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Heritability of yield and its attributing traits in lentil (*Lens culinaris* Medic).

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Abstract
Thirty lentil (*Lens culinaris* Medik.) genotypes were grown at the experimental farm of C.S.A.U.A. & T, Kanpur. A wide range of gross variation exist in character like number of pods per plant, followed by days to flowering, days to maturity, plant height, while comparatively a narrow range of gross variation was seen in number of seeds per pod followed by 100-grain weight, grain yield per plant and number of fruiting branches. Phenotypic coefficients of variation (PCV) were slightly higher than the corresponding genotypic coefficient of variation (GCV) for all traits studied. The broad sense heritability was estimated for number of fruiting branches, 100 grain weight, plant height, grain yield per plant, number of pods per plant, number of seeds per pod, days to flowering and days to maturity. In present investigation, it was found to have a very high value for heritability (88.5) with a very high value of genetic advance as percent of mean (36.89) indicating that if selection is made directly for number of fruiting branches, it may be rewarding. The lowest heritability was observed in days to maturity (30.10%); indicating that this trait is depends heavily on the variation available in the source material and of the effects of climate and weather.

Keywords: Heritability, lentil, yield, genetic advance, variability

Introduction

Lentil or Masur is one of the old Pulse crops, which provides a valuable and easily digestible protein (20.08-22.80). Lentil is known by different names in various countries such as Lentil (French), Lenteja (Spanish), ados (Arabic), mereimek (Turkish), hiramame (japanise), and Masur (Hindi). It belongs to the family Leguminosae. Globally Lentil share only 5% of the total area under pulses it occupies 3.765 million ha area and 3.165 million tones production annually with productivity of 852 kg/ha (2002-03). It is predominantly grown in Asia which accounts for 80% of the global area and 75% of the world production. Highest productivity (2111kg/ha) has been reported from Australia followed by Canada (1265kg/ha), China, Syria, Turkey, Spain and Bangladesh (825kg/ha). In India Lentil is the second most winter pulse crop under which area, production and productivity is 1.32 million ha, 0.88million tonnes and 663kg/ha (2002-2003). The total production could be enhanced either by making horizontal expansion in area, which is not possible owing to high population growth, so none of the option left other than vertical expansion, which could be done opting a suitable breeding method. Information on the nature and degree of genetic divergence would help the plant breeder in choosing the right parents for breeding programme. Since the crop is quite hardy and can withstand drought, it is an ideal crop for rainfed area and is suited for multiple and relay cropping system. A wide range of variability is present in microsperma and macrosperma types of in the rest part of state due to lack of desirable genotypes lentil breeding worked has been done for genetic improvement. Grain yield in crop plant quite complex inheritance and it determined by a number of its components. In obtaining of clear picture of each component characters in building of the total genetic architecture of grain yield, it become necessary to discernment them and studied their estimate the nature and degree of genetic divergence of lentil. Recognizing the importance of genetic variability in plant breeding experiments, the main objective of present research work was to assess the genetic variability for yield and yield contributing character.

Materials and Methods

The study was carried out in a complete randomized block design with three replications at the experimental farm of C.S.A.U.A. & T, Kanpur during Rabi 2003-04. with 30 lentil genotypes (K75, L4076, DPL 62, HUL 63, VL 508, PL 014, L4621, IPL 307, LL 933, LL 864, IPL 308, VL 509, PL 02, L4620, L 4652, IPL 408, L 4651, IPL 407, KLB 144, KLB 151, KLB 131, KLB 106, KLB 86-1, KLB 141, KLB 97-3, KLB 97-5, KLB 97-6, KLB-148, KLB 221-1). Each plot consisted six rows of 3 meter length. The distance between and within row was kept 30 cm and 10 cm respectively, standard agronomic package and practices were adopted to rise the good crop. The data were recorded on five randomly selected plants for eight quantitative characters viz., number of fruiting branches, 100 grain weight, plant height, grain yield per plant, number of pods per plant, number of seeds per pod, days to flowering and days to maturity. In the present investigation three types of coefficient of variations were estimated viz., phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and error/environmental coefficient of variation (ECV). The formulae used to calculate PCV, GCV and ECV were given by Burton, 1952. Heritability was calculated by the formula given by Lush, 1949 and Burton and Devane, 1953 while the estimates of genetic advance were obtained by the formula given by Lush, 1949 and Johnson *et al.*, 1955.

