



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 1806-1809
Received: 19-09-2018
Accepted: 21-10-2018

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Genetic variability, heritability, correlation coefficient and path analysis in *Lathyrus* for yield and its related contributes under NEH condition

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Abstract

Seven parental lines with 21 F₁ cross combination of *Lathyrus*, totally 28 treatments were grown in the RBD with three replications. Each parents and F₁s in single row 4m long were grown with the spacing of 30 x 10 cm between and within rows, respectively. The analysis of variance revealed significant differences among the parents and the F₁ cross combinations for all the traits studied indicating presence of sufficient genetic variability among the genotypes. In general, phenotypic coefficients of variability were higher than related genotypic coefficients of variability for all the characters which demonstrated the effect of environment upon the traits. A comparatively higher estimate of phenotypic coefficient of variation (PCV of more than 15%) were observed for plant height (17.29), harvest index (18.42), number of primary branches per plant (25.68), number of pods per plant (23.26), 100 seeds weight (15.89), biological yield per plant (31.48) and seed yield per plant (30.74). The highest genotypic coefficient of variability was observed for harvest index (12.21), 100 seed weight (14.30), plant height (16.12), number of primary branches per plant (23.58), number of pods per plant (20.55), seed yield per plant (27.31) and biological yield per plant (29.63) which shows the presence of utilizable genetic variability for these traits. The outcome of the present study showed that, the heritability (h²) estimates were recorded quite high (>50%) for the traits biological yield, plant height, number of primary branches per plant, 100 seed weight, seed yield per plant, number of pods per plant and pod length. Other characters were shown the less heritability. Biological yield, plant height and number of pods per plant were reveals significant and positive correlation with yield. High positive significant direct effect on seed yield was influenced by biological yield and Harvest index. In view of above correlation and path analysis, for selection of the yield contributing characters, in *Lathyrus*, the importance should be given to the following characters, viz., Biological yield, plant height and number of pods/plant.

Keywords: Genetic variability, heritability, *Lathyrus*

Introduction

Pulses are important food crops that can play a major role in addressing future global food security and environmental challenges, as well as contributing to healthy diets. Grasspea (*Lathyrus sativus* L.) has chromosome number 2n=14, belongs to the family Leguminosae, subfamily Papilionoideae, tribe Viciaeae. Botanically it is a self-pollinated annual grain legume grown for its grain but also used for fodder or green manure. It is rich in proteins (28.7-34.2%) (Sammour, 2007) [11] and possesses good qualities of essential amino-acids and micronutrients, thereby providing nutritional security to its consumers, who are mostly poor section of the society. Primarily it is used in the form of *Dhal*, *Pakoda*, and *Flour*. The availability of pulses has declined because their production could not keep pace with the population growth. Per capita pulses consumption over the years has declined from 61 g/day in 1951 to 39.4 g/day in 2011 (Anon., 2013) [3]. Though India is the world's largest producer of pulses, it imports a large amount of pulses to meet the growing domestic needs (Gowde, 2013) [6]. Hence the present study was undertaken to indentify suitable traits for selection with the aim to improve seed yield of *Lathyrus*.

Materials and methods

Twenty one F₁ crosses and seven parental genotypes were evaluated by Randomized block design with three replications during *Rabi* 2015-16 at Andro Research Farm, Central Agricultural University, Imphal, Manipur. Each genotype was grown in each one row of 4 m length with maintaining spacing of 22.5 cm between rows 5 cm between plants. The observation were recorded on 5 randomly selected plants for 12 quantitative characters viz., Days to First flowering, Days to 50% flowering, Days to maturity, Plant height (cm),

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Number of pods per plant, Number of primary branches per plant, Pod length (cm), Number of seeds per pod, Seeds yield per plant (g), Biological yield per plant (g), 100 seeds weight (g) and Harvest index (HI) % (Table.1). The data analyzed for different genetic parameters of variability and genotypic correlation using the Windostat software.

