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Research Article

Genetic variability studies in lentil (*Lens culinaris* Medic.) genotypes for seed yield and attributes

P. B. Vanave*, A. H. Jadhav, A.V.Mane, S. G. Mahadik, M. G. Palshetkar and S. G. Bhave
Department of Agril. Botany, College of Agriculture,
Dr.BalasahebSawantKonkanKrishiVidyapeeth, Dapoli - 415 712, Dist. Ratnagiri (MS)
***E-Mail**:pbvanave@gmail.com

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Abstract
An experiment was conducted with thirty five genotypes in *rabi* season of 2016-17.A wide range of variation exhibited for yield and yield attributing traits among the progenies under study. In general PCV was higher in magnitude than GCV. The analysis of variance revealed significant variation among the genotypes for all the characters studied. The estimates of mean sum of squares showed comparatively wide range of variation for the characters number of pods per plant, harvest index (%) and days to maturity while, the lowest variation was recorded for number of primary branches per plant. Highest PCV (50.66 %) and GCV (44.76 %) was recorded by seed yield per plant. Appreciable heritability values were observed for different characters under study. Highest heritability estimates were recorded for the number of seeds per pod (98.81), hundred seed weight(95.57), Harvest index (84.43) and number of pods per plant (84.38). The lowest heritability estimate recorded in number of primary branches per plant and plant height.

Keywords
Lentil , variability, GCV, PCV, heritability,.

Introduction

Lentil (*Lens culinaris* Medic.) (2n=14), is one of the important and most nutritious *Rabi* pulse crop. It has the potential to cover the risk of rainfed farming. It is also used as a cover crop to check the soil erosion in problem areas. The plants are ploughed back into the soil as green manure also. It is mostly eaten as 'dal'. The whole grain is also used in some of the dishes. It is rich in calcium (56 mg/100 gm seeds), iron (7.54 mg/100 gm seeds), and niacin (2.65 mg/100 gm seeds) (Lentil-wikipedia). It has the lowest content of lectins and trypsin inhibitors among legumes. Since, it is a leguminous crop; it improves the fertility of soil by biological nitrogen fixation. Lentil seeds also provide a source of starch for textiles and printing.

India is one of the major lentil growing countries of the world after Canada in production. In India, lentil occupied 1.59 million hectares area with 0.95 million tonnes production and productivity of 633 kilogram per hectare (FAO Stat., 2016). In the year 2015-16, area occupied under lentil in Uttar Pradesh was 6.08 lakh hectares and production 58.92 tonnes with the productivity 715 kilograms per hectare followed by Madhya Pradesh having area 5.64 lakh hectares and production 38.96 tonnes with productivity 508 kilograms per hectare. While, in Maharashtra occupied an area of 35 thousand hectares and production 14 thousand tonnes with productivity 453 kg per hectare (Anonymous, 2016).

Materials and Methods

The present investigation was carried out at Research and Education Farm, College of Agriculture, Dapoli, Dist. Ratnagiri during *Rabi* 2016-17. The material for the present study comprised of thirty five genotypes of lentil collected from Indian Institute of Pulses Research, Kanpur.The experiment was conducted in Randomized Block Design with three replications. The plot size was four rows of 2 m length. The seeds of lentil were dibbled at 30 cm distance between rows to rows and 20 cm between plant to plant in a row. The recommended fertilizer dose applied @ 25 kg N: 50 kg P_2O_5: 50 kg K_2O per hectare. The operation, like thinning was done within 10 days after sowing so as to maintain one plant per hill. Other cultural practices were carried out as per the standard recommendations. The simple correlation coefficients and path analysis between yield and yield components were estimated as per the standard procedure. Analysis of variance was performed following the standard procedure given by Panse and Sukhatme (1967).The phenotypic and genotypic coefficients of variation (PCV, GCV) were computed as per method described by Burton and Devane (1953). Heritabilityinbroadsenseestimatedforvariouscharacterbytheformulae suggested by Lush (1949) and genetic advance was calculated in percent by the formula suggested by Johnson *et al.*(1955).

