41	32.73	83.74	29.32	47.28
7	**Biological yield**	2.32	1.62	3.89	27.96	29.96	93.31	1.25	53.74
8	**Seed yield per plant**	1.32	0.67	2.46	29.63	33.45	88.59	0.71	54.07
9	**Harvest index**	56.84	41.33	64.23	9.60	14.42	66.55	7.48	13.16
10	**100 seed weight**	3.14	1.89	4.44	22.70	24.90	91.16	1.34	42.62
11	**Plot yield**	145.56	74.01	347.02	41.91	44.51	94.17	118.35	81.31

GCV- Genotypic Coefficient of Variation, PCV- Phenotypic Coefficient of Variation, h^2bs- Heritability in Broad Sense and GA (%)- Genetic Advance in percent of mean

The values of phenotypic coefficient of variation were higher than that of the genotypic coefficient of variation for all the character. Maximum PCV was (44.51) recorded for plot yield followed by seed yield per plant (33.45), number of seeds per plant (32.73), biological yield per plant (29.96), 100 seed weight (24.90), number of branches per plant (18.80), number of pods per plant (18.53), harvest index (14.42), plant height (11.15), days to 50% flowering (4.69) and days to maturity (4.30) (Table 3). Maximum GCV was (41.91) recorded for plot yield followed by seed yield per plant (29.63), biological yield per plant (27.96), number of seeds per plant (27.41), 100 seed weight (22.70), number of pods per plant (14.89), number of branches per plant(11.40), plant height (10.66), harvest index (9.60), days to 50% flowering (4.27) and days to maturity (4.15) (Table 3). Phenotypic coefficient of variation was observed to be higher than the genotypic coefficient variation for all the traits under study. It indicates the influence of environment in the expression of traits.

Similar result was given by Singh *et al.,* (2008), Kumar *et al.,* (2008), Reddy (2013), Pandey *et al.,* (2015). Characters *viz.,* days to 50% flowering and days to maturity showed low magnitude of GCV and PCV. Similar results were obtained by Rathi *et al.,* (2002). Number of branches per plant, number of pods per plant and plant height showed moderate magnitude on GCV and PCV. Whereas, the maximum GCV and PCV recorded for plot yield followed by seed yield per plant and biological yield per plant, number of seeds per plant and 100 seed weight. Thus, among the traits studied, these are the most variable one. Similar result was reported by Tyagi and Khan *et al.,* (2011). Some amount of variation present in between PCV and GCV such as number of pods per plant, number of seeds per plant, number of branches per plant, seed yield per plant and harvest index which are probably due to higher influences of environmental factors on the expression of these traits. Similar result was observed by Firas and Aysh (2014).

Heritability (broad sense) estimates were high for all the traits under study (Table 3) except number of branches per plant which has shown moderate heritability. The heritability ranged from 60.64 to 96.35. Among the eleven characters studied, heritability of days to maturity showed the highest value (96.35), followed by plant height (95.65), plot yield (94.17), biological yield per plant (93.31), 100 seed weight (91.16), days to 50% flowering (90.95), seed yield per plant (88.59), number of seeds per plant (83.74), number of pods per plant (80.39), harvest index (66.55) and number of branches (60.64) per plant showed the least values (Table 3).

Genetic advance (GA) was found highest for plot yield followed by number of seeds per plant and days to maturity. Whereas, high genetic advance over its mean was recorded for plot yield (81.31) followed by seed yield per plant (54.07), biological yield per plant (53.74), number of seeds per plant (47.28), and 100 seed weight (42.62). The estimates of genetic advance expressed as percentage of mean were presented in Table 3. Moderate genetic advance over its mean was recorded for the characters number of pods per plant (24.67), plant height (21.01), number of branches per plant (14.24) and harvest index (13.16). For days to maturity (8.23) and days to 50% flowering (8.00) very low value was recorded.

The proportion of genetic variability which is transmitted from parents to progeny is explained by heritability. Burton (1952) suggested that the genetic variation along with the heritability will give better idea about expected efficiency of selection. Heritability estimates along with genetic advance are more helpful in predicting the gain under selection (Johnson *et al.,* 1955). In the present study, all the characters under study like days to 50% flowering, days to maturity, number of branches per plant, number of pods per plant, number of seeds per plant, biological yield per plant, seed yield per plant and 100 seed weight and plant height and harvesting index have shown high heritability, similar results was seen in the following findings viz., Younis *et al.,* (2008), Rasheed *et al.,* (2008), Singh *et al.,* (2008) and Pandey *et al.,* (2015). The character number of branches per plant has shown moderate heritability, which is shown by Pandey *et al.,* (2015), Rasheed *et al.,* (2008).The highest genetic advance was shown by the characters number of seeds per plant, biological yield per plant, seed yield per plant, 100 seed weight and the plot yield, and the same results have been shown by Rajput and Sarwar (1989).

The high heritability coupled with high genetic advance was recorded for number of seeds per plant, biological yield per plant, seed yield per plant and 100 seed weight indicating the substantial contribution of additive gene action (Panse, 1957). On these traits direct selection may improve yield. Similar result was found by Rajput and Sarwar (1989), Rasheed *et al.,* (2008), Singh *et al.,* (2008), Younis *et al.,* (2008), Abdipur *et al.,* (2011), Pandey *et al.,* (2015).High heritability with moderate to low genetic advance was recorded for number of pods per plant, plant height, harvest index, number of branches per plant, days to 50% flowering and days to maturity which specify equal influence of additive and non-additive genetic action in the expression. Similar tendency was reported by Chakraborty and Haque (2000), Singh *et al.,* (2006), Reddy (2013).High estimates of heritability coupled with high genetic advance and high GCV were observed for number of seeds per plant 100 seed weight and seed yield per plant indicating that selection in such traits might be effective, and the same results were also shown by Mandal *et al.,* (2014), Pandey *et al.,* (2015) and Reddy (2013).Days to 50% flowering and days to maturity manifested high heritability coupled with low GCV and genetic gain indicating requirement selections for several successive generations for their improvement, this result was also obtained by Reddy (2013).

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How to cite this article:

Sardesh Rana, G., Ph. Ranjit Sharma, Kh. Pramesh, Bireswar Sinha and Gopimohan Singh, N. 2020. Genetic Variability of Lentil (*Lens culinaris* M.) Genotypes in Acidic Soil of Manipur. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 1550-1556. doi: https://doi.org/10.20546/ijcmas.2020.910.185