



Variability and association studies and screening of genotypes against pea seed borne mosaic virus (psmv) in lentil (*lens culinaris medik*) under NW-Himalayas of Jammu and Kashmir

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ABSTRACT

The phenotypic expression and heritability of quantitative traits vary due to genotypic differences and environmental influences. Maximum heritability was found in number of pods/plant (99.43%) followed by seed yield/plant (99.06%) and number of primary branches/plant (98.74%). The presence of considerable degree of genotypic variances among tested genotypes under different environments suggests that success in lentil breeding could possibly be achieved through direct phenotypic selection. Seed yield showed highly significant positive correlation with number of pods/plant and pod length. Maximum direct effect on seed yield was observed for pod length. There was a wide range of variability in disease reaction among the genotypes. Pea seed borne mosaic virus is basically a disease of pea has been found to be transmitted to lentil. It is suggested that these two crops should not be planted near each other. Therefore, number of pods/plant, pod length, days to maturity and number of seeds/pod was emphasized as primary seed yield.

Key words: Correlations, Lentil, Path analysis, Pea seed borne mosaic virus, Variability.

INTRODUCTION

Pulses are important component along with cereals in the staple diet of vegetarian population of the country. They are also important for sustainable agriculture enriching the soil through biological nitrogen fixation. In spite of the important role played by the pulses in protein energy supply and nutritional security, the efforts gone into the research and development of pulse crops appears to be low. Lentil occupies 13.8 lakh hectares of area with the total production of 9.5 lakh tons. The average yield of lentil in India is lower than the world average (ICARDA Annual Report 2011-12). It has however, exhibited yield potential of 1400-1500 kg/ha at research farms as far as Vipasha variety is concerned (Anonymous, 2004). Low in yield as compared to its potential is due to of many factors and among the biotic factors, pea seed borne mosaic virus is commonly detected in lentil seed (Bashir *et al.*, 1998). This virus is also transmitted from peas to lentil by aphid species. Yield losses in lentil due to this disease vary from 6-61% based on lentil genotypes and virus strain (Kumari *et al.*, 1996). The Most ideal and feasible control of this disease is the cultivation of resistant varieties. A thorough knowledge of the nature and

magnitude of genetic variability and the extent of association between yield and yield attributes are essential before launching any breeding programme. Similarly, heritability and genetic advance estimates may be helpful selecting superior individuals. Correlation studies provide the association of quantitative characters especially of seed yield and its attributes. Path coefficient analysis measures the direct influence of one variable upon another and permits the separation of correlation coefficients into direct and indirect effects. Therefore, the present investigation was undertaken to determine the magnitude of genetic variation, heritability, genetic advance, screening of genotypes against pea seed borne mosaic virus and also to identify characters which can help in yield improvement and breeding strategies to develop and enhance yield ability in diverse germplasm lines along with cultivated varieties.

MATERIALS AND METHODS

The present investigation was carried out at the Experimental Farm of Krishi Vigyan Kendra Poonch of Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu, situated at 1000 m above mean sea level and at 33.76 latitude and 74.09 longitudes under two environments viz.,

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during *rabi* 2008-09 and 2009-10. This region is characterized as sub-temperate mid hill zone of Jammu & Kashmir having high rainfall. The experimental material comprising fourteen genotypes including microsperma and macrosperma (L403, L649, L4147, L446, L652, L404, Markenday, L617, Vipasha, L651, L699, L4076, L632 and L635) procured from Choudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalay Palampur (H.P.) was grown in randomized complete block design with three replications under both the environments. The plot size consisted of single row of 2.25 m length of each genotype spaced 30 cm apart in each replication.

The data were recorded on plant height, days to 50 per cent flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, number of seeds per pod, number of pods per plant, 100-seed weight (g), pod length (cm) and seed yield per plant (g) on the basis of five randomly taken plants from each replication of each environment.

