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Genetic variability analysis for quantitative traits in lentil [*Lens culinaris* (L.)]

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Abstract: Wide range of variation in mean performance of genotypes was observed for all the characters under study. The comparison of mean performance of 96 entries for 11 characters using least significant differences revealed existence of very high level of variability in the evaluated germplasm of collections. The genotypes exhibiting highest mean performance for different characters were identified such as L 7911, L-2161/05, L7434, L-1197/05, L-1224/05, L7464, L2189/05, L7902, ILL9986, L-1787/05, L 7907, L-1815/05, L-7819, L-1194/05, for seed yield per plant. The high magnitude of PCV along with GCV was observed for harvest index, seed yield per plant, number of pods per plant, biological yield, number of secondary branches per plant and 100 seed weight; moderate estimate of PCV along with GCV were recorded for number of primary branches per plant, number of secondary branches per plant and plant height.

Key words: Genetic variability, quantitative traits, Lentil

Introduction

Lentil is considered to one of the ancient crops of world agriculture as evident from its occurrence in archeological excavations. It's probable progenitor is *L. orientalis* with Mediterranean region as the centre of genetic diversity (Zohari, 1973; Ladizinsky, 1979). Its cultivation started in the Neolithic farming about 7000-8000 years B.C. Lentil is proposed to be originated in Eastern Mediterranean region, such as Asia Minor, Greece and Egypt, from where it diffused eastwards to India. Endowed with several unique characteristics, it founds an important place in farming system by small and marginal land holders in a number of developing countries, In India, it is grown in about 1.42 m ha with total production 1.13 mt, and productivity 797 Kg/ha (2012-13). Uttar Pradesh occupies 0.459 m ha area with 0.441 tonnes production and productivity 891kg/ha. (2012-13). Lentil seeds contain protein concentration ranging from 22-34.6 per cent and 100g dried seeds contain 340-346 kcal, 20.2g protein, 0.6g fat, 65.0g total carbohydrates, about 4g fiber, 2.1g ash, 68mg Ca, 325mg P, 7.0mg Fe, 29mg Na, 780mg K, 0.46mg thiamine, 0.33mg riboflavin and 1.3mg niacin (Muehlbauer *et al.*, 1985; Adsule *et al.*, 1989). It also contains some anti-nutritional factors, such as, trypsin inhibitors, hemagglutinins and oligosaccharides that cause flatulence. These problems can be greatly reduced by heating and sprouting (Jambunathan *et al., 1994*). Three top ranking countries, viz., India, Canada and Turkey increased their productivity and production. Although area in Turkey has gone down in recent years, lentil area has increased greatly in India, Canada, Australia and Ethiopia. However, area expansion has mostly increased in the developed world, most particularly in Canada and USA, compared to the traditional lentil growing countries.

Materials and Methods

The materials for present investigation comprised of 96 lentil germplasm lines along with four standard checks namely NDL-1, NDL-2, Precoze, and DPL-62 which were evaluated in an Augmented Block Design, having 8 blocks and 16 plots in each block. Each plot consisted of single row of three meter length, the inter and intra-row spacing was 30 cm and 5 cm, respectively. The experiment was conducted at Genetics and Plant Breeding Research Farm Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during *Rabi,* 2011-12. The characters studied were days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, 100-seed weight (g), biological yield per plant (g), seed yield per plant (g) and harvest index (%).

Results and Discussion

The analysis of variance for the Augmented Design, accommodating 96 lentil germplasm accessions and the four checks replicated in eight blocks, was done for eleven characters. The mean squares due to blocks, checks, and error for all the characters are presented in table-1.The mean squares due to blocks was significant for plant height, 100 seed weight and biological yield per plant at 5% probability level. However, it was non-significant for remaining all the characters under study. A variation due to checks was significant for all the characters under study at 1% and 5% probability level expect 100 seed weight.

The days to 50% flowering ranged from 74 days (ET-123485) to 83 days (L-7921) with general mean of 79.732 days. Out of 96 genotypes 9 genotypes presented in top non significant group for early flowering L-7434, L-1836/05, I1833/05, L-7913, ILL-4401, ET-122451, L-7464, and ET-123485.The general mean for days to maturity was 111 days however, it ranged from 98 (ILL-6994) to 131days (L-1357/05). Out of 96 genotypes top non significant group L-2142/05, L-7902 and, ILL-10133 statistically at par with L-1357/05. Minimum days to maturity were recorded in L-1836/05 followed by L-1823/05, ILL-10835 and ILL10833. The highest and lowest mean performance for plant height was recorded by ILL-4605(43.69 cm) and ET-122451 (16.3cm) respectively. Maximum plant height was recorded in L-1357/05 fallowed by ILL-10233, L-7902, ILL-10236 and ILL-10133. The entries L-1823/05 and L- 1836/05 were statistically at par with ET-122451 which has shortest plant height among the 96 genotypes evaluated. Highest number of primary branches per plant was exhibited by ILL-4401(5.90) where as L-7919-1-A possessed minimum number of primary branches per plant (1.55); out of 96 genotypes, genotypes L-7902, L-338/05, L-7763, and ILL-4401 at par with L-7919-1-A for primary branches per plant. These line having maximum number of primary branches per plant. The genotype L-7921 (13.50) possessed highest number of secondary branches with the lowest mean performance for this character was shown by ET-122451 (1.88). Ten entries out of 96 genotypes were statistical at par with L-7921 producing higher secondary branches per plant. Highest numbers of pods per plant was observed in genotype L-1815/05(158.984) while the lowest number of pods per plant was recorded