Results

The ANOVA shows that significant differences were observed among genotypes for all the traits under study (Table. 1). Similar kind of result has given in *Lathyrus* by Singh *et al.* (2017) [15]. The general mean, range and S.E. for variance have given in table 2. This considerable variability provides a good chance of improvement in *Lathyrus*. In the present study, phenotypic coefficient of variability was higher than corresponding genotypic coefficient of variability for all the traits which demonstrated the effect of environment upon the traits (Table 3). Genetic parameters of variation, heritability and expected genetic advance as percentage over mean of seed yield and related traits are given in table 3. The genotypic and phenotypic coefficient of variation ranged from 1.09 (days to maturity) to 29.63 (biological yield per plant) and 1.34 (days to maturity) to 31.48 (biological yield per plant), respectively. The maximum phenotypic and genotypic coefficient of variability were observed for biological yield per plant (31.48 and 29.63), seed yield per plant (30.74 and 27.31), number of primary braches (25.68 and 23.58) and number of pods/plant (23.26 and 20.56), plant height (17.29 and 16.12). The least variability was found in days to maturity (1.34 and 1.09). These results were corroborated with findings of Sharma *et al.* (2013), Bicer *et al.* (2004) [4], Aich *et al.* (2007) [2], Singh *et al.* (2008) [13], Manish *et al.* (2017) [9] and Singh *et al.* (2012) [16].

The heritability estimates vary from 19.6% (days to maturity) to 88.6% (biological yield per plant). The high heritability for economic traits including biological yield per plant (88.6%), plant height (86.9%), number of primary braches (84.3%), 100 seeds weight (81.0%) and seed yield per plant (78.9%) indication for success in selection because their heritable in nature and can give anticipated gain in selection of the *Lathyrus*. These results were corroboration with result of Ahmadi *et al.* (2015) [1] in *Lathyrus*. The genetic advance in percent of mean was the highest for biological yield per plant (57.45%), seed yield per plant (49.99%) and number of primary branches (44.61%), whereas least genetic advance was found in days to first flowering (1.19%). Similar findings were reported by Singh *et al.*, 2004 [14], Bicer *et al.* 2004 [4], Jhosi *et al.*, 2005, Gengele *et al.*, 2005 [5], Aich *et al.*, 2007 [2], Singh *et al.*, 2008 [13], Tyagi *et al.*, 2011 [18] and Singh *et al.* 2012 [16] who were worked in lentil.

High heritability coupled with high expected genetic advance was observed for biological yield per plant, seed yield per plant, number of primary branches per plant shows that these

traits were least influenced by environmental interaction. Thus selection for these traits would be quite effective in enhancing seed yield per plant and also simultaneously its related attributes.

Correlation coefficients of seed yield per plant with other traits are given in Table 4. Seed yield per plant exhibited significant and positive correlation with biological yield per plant, plant height, number of pods per plant, biological yield per plant is positively significant correlation with number of pods per plant, pod length is with plant height and days to maturity with days to 50% flowering, 100 seeds weight is negatively correlated with some characters and non-significantly correlated with other characters. The present correlation study has strong conformity with the studies of Talukdar (2009) in *Lathyrus*.

Path coefficient was worked out based on the seed yield per plant as a dependant variable and all the other 11 characters as independent variables (Table 5.). The biological yield per plant exhibited highest positive and direct effect on grain yield followed by harvest index. Plant height and pods per plant shows significant positive indirect effect on seed yield. Therefore these characters can be considered for selecting genotypes to improve the grain yield in the *Lathyrus*. Similar results were found by Kumari and Prasad (2005) [8] and Parihar *et al.* (2015) [10]. The days to 50% flowering, plant height, number of primary branches, and 100 seed weight shows the negative direct effect. However, the negative direct effects of all these characters were nullified by their indirect effect through other characters, which ultimately resulted in to highly significant positive correlation with seed yield per plant. Therefore indirect selection through other component characters with these five traits exhibited positive indirect effects can be recommended so as to bring improvement in grain yield.