Results and Discussion

A reasonable amount of differences among thirty genotypes of lentil were observed for all the traits under study except, number of seeds per pod, 100 grain weight and grain yield per plant as evident from the table 1; indicating the presence of sufficient variability among the experimental materials. On the basis of result obtained, it may be concluded that grain yield per plant, number of fruiting branches, 100-grain weight and number of pods per plant in lentil content good amount of genetic variability and can be effectively utilized in selecting the superior genotype. The minimum variation recorded for number of seeds per pod was reported by El-Attar (1991) [5] and Chakraborty and Haque (2000) [2].

The mean performance of the genotypes for all the eight characters is presented in table 2. The results showed that the plant height ranged from 33.60 to 47.73 cm having the general mean 40.41 (cm); it showed that all the genotypes are not having the tall stature; some of them are of medium stature. The variety KLB151 attained the maximum height while HUL63 was found to be the shortest one. The days to flowering ranged from 55.60 to 75.89 comprising the general mean of 65.54 days indicating that majority of genotypes in experiment are delayed in days to flowering. The variety IPL 308 was found to be early while the variety KLB 86-6 took maximum time for its flowering. The days to maturity found to be ranged from 120.19 to 137.30 days comprising the general mean 129.21 days; suggesting that most of the genotypes belong to late maturity group. The early maturing variety was IPL308 than DPL 62. The number of fruiting branches ranged from 4.52 to 16.80 per plant with a general mean of 12.17 ; suggesting that very few genotypes are closer to the lowest range of the traits. The lowest number of fruiting branches was found in variety LL933 and the maximum number of fruiting branches in variety KLB 131. The number of pods per plant ranged from 67.20 to 115.60 having the general mean of 94.40; suggesting that the maximum genotypes are closer to more number of pods per plant. The lowest number of pods per plant was found in variety LL 933, and the highest was found in KLB-131. The number of seeds per pod ranged from 1.30 to 2.0 comprising the general mean of 1.67. The number of seeds per pod was highest in variety KLB97-5 and lowest in variety KLB131. 100 grain weight ranged from 2.30 gram to 3.90 gram comprising the general mean 2.89 gram; suggesting that most of the genotypes belong to higher yielding group. The grain yield per plant ranged from 3.46 to 5.61 g. The highest grain yield was shown by the variety HUL 63, while variety KLB 148 showed the lowest grain yield. A wide range of gross variation exist in character like number of pods per plant, followed by days to flowering, days to maturity, plant height, while comparatively a narrow range of gross variation was seen in number of seeds per pod followed by 100-grain weight, grain yield per plant and number of fruiting branches. The variety K 75 was found desirable for days to flower while strain KLB 151 found desirable for early maturity. The variety KLB 131 found desirable for maximum number of fruiting branches and number of pods per plant but number of seeds per pod is minimum. The variety HUL 63 was found desirable for grain yield per plant while variety KLB 97-5 found desirable in 100-grain weight. These results are in agreement with those of Rao *et al.* (1995) [9] and *Singh et al.* (1999) [11]. They also reported high estimates of variability for number of pods per plant and 100-grain weight and moderate to high variability for number of branches, pods per plant and grain yield per plant in Lentil. The magnitude of phenotypic variation in a character, however, does not reveal the relative amount of heritability (genetic) and non-heritable (environment) component of variation. It also does not allow a decision as to which character is showing the highest degree of inherent potential of variability. This can be done only by standardizing the phenotypic and genotypic variances and this effect has been made in the present case by calculating the coefficients of variability which are given in Table 3.The maximum value of genetic coefficient of variability was observed for number of fruiting branches (19.06%), followed by 100 grain weight (13.92 g), grain yield per plant (11.37 g), number of pods per plant (11.22), plant height (9.04), days to flowering (8.20), and number of seeds per pod (7.67). The lowest value of genotypic coefficient of variation was observed for days to maturity (2.56). The highest phenotypic coefficient of variation was recorded for number of fruiting branches (22.26), followed by 100 grain weight (15.37), number of pods per plant and grain yield per plant (12.90), plant height (10.11 cm), days to flowering (9.80), number of seeds per pod (8.97). The lowest phenotypic coefficient of variation was observed for days to maturity (4.66). The effectiveness of selection for any character depends not only on the amount of variability present but also on the extent to which it is transferred from parent to the offspring. Heritability, which denotes the proportion of phenotypic variance that is due to genotypic variance and is transmissible from parent to offspring is infect, on index for selection of a character or the characters. By studying the heritability, the value of the characters can be assessed for formulating a breeding programme. A greater advance under selection is achieved when the characters under selection are highly heritable and stable. Therefore, the characters with high heritable value are, much important to a plant breeder than those which are less heritable and more susceptible to the environmental factors. The heritability estimates along with genetic advance is a more reliable guide for making selection because heritability alone does not provide ample evidence regarding the amount of genetic progress which could be possible through selection. Genetic advance itself is not an independently but it has an added advantage over heritability as it denotes the amount of improvement in the character through selection.