Table-1: Analysis of variance of augmented design for 11 characters in lentil genotypes

Characters	Sources of variation		
	Blocks	Checks	Error
Degree of freedom	7	3	21
Days to 50% flowering	3.054	6.375*	1.542
Days to maturity	4.104	66.448**	11.38
Plant height (cm)	7.203*	10.363*	2.11
No. of primary branches plant^{-1}	0.114	0.641*	0.103
No. of secondary branches plant^{-1}	0.435	1.221**	0.180
No. of pods plant^{-1}	126.079	522.169**	78.41
No. of seeds pod^{-1}	0.180	0.422*	0.14
100-seed weight (g)	0.023*	0.055	0.009
Biological yield plant^{-1} (g)	26.465*	14.27 **	5.8
Harvest index (%)	119.22	251.06*	76.39
Seed yield plant^{-1} (g)	1.766	5.738**	1.03

Table-2: Range, mean, coefficient of variation (C.V.) (%) and least significant differences for eleven characters of lentil germplasms

Characters	Range	Mean	Coefficient of variation (%)		Coefficient of	Range of parameters			
	(Min-Max)	value	PCV (%)	GCV (%)	variation (%)	LSD_1 5%	LSD_2 5%	LSD_3 5%	LSD_4 5%
Days to 50% flowering	74-83	79.73	1.825	0.953	2.103	1.291	3.65	4.08	3.06
Days to maturity	98-131	111.02	5.652	4.761	6.173	3.51	9.92	11.09	8.32
Plant height (cm)	16.29-43.7	28.266	17.367	16.563	21.385	1.51	4.3	4.77	3.6
No. of primary branches plant^{-1}	1.55-5.9	3.645	19.874	17.837	21.338	0.33	0.94	1.06	0.79
No. of secondary branches plant^{-1}	1.88-13.5	8.437	23.652	23.097	27.454	0.44	1.25	1.4	1.05
No. of pods plant^{-1}	35-158.98	80.215	32.768	30.743	36.564	9.21	26.04	29.12	21.84
No. of seeds pod^{-1}	0.69-2.36	1.802	18.664	-8.455	20.554	0.38	1.08	1.21	0.91
100-seed weight (g)	1.30-3.43	1.927	20.873	20.289	22.86	0.1	0.28	0.31	0.23
Biological yield plant^{-1}(g)	2.58-17.18	10.217	28.156	15.578	28.686	2.50	7.08	7.92	5.94
Harvest index (%)	6.48-56.38	30.218	39.570	26.584	38.892	9.9	25.70	28.79	21.55
Seed yield plant^{-1}(g)	0.88-5.69	2.749	36.180	-9.225	43.163	1.1	2.99	3.34	2.51

LSD_1 = Differences between adjusted yield of two genotypes in the same block; LSD_2 = Differences between two check means; LSD_3 = Differences between adjusted yield of two genotypes in different block; LSD_4 = Differences between adjusted yield of genotype and check mean; PCV = Phenotypic coefficient of variation; GCV = Genotypic coefficient of variation

Table-3: Most desirable lentil genotypes identified for 11 characters

Characters	Genotypes
Days to 50% flowering	ET-123623, ILL-10655, ET-122675, ILL-10835, ILL6994, NDL-1, L-7434, L-1833/05, L-1836/05, L-7913
Days to maturity	ILL-10002, ET-122675,L-711,L-7763,L-7720,L-7740
Plant height (cm)	ILL-4605, L-1357/05, NDL-1, NDL-2, DPL-62, ILL-10233
No. of primary branches plant^{-1}	ILL-4401, L-7763, L-338/05, L-7902,L-7740, L-2136/05, L-1197/05, L-1214/05, L-1224/05,L-7923,L-2160/05,L-2189/05
No. of secondary branches plant^{-1}	L-7921, L-7902, L-7763, ILL10236, L-7740, L-7907, L-238/05, ILL-10158,L-7902, L-2160/05, ILL-10133, NDL-1, ILL-4401, L-2189/05
Number of pods plant^{-1}	L-1815/05, L-1194/05, ILL-10253, Precoze, L-7923, DPL-62, L-7902, ILL-10233, L-2161/05, NDL-2, L-7921, NDL-1, ILL-10659
No. of seeds pod^{-1}	L-7434, L-7464, L-2166/05, L-1836/05, L-338/05, L-2189/05, L-2160/05, NDL-2, L-7923, L-7920, ILL-10112
100-seed weight (g) plant^{-1} (g)	L-7819, L-7919-1, L-1815/05, ILL-10253, L-7502, L-7920, ILL-10133, L-7901, ILL-9981, L-1194/05, L-1224/05, ILL-4401, ILL-10829, ILL-10749
Biological yield	L-1836/05, L-1833/05, ILL-7537, L-1815/05, ILL-8076, ILL-7219, L-7434, ILL-7713, L-2189/05, ILL-9981, ILL-7199, L-7917, L-1194/05L-7919
Harvest index (%)	L-7908, ILL-10253, L-7906, L-7938, L-7740, ILL-10158, L-7913, ILL-9979, ILL-1752/05, NDL-2,L-1729/05,L-1820/05,L-7911
Seed yield plant^{-1} (g)	L-7911, L-2161/05, L-7434, L-1197/05, L-1224/05, L-7464, L-2189/05, L-7902, ILL-9986, L-1787/05, L-7907, L-1815/05, L-7819, L-1194/05