Results and Discussion

The mean sums of square due to genotypes were found significant for all the eleven quantitative characters under study. Significant variation was observed among the genotypes for all the traits under study. The genotypic and error mean sum of squares were further used for analysis of genotypic and phenotypic variances (Tabel.1)

The amount of genetic variation present in all genotypes was worked out in terms of the genotypic coefficient of variation. The highest genotypic coefficient of variation was noticed by seed yield (44.76 %), followed by harvest index (42.53 %) while lowest GCV was exhibited by days to maturity (2.32 %), followed by plant height (3.39 %). The remaining characters showed genotypic coefficient of variation as, number of seeds pod (32.91 %), number of pods per plant (30.60 %), hundred seed weight (25.23 %), straw yield per plant (19.78 %), number of primary branches per plant (5.49 %), days to 50 per cent flowering (3.72 %), days to initiation of flowering (3.51 %).

The estimates of genetic parameters are given in Table 3, phenotypic coefficients of variation were greater in magnitude over the respective genotypic coefficient of variation. The character, seed yield per plant exhibited highest phenotypic coefficient of variation (50.66 %), followed by harvest index (46.29 %), number of pods per plant (33.32 %) and number of seeds per pod (33.11 %). The remaining characters had phenotypic coefficient variation at the tune of 25.81 per cent for hundred seed weight, 22.65 per cent for straw yield per plant, 9.64 per cent for number of primary branches per plant, 5.49 per cent for plant height, 4.91 per cent for days to 50 per cent flowering, 4.63 per cent for days to initiation of flowering and 2.92 per cent for days to maturity.. The highest genotypic coefficient of variability was recorded for seed yield (42.53%) and harvest index (44.76%) that indicates the presence of exploitable genetic variability for these traits and there is scope for improvement. (Table 3) Similar results were found by Joshi *et al.* (2005) and Singh *et al.* (2009).

Mean performance of various genotypes exhibited wide range of variation for most of the traits studied (Table 2). But some traits *viz*; number of pods per plant (18.46 to 72.66) and harvest index (6.83 to 39.49) exerted more variation. Out of 35 genotypes, G-31 recorded highest seed yield per plant due to more number of pods per plant, number of primary branches per plant hundred seed weight (Table 2)

Heritability in broad sense was ranged between 32.35 to 98.81 per cent. High heritability values were computed for number of seeds per pod (98.81%) followed by 100 seed weight (95.57%), harvest index (84.43%) and number of pods per plant (84.38%). Moderate heritability estimates were recorded in seed yield per plant (78.08 %) followed by straw yield per plant (76.28%) and days to maturity (63.03%). These results are in agreement with Younis *et al.* (2008) and Pandey *et al.* (2015) in lentil.

The genetic advance was ranged from 0.26 to 21.99. The higher estimates of genetic advance (GA) were recorded in number of pods per plant (21.99) followed by harvest index (14.90), whereas lowest estimates of genetic advance were recorded in number of primary branches per plant (0.26) followed by number of seeds per pod (0.82). The range of genetic advance as percentage of mean was found 3.79 to 81.57 per cent. The highest value was observed in seed yield per plant (81.57 %) followed by harvest index (80.51%), number of seeds per pod (67.40%), while the low value in days to maturity (3.79%) followed by plant height (4.32%). Similar results were also reported by Tyagi and Khan (2010).

The analysis of variance revealed significant variation among the genotypes for all the characters studied. In general, phenotypic coefficient of variation was higher in magnitude over the respective genotypic coefficient of variation for all the characters. High heritability coupled with higher genetic advance as per cent of mean was observed for plant height, number of peduncles per plant, number of pods per plant, 100 seed weight and seed yield per plant thus indicating the role of additive gene action in the expression of these characters and can be improved by selection.

