Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 2175-2178
Received: 24-09-2020
Accepted: 26-10-2020

Ram Kishor
M. Sc. (Ag), student, Department of Genetics and Plant Breeding, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Kamaluddin
Department of Genetics and Plant Breeding, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Vijay Sharma
Department of Genetics and Plant Breeding, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Corresponding Author:
Ram Kishor
M. Sc. (Ag), Student, Department of Genetics and Plant Breeding, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Correlation and Path analysis for yield and its component traits in Lentil (*Lens culinaris* Medik.) in Bundelkhand

Ram Kishor, Kamaluddin and Vijay Sharma

Abstract
Eighty four genotypes/varieties including four checks of lentil were evaluated in Augmented design II to study correlation coefficient among yield and yield related traits and direct and indirect effects of yield contributing traits on seed yield using path analysis in lentil. The study was carried out during *rabi* 2019-2020 at P.G. Research Block of College of Agriculture, Banda University of Agriculture and Technology, Banda (24º53' and 25º55' North and 80º07'and 81º34' East at altitude of 113 m amsl). The data were recorded on ten randomly selected plants for eleven traits namely days to 50 % flowering, days to maturity, plant height (cm), number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, 100-seed weight (g), biological yield plant^{-1} (g), seed yield plant^{-1} (g) and harvest index (%). Significant differences were found among test entries except plant height, number of seeds pod^{-1} and harvest index indicated the presence of considerable genetic variability in the tested material. Seed yield plant^{-1} had significant and positive association with plant height, number of secondary branches plant^{-1}, number of pod plant^{-1}, 100 seed weight, biological yield plant^{-1} and harvest index. Path analysis revealed that highest positive direct effect was observed in number of pod plant^{-1} followed by seed weight while other traits contributing considerably were biological yield plant^{-1}, harvest index, number of primary branches plant^{-1}, days to 50% flowering, days to maturity and secondary branches plant^{-1} suggesting that the above traits are most important and necessity of adopting them as selection criteria while making selection for yield improvement.

Keywords: Lentil, seed yield, correlation coefficient, path analysis

Introduction
Lentil (*Lens culinaris* Medikus spp. *Culinaris*), commonly known as "Masur" is predominantly self-pollinated crop (2n = 2x = 14) belongs to family Fabaceae (Leguminosae), sub family Papilionacea and its haploid genome size is 4063 Mbps (Arumuganathan and Earle, 1991). Early Stone Age evidences suggested that this is the earliest domesticated cool season grain legume crop (Get *et al*., 2019) [4]. The wild sub species of lentil *L. culinaris* ssp. *orientalis* is thought to be the progenitor of cultivated lentil (Koul *et al*., 2017) [6]. Lentil is mostly consumed as dhal, either whole or in split form whereas its flour is used to prepare soup and purees. Bread and cakes are also prepared when its flour is mixed with cereal flour (Williams and Singh, 1988) [13].
Lentil grains contain as much as 30% protein (Singh *et al*., 2018) [11] and also rich in micronutrient like Iron (Fe), selenium (Se), copper (Cu), manganese (Mn) and other dietary nutrients (Kumar *et al*., 2019) [7]. Being rich source of protein, it is commonly known as "Poor man's meat" (Rani and Grewal, 2014) [8]. They also comprise high concentrations of essential amino acids, like, lysine, leucine, isoleucine, valine, phenylalanine, etc. and when consumed with cereals (being rich in methionine, tryptophane etc.) provide balanced dietary requirement of the vegetarian population of the world (Adhikari *et al*., 2018a) [1].
Grain yield is a complex trait and is influenced by its various component traits. Hence, grain yield *per se* may not use as a selection criterion for improvement in yield in any crop improvement programme. Knowledge regarding nature and relationship among yield and its contributing traits which are comparatively less complex and high heritable is important for use as indirect selection criteria for seeking improvement in yield. However, information about correlation among the characters alone is often misleading as the correlation observed may not be always true. Path coefficient analysis partition correlation in to its direct and indirect effects and measures the direct influence of one variable upon the other variable. It provides actual information on contribution of characters and thus form the basis for selection to improve the yield.