Pea seed borne mosaic virus: Disease observations were recorded 20 days before harvesting i.e. at podding stage in the month of April, 2009 and 2010. Total numbers of affected plants of each genotype in the three replications were counted. The interaction percentage was also calculated and rated on 1-9 scale (ICARDA, 2003), where 1= no plant showing symptoms (Immune), 3=1-10% plants affected (resistant), 5=11-20% (medium resistant), 7=21-40 % (Susceptible) and 9=40% (highly susceptible)

Analysis of variance: The data were statistically analyzed as per the procedure given by Panse and Sukhatme (1984). Separate statistical analysis was done for all the characters studied under different environments (*Rabi* 2008-09 and 2009-10). Estimation of parameters of variability and genotypic and phenotypic coefficient of variation following Burton and De Vane (1953). The expected genetic advance

(GA) was calculated as per Burton and De Vane (1953) and Johnson *et al.* (1955). The phenotypic, genotypic and environmental coefficients of correlation were computed following Al-Jibouri *et al.*, (1958). The path coefficients were calculated by employing the method suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

A thorough screening of the material studied under the present investigation revealed sufficient variability for all the eight characters *viz.*, days to 50 per cent flowering, days to maturity, number of primary branches/plant, number of secondary branches/plant, number of seeds per pod, 100-seed weight, seed yield per plant, pod length and number of pods/plant during both the years i.e. *rabi* 2008-09 and 2009-10 (Table 1). Thus, there appears to be a greater scope for bringing about improvement in these traits. Similarly wide variability for pods per plant, seeds per plant and seed yield per plant has also been reported in lentil by Sharma and Luthra (1987) and Jain and Rao (1995).

It is evident from the (Table 1) that phenotypic coefficient of variation was higher than the genotypic coefficient of variation for all the traits under studied indicating that all the characters studied had interacted with environments. High heritability along with high genetic advance was observed for the traits *viz.*, plant height, number of primary branches/plant, number of secondary branches/plant, number of pods/plant, seed yield/plant and pod length (Table 1). Hence, direct phenotypic selection would be effective in improving these traits. High heritability along with moderate genetic advance was exhibited for number of seeds/pod indicating the existence of non-additive genetic variance. High heritability along with low genetic advance was observed for days to 50% flowering and days to maturity indicating the existence of heterosis breeding. All the traits were least affected by environment. High coefficient of

TABLE 1: Genetic parameters for yield and yield contributing traits in combined over environments in lentil

Traits/Characters	H b s (%)	GA	% GA	PCV	GCV	GM	CV%	Mean sum of square
Plant height	94.38	7.04	21.11	10.86	10.55	33.34	2.58	37.84**
Number of primary branches/plant	98.74	1.34	63.91	31.42	31.22	2.10	3.53	1.29**
Number of secondary branches/plant	94.64	0.78	38.26	19.62	19.09	2.04	4.54	0.46**
Number of Pods/Plant	99.43	31.24	73.26	35.77	35.67	42.63	2.70	694.99**
Number of Seeds/pod	96.87	0.29	17.02	8.53	8.40	1.69	1.51	0.06**
Days to 50% flowering	92.71	9.89	8.31	4.35	4.19	119.08	1.17	76.56**
Days to maturity	97.86	0.27	38.72	19.21	19.00	0.70	2.81	110.87**
Seed yield/plant	99.06	1.11	41.92	20.54	20.45	2.64	1.99	10.10**
100 seed weight	96.91	12.26	8.39	4.20	4.14	146.23	0.74	0.87**
Pod length	96.90	3.70	54.23	27.17	26.74	6.83	4.78	0.05**

** Significant at 1%

variation was observed for pod length followed by number of secondary branches /plant, number of primary branches / plant. These results are in conformity with the findings of Singh *et al.*, (1999) and Abo *et al.*, (2012).

Seed yield / plant exhibited significant positive association with number of pods/plant and pod length (Table 2). Pod length showed significant positive correlation with number of primary branches/plant, pods/plant, days to 50% flowering and days to maturity. Similar associations have been observed among these traits (Table 2). Days to maturity exhibited association with number of primary branches /plant and days to 50% flowering. Pods per plant revealed positive significant association with number of primary branches. Similar results were also reported by Ramgiri (1989) for seed yield/plant. Kumar and Sharma (2009) for number of primary branches/plant, pod length and 100 seed weight. The negative association of seed yield /plant with number of secondary branches / plant and seeds/ pod as observed in the present study is indicative of the fact that any improvement in positive direction in any of these traits would lead to reduction in seed yield. However, such association signifies the possibility of development of high yielding and early maturing but small seeded genotypes of lentil. Seeds/pod also exhibited negative association with the plant height and pods/plant. However, 100 seed weight exhibited negative association with all the traits understudied except plant height and days to maturity. Further, genetic and environmental correlations have been observed of same sign in case of seed yield /plant with number of secondary branches/plant, seeds/pod, indicating thereby

that such associations are governed by more or less similar physiological mechanisms.