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Table 1. Analysis of variance for the different characters studied in lentil

Sr. No.	Characters	Mean sum of squares			'P' value
		Replications	Genotypes	Error	
	Degrees of freedom	(2)	(34)	(68)	
1.	Days to initiation of flowering	3.54	15.90**	3.15	0.001
2.	Days to 50 per cent flowering	1.23	22.18**	4.38	0.001
3.	Days to maturity	1.98	26.44**	4.32	0.001
4.	Plant height (cm)	5.23	8.73**	3.06	0.002
5.	Number of primary branches per plant	0.18	0.24**	0.10	0.000
6.	Number of pods per plant	46.23	430.07**	25.00	0.009
7.	Number of seeds per pod	0.01	0.48**	0.01	0.000
8.	Hundred seed weight (g)	0.03	1.24**	0.02	0.000
9.	Straw yield per plant (g)	0.26	4.60**	0.43	0.000
10.	Harvest index (%)	10.80	197.18**	11.41	0.005
11.	seed yield per plant (g)	0.15	0.80**	0.07	0.000

P= 0.01 significant value

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Table 2 . Mean performance for different quantitative characters in lentil.

Sr. No.	Genotypes	Days to initiation of flowering	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of pods/ plant	Number of seeds / pod	100 seed weight (g)	Straw yield / plant (g)	Harvest index (%)	Seed yield / plant (g)
1	G1	58	66	117	39	3.66	31.46	1.00	2.70	6.60	13.18	0.89
2	G2	57	62	120	36	3.46	36.86	1.20	1.76	4.53	22.41	0.84
3	G3	62	69	121	40	3.86	40.53	1.00	2.04	5.56	19.88	1.10
4	G4	57	64	115	41	3.93	42.33	1.00	2.28	6.76	18.80	1.27
5	G5	62	70	120	42	4.46	51.33	1.00	2.06	5.53	36.02	2.00
6	G6	58	63	119	39	3.66	36.03	1.13	2.80	4.26	27.24	1.18
7	G7	59	66	117	40	3.46	28.60	1.00	2.46	7.10	12.34	0.84
8	G8	57	64	118	42	4.06	58.63	1.00	2.56	6.41	22.46	1.44
9	G9	55	62	111	41	3.80	51.00	1.00	2.96	8.31	20.16	1.68
10	G10	59	65	117	43	4.46	54.40	1.26	2.00	7.36	23.38	1.71
11	G11	60	67	120	42	3.93	37.66	1.00	3.27	5.03	32.32	1.62
12	G12	60	65	114	42	3.66	48.26	1.00	3.24	4.16	39.49	1.66
13	G13	64	71	122	39	3.86	38.93	1.00	2.92	4.90	17.39	0.97
14	G14	59	67	114	37	4.00	38.00	1.00	2.99	6.16	16.35	1.00
15	G15	61	66	118	38	4.13	25.00	1.00	3.69	7.40	7.39	0.54
16	G16	55	62	111	40	4.00	32.06	1.00	2.12	7.46	6.83	0.51
17	G17	58	64	119	42	4.40	37.06	2.00	1.82	6.56	21.62	1.42
18	G18	60	65	120	41	3.86	29.06	2.00	1.85	5.26	14.76	0.78
19	G19	59	65	119	45	4.53	53.93	1.00	3.45	7.93	25.63	2.03
20	G20	58	64	116	41	3.86	27.86	1.00	3.14	7.33	10.22	0.74
21	G21	53	60	113	41	4.20	27.53	1.00	3.26	5.80	12.96	0.74
22	G22	58	67	120	38	3.66	36.66	2.00	1.57	7.40	9.29	0.69
23	G23	60	66	120	41	4.13	30.13	2.00	1.91	4.33	11.45	0.49
24	G24	54	60	114	43	4.00	56.13	1.00	2.83	6.50	23.05	1.49
25	G25	59	66	113	41	4.00	46.46	1.00	2.22	5.03	17.63	0.91
26	G26	59	64	118	42	4.06	27.93	2.00	1.17	4.55	9.87	0.83
27	G27	58	64	117	40	4.40	21.53	1.00	2.31	4.80	9.32	0.42
28	G28	59	69	118	40	3.80	37.73	1.00	3.25	6.23	17.84	1.12
29	G29	60	69	121	41	4.13	18.46	1.00	3.10	4.20	11.26	0.47
30	G30	59	67	119	40	3.73	25.53	1.00	2.71	5.16	12.12	0.62
31	G31	58	65	115	41	4.60	72.66	1.00	2.46	8.06	32.73	2.69
32	G32	63	71	122	40	3.93	32.46	2.00	1.79	5.90	16.93	1.00
33	G33	59	65	116	39	4.13	39.53	1.00	3.68	6.26	20.76	1.30
34	G34	61	67	116	41	3.93	31.86	1.00	2.36	5.30	13.11	0.70
35	G35	56	64	116	40	4.00	25.06	2.00	1.76	4.33	21.21	0.91
General mean		59	65	117	41	3.99	37.96	1.21	2.53	5.95	18.50	1.10
Range	Min	53	60	111	36	3.46	18.46	1.00	1.17	4.16	6.83	0.42
	Max	64	71	122	45	4.60	72.66	2.00	3.69	8.31	39.49	2.69
	S.E. ±	1.02	1.20	1.20	1.01	0.18	2.88	0.02	0.07	0.37	1.95	0.15
	C.D. at 5 %	2.89	3.40	3.39	2.85	0.51	8.14	0.07	0.22	1.07	5.50	0.42
	C.V. %	3.02	3.19	1.78	4.31	7.93	13.17	3.60	5.43	11.03	18.26	23.71