The high and positive direct effect was also reported by Tyagi *et al.*, 2011 [18] and Singh *et al.* 2012 [16]. Further, in the present study, it is revealed that 92 percent of the yield contributing characters was utilized in this data analysis as the residual effect was 0.08(8%) as revealed in the result (Fig. 1.). In the present investigation, biological yield per plant, plant height, number of primary branches per plant and 100 seeds weight appear to have large heritabilities indicating low environmental effects for these characters. Seed yield per plant, number of pods per plant, pod length per plant and days to maturity showed a moderate heritability, whereas days to first flowering has low heritability indicating moderate and high environmental effects on these characters. Therefore, more emphasis need to be given on above mentioned traits which is having high heritabilities for improving the productivity during selection. Based on this study it is suggested to develop varieties with high biological yield with good pod bearing clusters.

Table 1: Analyses of variance of different morphological and economic traits of *Lathyrus*

SOV	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height	No of branches/ plant	Pods/ plant	Pod Length	No. of seed/plant	100 seed weight	Biological yield/plant	HI	Seed yield/plant
Sum of squares	246.89	127.25	196.57	3008.52	71.13	4670.92	2.83	5.93	110.54	1279.45	4959.86	315.94
Mean squares	9.14	4.73	7.28	111.43	2.63	172.99	0.10	0.22	4.09	47.39	183.70	11.70
F value	1.73	4.78	7.16	20.99	17.14	11.72	10.24	2.73	13.76	24.30	3.36	12.25

**= Significant at 0.01 probability level, NS= Non-significant

Table 2: General mean, range and S.E for variance characters in *Lathyrus*

S. No.	Characters	Range		Grand mean	S.E difference
		Min	Max		
1.	Days to first flowering	84.67	91.33	86.96	1.33
2.	Days to 50% flowering	90.67	95.33	92.42	0.57
3.	Days to maturity	129.00	135.00	131.43	0.58
4.	Plant height (cm)	25.00	46.27	36.89	1.33
5.	Primary branches/plant	2.9	6.53	3.86	0.22
6.	Pods/plant	24.73	47.50	35.33	2.22
7.	Pod Length (cm)	2.28	3.02	2.57	0.06
8.	No. of seed/pod	2.9	3.97	3.48	0.16
9.	100 seed weight (g)	4.88	9.92	7.87	0.32
10.	Biological yield/plant	7.80	22.73	6.93	4.27
11.	Harvest Index	39.13	61.56	13.13	0.81
12.	Seed Yield (g)	4.42	12.43	53.68	0.56

Table 3: The estimates of genetic parameters of variability for seed yield and its components in *Lathyrus*

S. No.	Characters	Coefficient of variability		Heritability (%)	Genetic Advancement (5%)		Genetic advance in percent of mean	
		GCV	PCV		5%	1%	5%	1%
1.	Days to first flowering	1.31	2.95	19.6	1.04	1.33	1.19	1.53
2.	Days to 50% flowering	1.21	1.62	55.7	1.72	2.20	1.86	2.38
3.	Days to maturity	1.10	1.34	67.2	2.44	3.13	1.86	2.38
4.	Plant height (cm)	16.12	17.29	86.9	11.42	14.64	30.97	39.69
5.	Primary branches/plant	23.58	25.68	84.3	1.72	2.21	44.61	17.17
6.	Pods/plant	25.56	23.26	78.1	13.22	16.95	37.43	47.97
7.	Pod Length (cm)	6.91	7.96	75.5	0.32	0.41	12.37	15.86
8.	No. of seed/pod	6.20	10.25	36.6	0.27	0.34	7.73	9.90
9.	100 seed weight (g)	14.30	15.89	81.0	2.09	2.67	26.50	33.97
10.	Biological yield/plant (g)	29.63	31.48	88.6	7.55	9.67	57.45	73.63
11.	Harvest Index	12.21	18.42	44.0	8.96	11.48	16.66	21.38
12.	Seed Yield (g)	27.31	30.74	78.9	3.46	4.44	49.99	64.06

PCV%= Phenotypic coefficient of variability, GCV= Genotypic coefficient of variability, h^2 = heritability and GA= Genetic advance