Path coefficient divided the correlation coefficient into a series of direct and indirect effects of morphophysiological and phenological traits on seed yield of lentil. The maximum direct effect on seed yield/plant was exhibited by pod length/plant followed by number of pods/plant, days to maturity, days to 50% flowering, number of secondary branches/plant, number of primary branches/plant and number of seeds /pod (Table 3) while it was strongly negative for 100 seed weight and plant height. Similar results were also reported by Kumar and Sharma (2009), Singh and Srivastava (2013) and Tadesse *et al.*, (2014). The study on direct and indirect effects further confirmed that characters like number of primary branches/plant, days to 50% flowering, days to maturity, pod length seed yield/plant, in general also showed desirable direct or indirect effects and thus are likely to bring about improvement in seed yield if selection is focused upon them. The low estimates of correlation coefficient for seed yield with number of secondary branches/plant and seeds / pod have been recorded due to low direct and indirect effects of these traits towards seed yield indicating that improvement in these traits is not expected to bring an improvement in seed yield and thus selection of high yielding genotypes can be done independent of these traits.

A considerable variation was found for disease reaction along with seed yield / plant among the lentil genotypes for both the environments. Mainly three types of disease reaction i.e. resistance, moderately resistance and

TABLE 2: Estimates of correlation coefficients at phenotypic & genotypic levels among different traits studied in combined over environments in lentil

Traits/ Characters		Plant height	Number of Primary branches	Number of secondary branches	Pods / Plant	Seeds / pod	Days to 50% flowering	Days to maturity	Seed yield / Plant	100 seed weight
Number of primary branches/plant	P	0.10								
	G	0.10								
Number of secondary branches/plant	P	0.20	-0.18							
	G	0.19	-0.20							
Number of Pods/Plant	P	0.25	0.65*	-0.18						
	G	0.25	0.65	-0.19						
Number of Seeds/pod	P	-0.61**	-0.02	0.10	-0.04					
	G	-0.64	-0.02	0.09	-0.04					
Days to 50% flowering	P	0.23	0.79 *	-0.04	0.44*	-0.23				
	G	0.24	0.84	-0.06	0.47	-0.26				
Days to maturity	P	0.34 **	0.70 *	-0.24	0.48*	-0.37*	0.82**			
	G	0.34	0.70	-0.27	0.48	-0.39	0.87			
Seed yield/plant	P	0.44*	0.50 *	-0.06	0.73 *	-0.30	0.42 *	0.47*		
	G	0.47	0.50	-0.06	0.74	-0.31	0.45	0.48		
100 seed weight	P	0.07	-0.03	-0.33	-0.14	-0.32	-0.15	0.18	0.00	
	G	0.07	-0.03	-0.36	-0.15	-0.34	-0.17	0.18	0.00	
Pod length	P	0.21	0.71 *	-0.26	0.64 *	-0.23	0.57 *	0.76 *	0.53 **	0.48*
	G	0.21	0.72	-0.27	0.66	-0.25	0.60	0.78	0.55	0.49

** Significant at 5% and * at 1% level

P-Phenotypic value and G-Genotypic value

TABLE 3: Estimates of direct and indirect effects at phenotypic (P) & genotypic (g) levels for different characters studied in combined over environment in lentil