Materials and Methods

Location

The present study was carried out during *rabi* 2019-2020 at P.G. Research Block of College of Agriculture, Banda University of Agriculture and Technology, Banda. The center is located at 24º53' and 25º55' North and 80º07'and 81º34' East at altitude of 113 m amsl. Climatic conditions of the region is like the climatic conditions of semi-arid region of the country. Erratic rainfall occur in the region and total average annual rainfall of is about 800-910 mm. The highest relative humidity (85%) occurs in the month of August and lowest in April.

Plant Material

The experimenting material comprised of 80 genotypes/varieties of lentil having exotic as well as indigenous germplasm lines and four check (DPL-62, KML-320, L4076 and IPL316). These genotypes/ varieties were obtained from Chandra Shekhar Azad University of Agriculture and Technology, Kanpur and ICAR-Indian Institute of Pulse Research, Kanpur. The checks used in this study were well performing varieties of this region. The list of the experimenting material used in present investigation are given in Table 1.

Table 1: List of Lentil Genotypes/varieties including Check Used in Present investigation along with their source

S. N.	Genotype	Source	S. N.	Genotype	Source	S. N.	Genotype	Source
1	KML-326	CSAU, Kanpur	29	TAL-7	IIPR, Kanpur	57	IPLS-09-10	IIPR, Kanpur
2	KLB-112	CSAU, Kanpur	30	LEE-18-172	IIPR, Kanpur	58	98-3LA	IIPR, Kanpur
3	KL-1658	CSAU, Kanpur	31	LEE-18-169	IIPR, Kanpur	59	EC-542161	IIPR, Kanpur
4	KLO8-5	CSAU, Kanpur	32	TAL-3	IIPR, Kanpur	60	LL-1	IIPR, Kanpur
5	KLB114	CSAU, Kanpur	33	LEE-18-173	IIPR, Kanpur	61	LH-84-8	IIPR, Kanpur
6	KLB-115	CSAU, Kanpur	34	LEE-18-165	IIPR, Kanpur	62	ILL-81-14	IIPR, Kanpur
7	LSS-18-149	CSAU, Kanpur	35	KL-59-3	IIPR, Kanpur	63	EC-208362	IIPR, Kanpur
8	KL 122	CSAU, Kanpur	36	IC560332	IIPR, Kanpur	64	L-3555	IIPR, Kanpur
9	IPL416	IIPR, Kanpur	37	L-112-7	IIPR, Kanpur	65	EC-208345	IIPR, Kanpur
10	KL127	CSAU, Kanpur	38	IPLS-09-34	IIPR, Kanpur	66	PANT-L-04	IIPR, Kanpur
11	KL129	CSAU, Kanpur	39	98-15L-A	IIPR, Kanpur	67	L-112-6	IIPR, Kanpur
12	KLB-116	CSAU, Kanpur	40	96-15L-A	IIPR, Kanpur	68	EC-520204	IIPR, Kanpur
13	KL123	CSAU, Kanpur	41	IG-4284	IIPR, Kanpur	69	ILL-9957	IIPR, Kanpur
14	KLB-1452	CSAU, Kanpur	42	FLIP-98-318	IIPR, Kanpur	70	PANT L-234	IIPR, Kanpur
15	KLB-1454	CSAU, Kanpur	43	2002-76-L	IIPR, Kanpur	71	ILL-9967	IIPR, Kanpur
16	KLB-5	CSAU, Kanpur	44	SEHORE-74-3	IIPR, Kanpur	72	EC-522160	IIPR, Kanpur
17	KLB-1460	CSAU, Kanpur	45	L-112-16	IIPR, Kanpur	73	EC-542186	IIPR, Kanpur
18	KLB-1462	CSAU, Kanpur	46	IP25-09-22	IIPR, Kanpur	74	EC-582180	IIPR, Kanpur
19	KLB-1464	CSAU, Kanpur	47	IG4200	IIPR, Kanpur	75	ILL-7723	IIPR, Kanpur
20	KLB-1453	CSAU, Kanpur	48	IPLS-09-1	IIPR, Kanpur	76	ILL-9913	IIPR, Kanpur
21	KLS-1455	CSAU, Kanpur	49	IG4208	IIPR, Kanpur	77	ILL-9948	IIPR, Kanpur
22	KLS-1459	CSAU, Kanpur	50	TAL-6	IIPR, Kanpur	78	L-45996	IIPR, Kanpur
23	IPL-313	IIPR, Kanpur	51	IG-4000	IIPR, Kanpur	79	PANT L-639	IIPR, Kanpur
24	TAL-4	IIPR, Kanpur	52	IPLS-09-03	IIPR, Kanpur	80	L-112-19	IIPR, Kanpur
25	KL-3230	CSAU, Kanpur	53	IPLS-09-33	IIPR, Kanpur	81	DPL-62	IIPR, Kanpur
26	KLS-1461	CSAU, Kanpur	54	IPLS-09-06	IIPR, Kanpur	82	KML-320	IIPR, Kanpur
27	KL-09-3	CSAU, Kanpur	55	IG4244	IIPR, Kanpur	83	L4076	IIPR, Kanpur
28	KL-09-5	CSAU, Kanpur	56	L-4147	IIPR, Kanpur	84	IPL316	IIPR, Kanpur