in L-2160/05 (34.96). The top three non significant group of best line for number of pods per plant *viz.,* L-1815/05, L-1194/05 and ILL-10253 which were statistical superior to the other entries for this trait. Highest number of seeds per pod was observed in case L-7434 (2.36) while the lowest value was recorded in L-1194/05 (0.69) , in the top non significant group of higher seeds per pod were L-1836/05, L-2160/05, L-2166/05, L-2189/05, L-338/05, L-7434, and L-7464. Highest and lowest mean value for biological yield was recorded in L-1836/05(17.18 g) and lowest L-7908 (2.578 g) respectively. Best seven lines for biological yield were L-1833/05, ILL-7537, L-1815/05, ILL-8076, ILL-7215, L-7434 and ILL-7713. The highest seed yield per plant (5.690g) was observed by L-7911 while lowest seed yield per plant was found in ILL-10833(0.885g). The most promising lines for this character in order to merit were L-2161/05, L-7434, L-1197/05 and L-1229/05. Highest harvest index was exhibited by L-7908 (56.38) while the ILL-7713 (6.48) showed lowest harvest index; the best line for this character were ILL 10253, L-7906 and L-7763. The 100 seed weight varied from 3.434 g (L-7819) to 1.31g (ILL-9942). The most promising lines for this character in order of merit were L-7919-1, L-1815/05, ILL-10283, and L-7902. Genotypes ILL-9974, L-1833/05, ILL-10834, L-1823/05, ET-122657, L-7919, ILL-9979, L-7908, and ILL-10833 were present in non significant group of lowest 100 seed weight. Among the evaluated germplasm /genotypes, the most desirable genotypes were ET-123623, ILL-10655, ET-122675, ILL-10835, ILL6994, NDL-1, L-7434, L-1833/05, L-1836/05 and L-7913. for early flowering ; ILL-10002, ET-122675, L-711, L-7763, L-7720 and L-7740.for early maturity; ILL-4605, L-1357/05, NDL-1, NDL-2, DPL-62 and ILL-10233, for tall stature and short stature for plant height; ILL-4401, L-7763, L-338/05, L-7902, L-7740, L-2136/05, L-1197/05, L-1214/05, L-1224/05, L-7923, L-2160/05 and L-2189/05 for primary branches per plant ; L-7921, L-7902, L-7763, ILL10236, L-7740, L-7907, L-238/05, ILL-10158, L-7902, L-2160/05, ILL-10133, NDL-1, ILL-4401 and L-2189/05 for number of secondary branches per plant; L-1815/05, L-1194/05, ILL-10253, Precoze, L-7923, DPL-62, L-7902, ILL-10233, L-2161/05, NDL-2, L-7921, NDL-1 and ILL-10659 for number pods per plant ; L-7434, L-7464, L-2166/05, L-1836/05, L-338/05, L-2189/05, L-2160/05, NDL-2, L-7923, L-7920 and ILL-10112 for number of seeds per pods ; L-7819, L-7919-1, L-1815/05, ILL-10253, L-7502, L-7920, ILL-10133, L-7901, ILL-9981, L-1194/05, L-1224/05, ILL-4401, ILL-10829 and ILL-10749 for 100 seed weight (g); L-1836/05, L-1833/05, ILL-7537, L-1815/05, ILL-8076, ILL-7219, L-7434, ILL-7713, L-2189/05, ILL-9981, ILL-7199, L-7917, L-1194/05 and L-7919 for biological yield per plant; L-7908, ILL-10253, L-7906, L-7938, L-7740, ILL-10158, L-7913, ILL-9979, ILL-1752/05, NDL-2, L-1729/05, L-1820/05 and L-7911 for harvest index (%); The genotype showing very high performance in desirable direction for various character listed in table-3 can serve as suitable donors for improving the characters for which they had high mean performance (Anwar and Bhatt, 1986; Bicer and Sakar, 2004; Chakraborty and Haque, 2000; Joshi *et al.,* 2005).

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