Traits/ Characters		Plant height	Number of Primary branches	Number of secondary branches	Pods/ Plant	Seeds/ pod	Days to 50% flowering	Days to maturity	100 seed weight	Pod length
Plant height	P	-0.01	0.01	0.03	0.14	-0.02	0.03	0.10	-0.03	0.04
	G	0.10	-0.00	0.03	0.17	-0.05	0.11	0.04	-0.05	0.05
Number of primary branches/plant	P	-0.01	0.09	-0.02	0.38	-0.00	0.13	0.20	-0.04	-0.02
	G	-0.01	-0.06	-0.03	0.46	-0.00	0.38	0.09	-0.06	-0.02
Number of secondary branches/plant	P	-0.02	-0.01	0.15	-0.10	0.00	-0.00	-0.07	0.00	-0.20
	G	-0.02	0.01	0.09	-0.03	0.00	-0.02	-0.03	0.00	
Pods/Plant	P	-0.02	0.06	-0.02	0.58	-0.00	0.07	0.14	-0.06	-0.09
	G	-0.02	-0.04	-0.03	0.19	-0.00	0.21	0.06	-0.09	-0.27
Seeds/pod	P	0.63	-0.00	0.01	-0.02	0.03	-0.04	-0.10	0.02	-0.20
	G	0.06	0.00	0.01	-0.03	0.08	-0.12	-0.05	0.03	-0.11
Days to 50% flowering	P	-0.02	0.07	-0.00	0.25	-0.00	0.17	0.24	-0.03	-0.09
	G	-0.02	-0.05	-0.01	0.32	-0.02	0.45	0.11	-0.05	-0.25
Days to maturity	P	-0.03	0.06	-0.03	0.28	-0.01	0.14	0.29	-0.04	0.11
	G	-0.03	-0.04	-0.05	0.34	-0.03	0.39	0.13	-0.06	-0.12
100 seed weight	P	-0.04	0.04	-0.01	0.42	-0.01	0.07	0.13	-0.08	0.00
	G	-0.04	-0.03	-0.01	0.51	-1.02	0.20	0.06	-0.12	0.13
Pod length	P	-0.00	-0.00	-0.05	-0.08	-0.01	-0.02	0.05	-0.00	0.62
	G	-0.00	0.00	-0.07	-0.10	-0.02	-0.07	0.02	-0.00	0.75

Bold values (Direct effect), P-Phenotypic value and G-Genotypic value

TABLE 4: Reaction of lentil germplasm against *Fusarium wilt* under natural disease conduction during 2008-09 and 2009-10

Genotypes	Rating Disease Reaction		Seed Yield(g/plant)		Pooled
	2008-09	2009-10	2008-09	2009-10	Mean(g/plant)
L-649	Resistant	Moderately Resistant	2.86	6.96	4.91
Markenday	Resistant	Resistant	6.87	9.83	8.35
L-617	Resistant	Resistant	2.55	8.80	5.67
L-635	Resistant	Resistant	5.44	14.14	9.79
Vipasha	Resistant	Moderately Resistant	2.66	8.60	5.63
L-651	Resistant	Moderately Resistant	2.36	8.32	5.34
L-632	Moderately Resistant	Moderately Resistant	3.01	11.63	7.32
L-403	Moderately Resistant	Moderately Resistant	3.32	7.97	5.65
L-404	Moderately Resistant	Moderately Resistant	2.04	9.41	5.72
L-652	Moderately Resistant	Resistant	3.19	9.39	6.29
L-446	Susceptible	Susceptible	3.65	9.56	6.60
L-4147	Susceptible	Susceptible	7.67	13.50	5.52
L4076	Resistant	Resistant	5.25	5.45	5.35
L699	Resistant	Resistant	4.78	6.00	5.39

susceptible were observed (Table 4). Most of the lines showed resistance against PSBMV in both the environments. Out of 14 genotypes, 8 were found with resistance, 4 moderately resistance and 2 susceptible during rabi 2008-09. During 2009-10, 6 genotypes exhibited resistance, 6 moderately resistance and 2 susceptible. Genotypes L635, markenday and L632 exhibited resistance along with good yield/plant, 9.79g, 8.35g and 7.32, respectively. These results are in conformity with the findings of Anjum *et al.*, (2005) and van

Leur *et al.*, (2013). The other possible control measure is the selection of resistant varieties.

CONCLUSION

From the present study, it was concluded that the early maturity coupled with high number of pods/plant, number of seeds / pod and number of secondary branches/plant appear to be constituents of an ideal high yielding lentil ideotype. 06 genotypes were identified as resistant these could be used for future breeding for developing resistant varieties.

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