Field design

The material was sown in augmented block design II (Federrer, 1956). The experimental plot was divided in to eight blocks comprising 14 genotypes in each block with 10 test entries and four checks. The check varieties were planted randomly in each block along with test genotypes. The row length was 5 m long, row to row distance was 30 cm and plant to plant spacing was 10 cm. Recommended agronomical package and practices were followed to raise good crop.

Statistical analysis

The observation were taken on ten randomly sampled plants for eleven characters *viz*. days to 50 % flowering, days to maturity, plant height (cm), number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, 100-seed weight (g), biological yield plant^{-1} (g), seed yield plant^{-1} (g) and harvest index (%). The average values were subjected to the statistical analyses using the statistical package XLSTAT, R 4.0 and online software developed by IASRI. Correlation coefficient was calculated as per the formula given by Searle (1961) and path coefficient analysis was done by the method suggested by Dewey and Lu (1959).

Result and Discussion

Significant differences were found among test entries for all the characters under study except plant height, number of seeds pod^{-1} and harvest index (Table-2) indicated presence of considerable amount of variability in the tested genotypes/varieties. This variation could be exploited to improve yield.

The estimates of correlation coefficients among the yield and its attributing traits are given in Table 3. Seed yield plant $^{-1}$ was positively and significantly correlated with plant height, number of secondary branches plant^{-1}, number of pod plant^{-1}, 100 seed weight, biological yield plant^{-1} and harvest index; days to 50% flowering displayed positive and significant correlation between plant height and days to maturity while days to maturity was found positively and significantly correlated with days to 50% flowering and biological yield plant^{-1}. Plant height showed positive and significant correlation with number of pod plant^{-1}, days to 50% flowering, biological yield plant^{-1} and seed yield plant^{-1}. Number of primary branches plant^{-1} exhibited positive and significant correlation with number of secondary branches plant^{-1}. Number of secondary branch plant^{-1} showed significant and positive correlation with number of primary branches plant^{-1}, seed yield plant^{-1}, biological yield plant^{-1} and number of pod plant^{-1}. Number of pod plant^{-1} showed positive and significant correlation with seed yield plant^{-1}, biological yield plant^{-1}, plant height, harvest index and number of secondary branches plant^{-1}. Seed weight displayed positive and significant correlation with biological yield plant^{-1}, seed yield plant^{-1} and harvest index. Biological yield plant^{-1} exhibited significant and positive correlation with seed yield plant^{-1}, number of pod plant^{-1}, seed weight, plant height, secondary branches plant^{-1}, harvest index and days to maturity. Harvest index showed positive and significant correlation with seed yield plant^{-1}, pod plant^{-1}, biological yield plant^{-1} and seed weight. In present investigation, grain yield is positively and significantly correlated with plant height, number of secondary branches plant^{-1}, number of pod plant^{-1}, 100 seed weight, biological yield plant^{-1} and harvest index indicated that these traits were positively associated because of linkages of genes governing the characters at coupling phase and direct selection of these traits may ultimately improve the seed yield. These results were conformity with the findings of Chowdhury *et al.* (2019), Hussan *et al.* (2018) and Yadav *et al.* (2016) [3, 5, 12]. Path coefficient analysis revealed highest positive direct effect on seed yield plant^{-1} exerted by number of pod plant^{-1} followed by seed weight while other traits contributing considerably were biological yield plant^{-1}, harvest index, number of primary branches plant^{-1}, days to 50% flowering, days to maturity and secondary branches plant^{-1}. Plant height and number of seed per pod showed negative direct effect on seed yield plant. The contribution towards yield other than the component traits i.e. residual effect was 0.1635. This suggested that these traits are major contributing traits towards seed yield plant^{-1} and more emphasis needs to be given while making any strategy for improving lentil cultivar through selection. The above findings are in agreement with the finding of Shaktivel *et al.* (2019) and Chowdhury *et al.* (2019) [4, 3].