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Table 3. Estimates of genetic parameters for various characters in lentil

Sr. No	Characters	PCV (%)	GCV (%)	H^2bs (%)	GA	GAM (%)
1	Days to initiation of flowering	4.63	3.51	57.43	3.22	5.48
2	Days to 50 % flowering	4.91	3.72	57.56	3.81	5.82
3	Days to maturity	2.92	2.32	63.03	4.44	3.79
4	Plant height (cm)	5.49	3.39	38.20	1.75	4.32
5	Number of primary branches per plant	9.64	5.49	32.35	0.26	6.43
6	Number of pods per plant	33.32	30.60	84.38	21.99	57.91
7	Number of seeds per pod	33.11	32.91	98.81	0.82	67.40
8	Hundred seed weight (g)	25.81	25.23	95.57	1.29	50.81
9	Straw yield per plant (g)	22.65	19.78	76.28	2.12	35.60
10	Harvest index (%)	46.29	42.53	84.43	14.90	80.51
11	Seed yield per plant (g)	50.66	44.76	78.08	0.90	81.57

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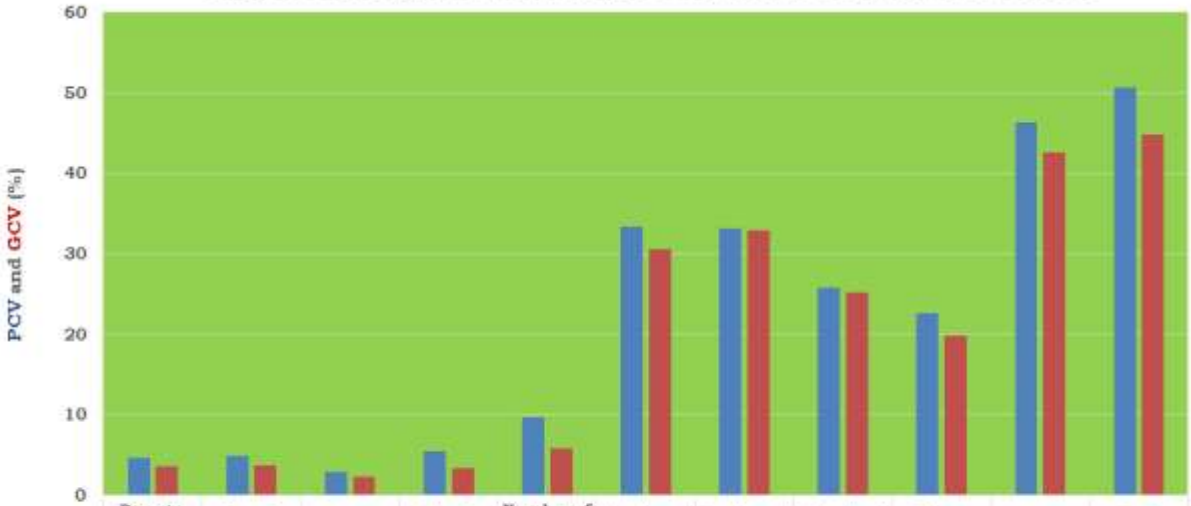