The highest value of heritability were observed for number of fruiting branches (88.5%) followed by 100 grain weight (82.0%), plant height (79.90%), grain yield per plant (77.7%), number of pods per plant (75.50%), number of seeds per pod (73.50%) days to flowering (70.10%). There are several reports of high heritability value for seed yield in lentil (Dixit and Dubey, 1985; Hamdi *et al*., 1991 and Tambal *et al*., 2000). Chauhan and Singh (1998) [3] reported that the highest broad-sense heritability was noted for seed yield per plant and number of pods per plant. Bicer and Sakar (2010) [1] reported high broad sense heritability in plant height.The lowest heritability was observed in days to maturity (30.10%). The high value of genetic advance in percent of mean were recorded for number of fruiting branches (36.89), followed by 100 grain weight (25.95), grain yield per plant (20.57), number of pods per plant (20.11), plant height (16.62), days to flowering (14.14), number of seeds per pod (13.11). The lowest value of genetic advance in percent was found for days to maturity (2.88). The results are in agreement with Singh *et al.* (2005) [12]. The genotypic coefficient of variation, in general is less than the phenotypic coefficient of variation. The variability due to genotypic coefficient of variation point out that there is a large scope for selection. As such the characters like number of fruiting branches, 100-grain weight, grain yield per plant and number of pods per plant are genetically potent for the purpose of selection. On the other hand, those characters which had lowest amount of genetic variability with a high range of gross variation may perhaps be due to the environmental effect on these characters and they show a high range of gross variation but low genetic variability. Phenotypic coefficient of variation (PCV) was slightly higher in magnitude than the genotypic coefficient of variation (GCV) for all the characters indicates the influence of environmental factors on these traits. All the traits exhibited high heritability in broad sense except days to maturity. Since all the traits were comprising the low to high genetic advance as percent of mean coupled with the high heritability; suggesting that there is a preponderance of additive gene action for the traits number of fruiting branches, 100 grain weight, grain yield per plant and number of pod per plant which exhibiting high genetic advance as percent of mean. This type of characters could be improved by mass selection and other breeding methods based on progeny testing.

While the lowest genetic advance as percent of mean coupled with high heritability was observed for days to maturity and number of seeds per pod which is indicative of non-additive gene action in their inheritance. Therefore heterosis breeding could be used to improve these traits. The high heritability is being exhibited due to favorable influence of environment rather than genotype and selection for such traits may not be rewarding. These results are in agreement to the finding of Kumar and Dubey (2001) [8], Rathi *et al*. (2002) [10], Hamid *et al*. (2003) [7] and Tyagi and Khan (2011) [14].

An interesting point was noted that grain yield, which is supposed to be a complex character was much influenced by environmental fluctuations and selection made for seed yield alone may not give any fruitful result. In present investigation, it was found to have a very high value for heritability (88.5) with a very high value of genetic advance as percent of mean (36.89) indicating that if selection is made directly for number of fruiting branches, it may be rewarding.

It is discussed on many occasions that the heritability of a given character varies from population to population, crop to crop, cross to cross, location to location and year to year. Therefore, much reliance cannot be laid on the numerical value of heritability as a rational generalization.

Table 1: Analysis of variance for eight quantitative characters of 30 lentil genotype.