Table 2: Analysis of variance of augmented design for eleven characters in lentil genotypes

Characters	Sources of variation					
	Blocks	**Treatment**	**Genotype**	**Checks**	**Genotype vs Check**	**Error**
	d.f. (7)	**d.f.** (83)	**d.f.** (79)	**d.f.** (3)	**d.f.** (1)	**d.f.** (21)
Days to 50% flowering (days)	9.817	26.584*	25.044*	74.948*	3.108	10.805
Days to maturity (days)	15.888*	7.912*	7.165*	28.281*	5.858	1.734
Plant height (cm)	30.877	44.582*	31.986	275.061*	348.214*	20.827
No. of primary branches per plant	0.304	0.432*	0.371*	1.370*	2.433*	0.125
No. of secondary branches per plant	5.751	11.144*	10.780*	10.448*	41.928*	3.120
Number of pod per plant	115.714	351.34*	306.013*	414.368*	3743.086*	122.898
Number seed per pod	0.028	0.037*	0.032	0.062*	0.422*	0.018
100-seed weight (g)	0.024	0.202*	0.169*	0.841*	0.859*	0.053
Biological yield per plant (g)	2.885*	8.190*	7.914*	6.89	33.903*	2.626
Seed yield per plant (g)	0.163	0.770*	0.644*	1.337*	8.984*	0.219
Harvest index (%)	69.776	78.919	64.869	298.437*	530.305*	43.752

*, ** Significant at 5% and 1% probability level, respectively

Table 3: Phenotypic correlation coefficients among different yield and yield component traits in Lentil germplasm

Characters	DF	DM	PH	NPB	NSB	NPP	NSP	SW	BY	SY	HI
DF	1	0.238*	0.335**	0.133	0.031	-0.078	0.023	-0.172	0.017	-0.147	0.198
DM		1	0.078	-0.135	-0.056	0.068	-0.109	-0.058	0.024**	0.035	0.015
PH			1	-0.145	-0.012	0.339**	0.133	-0.081	0.308**	0.236*	-0.026
NPB				1	0.413**	-0.129	-0.038	0.056	-0.03	-0.07	-0.125
NSB					1	0.238*	-0.031	0.208	0.297**	0.320**	0.005
NPP						1	0.096	-0.032	0.595**	0.829**	0.309**
NSP							1	0.116	0.001	0.115	0.1327
SW								1	0.358**	0.503**	0.271**
BY									1	0.708**	0.288**
SY										1	0.408**
HI											1

DF, days to 50% flowering; DM, days to maturity; PH, plant height; NPB, number of primary branches per plant; NSB, number of secondary branches per plant; NPP, number of pod per plant; NSP, number of seed per pod; SW, seed weight; BY, biological yield; SY, seed yield; HI, harvest index

Table 4. Direct (diagonal) and indirect effects of different characters on seed yield per plant in lentil germplasm

Characters	Indirect effect									
	DF	**DM**	**PH**	**NPB**	**NSB**	**NPP**	**NSP**	**SW**	**BY**	**HI**
DF	0.010	0.001	-0.006	0.002	0.000	-0.057	0.000	-0.075	0.003	-0.024
DM	0.002	0.005	-0.002	-0.002	0.000	0.049	0.002	-0.025	0.004	0.002
PH	0.003	0.000	-0.019	-0.002	0.000	0.243	-0.002	-0.036	0.052	-0.003
NPB	0.001	-0.001	0.003	0.013	0.001	-0.093	0.001	0.025	-0.005	-0.015
NSB	0.000	0.000	0.000	0.005	0.003	0.170	0.001	0.091	0.050	0.001
NPP	-0.001	0.000	-0.006	-0.002	0.001	0.716	-0.002	-0.014	0.100	0.038
NSP	0.000	-0.001	-0.003	-0.001	0.000	0.069	-0.016	0.050	0.000	0.016
SW	-0.002	0.000	0.002	0.001	0.001	-0.024	-0.002	0.435	0.060	0.033
BY	0.000	0.000	-0.006	0.000	0.001	0.427	0.000	0.156	0.167	-0.035
HI %	-0.002	0.000	0.001	-0.002	0.000	0.222	-0.002	0.118	-0.048	0.122