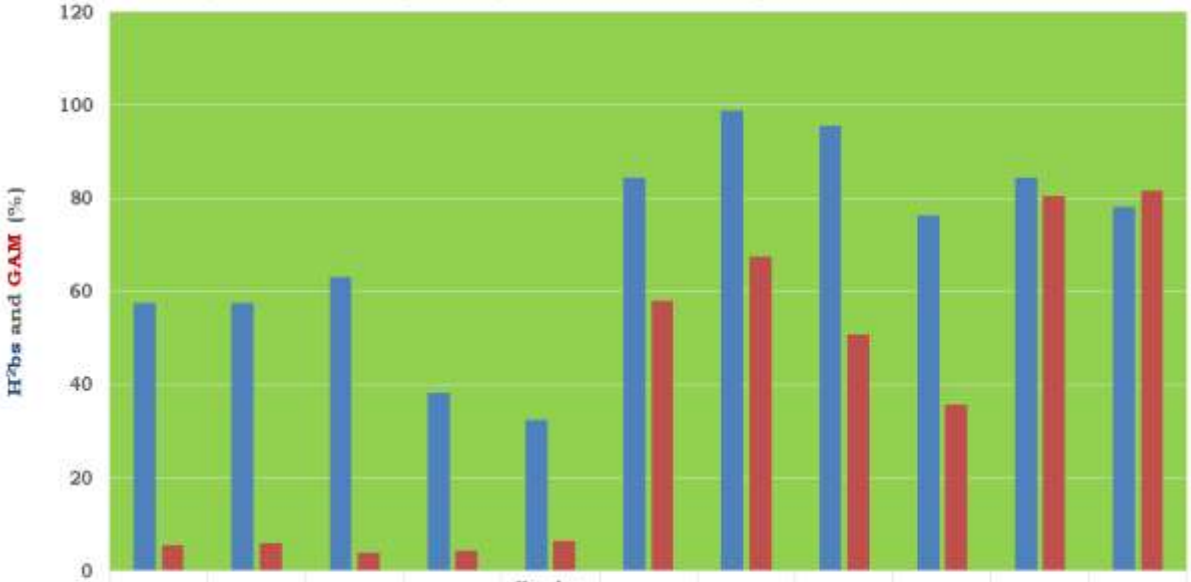
Fig. 1. Phenotypic and genotypic coefficient of variation in lentil



	Days to initiation of flowering	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	Hundred seed weight (g)	Straw yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
PCV (%)	4.63	4.91	2.92	5.49	9.64	33.32	33.11	25.81	22.65	46.29	50.66
GCV (%)	3.51	3.72	2.32	3.39	5.79	30.6	32.91	25.23	19.78	42.53	44.76

Fig. 2. Heritability and genetic advance as per cent of mean in lentil



	Days to initiation of flowering	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	Hundred seed weight (g)	Straw yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
H2bs (%)	57.43	57.56	63.03	38.2	32.35	84.38	98.81	95.57	76.28	84.43	78.08
GAM	5.48	5.82	3.79	4.32	6.46	57.91	67.4	50.81	35.6	80.51	81.57

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