S No.	Characters	Mean sum squares			
		Replication (df=02)	Treatment (df=29)	Error (df=58)	F (cal.) treatment
1.	Plant Height (cm)	1.19	43.38**	3.36	12.89
2.	Days to Flowering	131.10**	99.05**	12.33	8.03
3.	Days to Maturity	183.43**	58.12**	25.36	2.29
4.	No. of fruiting branches	14.45**	16.84**	0.70	24.05
5.	No of pods/plant	61.75**	372.76**	36.03	10.34
6.	No. of seeds/pod	0.01	0.05	0.005	0.09
7.	100 grain weight (g)	0.10	0.52	0.03	14.71
8.	Grain Yield/Plant (g)	0.11	0.86	0.075	11.46

** indicate significance at 1% level of significant. * indicate significance at 5% level of significant**.**

Table 2: Mean values of thirty genotypes for ten quantitative characters with range, standard error and critical differences in lentil

Sr. No.	Genotype	Plant Height (cm)	Days to Flowering	Days to Maturity	No. of fruiting branches	No of pods/plant	No. of seeds/pod	100 grain weight (g)	Grain Yield/Plant (g)
1	K75	38.33	72.47	135.74	9.73	80.00	1.60	3.30	4.22
2	L4076	35.97	70.53	130.05	9.92	93.30	1.70	2.40	3.80
3	DPL62	40.00	64.53	137.30	11.05	102.00	1.50	2.47	3.82
4	HUL63	33.60	68.60	134.29	9.98	103.13	1.70	3.20	5.61
5	VL508	41.13	58.23	125.44	9.48	85.20	1.80	2.80	4.29
6	PL014	36.57	61.53	121.71	8.92	80.39	1.60	3.50	4.53
7	L4621	35.73	66.50	134.27	9.53	100.80	1.73	3.00	5.14
8	IPL307	37.00	71.52	124.29	11.48	92.30	1.77	2.60	4.35
9	LL933	37.80	62.30	134.09	4.52	67.20	1.70	3.20	4.74
10	LL864	37.00	64.20	130.79	9.80	105.40	1.60	2.70	4.55
11	IPL308	39.53	55.60	120.19	9.23	85.50	1.80	2.80	4.30

12	VL509	35.27	60.38	122.70	10.92	103.20	1.70	2.40	4.21
13	PL02	42.93	65.47	128.55	13.67	100.70	1.60	2.50	4.51
14	L4620	39.67	62.28	128.62	13.47	110.10	1.60	2.80	4.93
15	L4652	41.47	63.53	129.55	14.53	93.50	1.70	3.00	4.76
16	IPL408	42.08	60.20	131.27	12.47	85.20	1.60	3.90	5.31
17	L4651	34.47	62.31	128.14	15.69	107.30	1.70	2.80	4.79
18	IPL407	45.73	65.23	130.36	14.23	110.10	1.70	2.30	4.30
19	KLB86-6	42.87	75.89	129.20	10.60	95.75	1.80	2.77	4.82
20	KLB144	40.47	70.62	130.58	15.99	94.50	1.50	2.60	3.68
21	KLB151	47.73	60.47	120.72	12.83	80.80	1.82	2.87	4.07
22	KLB131	37.73	63.97	130.43	16.80	115.60	1.30	3.10	4.92
23	KLB106	45.40	65.37	128.51	14.93	100.40	1.50	3.70	4.06
24	KLB86-1	45.40	67.50	132.63	11.33	70.00	1.80	3.30	4.15
25	KLB141	41.07	70.60	131.54	12.62	90.40	1.57	3.62	4.96
26	KLB97-3	45.80	60.40	125.53	14.67	85.90	1.70	3.80	5.52
27	KLB97-5	42.53	65.00	128.32	13.53	90.30	2.00	2.63	4.15
28	KLB97-6	43.33	66.43	129.00	15.46	110.20	1.70	2.60	5.24
29	KLB148	44.93	72.13	135.33	10.03	80.10	1.60	2.70	3.46
30	KLB221-1	40.87	62.69	125.39	12.20	93.17	1.90	2.60	4.47
Mean		40.41	65.54	129.21	12.17	94.40	1.67	2.89	4.52
Range	Max	47.73	85.89	137.30	16.80	115.60	1.90	3.80	5.61
	Min	33.60	55.60	120.92	9.23	67.20	1.30	2.30	3.46
S.E.		0.14	0.26	0.41	0.68	0.49	0.63	0.15	0.22
C.D.		0.290	0.572	0.822	1.366	0.98	1.262	0.308	0.448

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