Table 4: Genotypic correlation coefficient for different traits in *Lathyrus*

Character	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height	Primary branches/plant	Pods/plant	Pod Length	No. of seed/plant	100 seed weight	Biological yield/plant	Harvest Index
Days to first flowering	1.00										
Days to 50% flowering	1.0476	1.00									
Days to maturity	1.2255	0.8705	1.00								
Plant height (cm)	-0.3794	-0.3114	-0.2807	1.00							
Primary branches/plant	-0.4787	-0.1551	-0.2827	0.3839	1.00						
Pods/plant	0.0678	0.0216	-0.0040	0.3526	-0.1252	1.00					
Pod Length (cm)	-0.1750	-0.0666	-0.1575	0.5352	0.2594	0.3764	1.00				
No. of seed/pod	-0.1141	-0.0562	-0.0634	0.4513	0.4160	-0.0778	0.0347	1.00			-
100 seed weight (g)	-0.3038	-0.7189	-0.4452	0.2746	-0.1615	0.2757	0.2187	0.2783	1.00		
Biological yield/plant (g)	-0.2998	-0.1721	-0.1642	0.4984	0.2253	0.6919	0.4591	0.2128	0.2660	1.00	
Harvest Index	-0.1798	-0.4957	-0.3271	0.1471	-0.1293	-0.3385	-0.1185	0.2387	0.3124	-0.3399	1.00
Seed Yield (g)	-0.4062	-0.3648	-0.2966	0.5886**	0.2164	0.5689**	0.4472	0.3411	0.3958	0.8978**	0.1028

*,**= Significant at 0.05 and 0.01 probability levels, respectively

Table 5: Direct and indirect effects of different traits on seed yield in *Lathyrus*

Traits	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches/plant	Pods/plant	Pod Length (cm)	No. of seed/pod	100 seed weight (g)	Biological yield/plant (g)	Harvest Index
Days to first flowering	0.0204	0.0213	0.0249	-0.0077	-0.0097	0.0014	-0.0036	-0.0023	-0.0062	-0.0061	-0.0037
Days to 50% flowering	-0.2798	-0.2671	-0.2325	0.0832	0.0414	-0.0058	0.0178	0.0150	0.1920	0.0460	0.1324
Days to maturity	0.1553	0.1103	0.1268	-0.0356	-0.0358	-0.0005	-0.0200	-0.0080	-0.0564	-0.0208	-0.0415
Plant height (cm)	0.0398	0.0327	0.0294	-0.1049	-0.0403	-0.0370	-0.0561	-0.0473	-0.0288	-0.0523	-0.0154
Primary branches/plant	0.0026	0.0009	0.0016	-0.0021	-0.0055	0.0007	-0.0014	-0.0023	0.0009	-0.0012	0.0007
Pods/plant	0.0066	0.0021	-0.0004	0.0343	-0.0122	0.0974	0.0367	-0.0076	0.0269	0.0674	-0.0330
Pod Length (cm)	-0.0193	-0.0073	-0.0174	0.0590	0.0286	0.0415	0.1102	0.0038	0.0241	0.0506	-0.0131
No. of seed/pod	-0.0146	-0.0072	-0.0081	0.0576	0.0531	-0.0099	0.0044	0.1277	0.0355	0.0272	0.0305
100 seed weight (g)	0.0588	0.1391	0.0861	-0.0531	0.0312	-0.0533	-0.0423	-0.0539	-0.1935	-0.0515	-0.0605
Biological yield/plant (g)	-0.2965	-0.1702	-0.1624	0.4929	0.2228	0.6842	0.4540	0.2104	0.2631	0.9889	-0.3362
Harvest Index	-0.0795	-0.2193	-0.1624	0.0651	-0.0572	-0.1497	-0.0524	0.1056	0.1382	-0.1504	0.4424
Seed Yield (g)	-0.4062	-0.3648	-0.2966	0.5886	0.2164	0.5689	0.4472	0.3411	0.3958	0.8978	0.1028