Residual factor = 0.1635

Conclusion

In present investigation, significant differences were observed among genotypes/varieties for all the traits except plant height, number of seeds pod^{-1} and harvest index. Positive and significant correlation were recorded for plant height, number of secondary branches plant^{-1}, number of pod plant^{-1}, 100 seed weight, biological yield plant^{-1} and harvest index suggesting that these traits may use for direct selection to improve seed yield. Number of pod plant^{-1} followed by seed weight, biological yield plant^{-1}, harvest index, number of primary branches plant^{-1}, days to 50% flowering, days to maturity and secondary branches plant^{-1}.had positive direct effect on seed yield plant^{-1} indicated that these traits should keep in mind while making selection for improving yield.

References

1. Adhikari BN, Shrestha J, Joshi BP, Bhatta NR. Agronomic traits evaluation and correlation study in lentil (*Lens culinaris* Medikus) genotypes. Interna. J Advan. Res. Biologi. Sci 2018a;5(12):1-10.
2. Arumuganathan K, Earle ED. Nuclear DNA content of some important plant species. Plant Mol. Biol 1991;9:208-218.
3. Chowdhury MM, Haque MA, Malek MA, Rasel M, Ahamed KU. Genetic variability, correlation and path coeffcient analysis for yield and yield components of selected lentil (*Lens culinaris* Medik.) genotypes. Funda Appl Agri 2019;4(2):769-776.
4. Get S, Gothwal DK, Choudhary RC, Shekhawat K. Genetic variability in lentil (*Lens culinaris* M.) genotypes for seed and seedling characteristics. J Pharmacog. Phytochem 2019;8(3):3000-3004.
5. Hussan S, Khuroo NS, Lone AA, Dar ZA, Dar SA, Dar MS. Study of variability and association analysis for various agromorphological traits in lentil (*Lens culinaris* Medik). J. Pharmacog. Phytochem 2018;7(2):2172-2175.
6. Koul PM, Sharma V, Rana M, Chahota RK, Kumar S, Sharma TR.. Analysis of genetic structure and interrelationships in lentil species using morphological and SSR markers. 3 Biotech 2017;7:83.
7. Kumar H, Singh A, Dikshit HK, Mishra GP, Aski M, Meena MC, Kumar S. Genetic dissection of grain iron and zinc concentrations in lentil (*Lens culinaris* Medik.). J Genet 2019;98:66.
8. Rani V, Grewal RB. Physical and functional properties of six varieties of Lentil (*Lens Culinaris* Medik.). Asian J Dairy & Food Res 2014;33(2):126-130.
9. Sakthivel G, Jeberson S, Singh NB, Sharma PR, Kumar S, Jalaj VK, Sinha B, Singh NO. Genetic variability, correlation and path analysis in lentil germplasm (*Lens culinaris* Medik.). J Pharma. Innov 2019;8(6):417-420.
10. Searle SR. Phenotypic, genotypic and environmental correlations. Biomet 1961;17:474-480.
11. Singh SS, Kumar A, Kumar S. Heritability of yield and its attributing traits in lentil (*Lens culinaris* Medic). Intern. J Chem. Stud 2018;SP4:61-64.
12. Yadav NK, Ghimre SK, Shah BP, Sarkar A, Shreshtha SM, Shah SK. Analysis of Genetic Variability and Divergence for Quantitative Traits in Lentil (*Lens Culinaris* Medik.). Interna. J Current Res 2016;8(9): 38422-38428.
13. Williams PC, Singh U. Quality screening and evaluation in pulse breeding. p. 445-457. In: R.J. Summerfield (ed.), World Crops: Cool Season Food Pulses. Kluwer Academic Publishers, Dordrecht The Netherlands, 1988.