GENETIC VARIABILITY AND COMBINING ABILITY ANALYSIS FOR 6-PARENT HALF DIALLEL CROSS IN LATHYRUS

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Abstract: Fifteen F_1 hybrids of grasspea and their parents were evaluated in randomized complete block design to estimate variability and combining ability of seed yield and neurotoxin content. Analysis of variance indicated significant differences due to genotypes for all the characters except plant height (cm), pod length (cm), no. of seeds pod^{-1}, biological yield plant^{-1} and harvest index (%). High heritability coupled with high genetic advance was observed for only protein content. Analysis of combining ability revealed the existence of highly significant variation among crosses for all characters in F_1 generation. Combining ability analysis indicating predominance of additive gene action in the expression of pod length (cm) and harvest index (%). The parent Mahateora, Pusa-24, RLS-3004 and Siraha Local appeared to be good general combiners. The cross Pusa-24 x RLS-3004 proves the best combination for early maturity; Prateek x Siraha Local and Pusa-24 x Ratan proves the best combination for seed yield plant^{-1}; Pusa-24 x Ratan and Mahateora x RLS-3004 proves the best specific combination for ODAP content.

Keywords: Grasspea, hybrid, seed, *Lathyrus*

INTRODUCTION

Grasspea (*Lathyrus sativus* L.) locally called '*Khesari*', '*Teora*', '*Lakh*'/'*Lakhdi*' is an important rabi pulse crop of the Chhattisgarh region. In India it occupies an area of about 1.6 million ha. *Lathyrus* belongs to family Leguminosae, and sub family Poaceae a grain legume with high nutritional profile having diploid chromosome 2n=14. Advancements in the development of crop varieties greatly depend upon genetic variability. The study of genetic variability with the estimates of phenotypic and genotypic variance along with heritability and genetic advance using methods of analysis of variance and computation of heritability are necessary to start crop development programme. These simple statistical derivations give knowledge of mean, variance, standard deviation present in the population. The ultimate aim of a farmer or breeder is to get high quality yield. Yield is a complex character and is the multiplicative end product of many yield components and hence knowledge of the existing genetic variations between various yields traits and their heritability assumes importance. Heritability (h^2) is an approximate measure of the expression of a character.

Lathyrus being an essentially self pollinated crop requires strategies to allow accumulation of fixable gene effects in a homozygous line. In order to exploit gene actions operating in the population, information pertaining to magnitude of genetic variances, combining ability for different traits is essential. Identifying suitable parents is another pre-requisite in self pollinated crops. Under such circumstances combining ability helps in evaluation of parents in terms of their genetic value. In addition to this it also provides nature and magnitude of gene effects involved in the expression of targeted traits.

MATERIAL AND METHOD

Fifteen F_1 hybrids and their parents constituted the experimental material of this study. The hybridization between pure lines was performed under field conditions following emasculation and pollination simultaneously in morning. The experiment was laid out in a Randomized Complete Block Design (RBD) with three replications. Each genotype was grown in a row of 2 meter length. The row to row distance was 30 cm and 20 cm between plants. All the recommended package of practices was followed to facilitate good crop growth and development. Five competitive plants were randomly selected from each genotype of each replication to record data on 17 characters.

Combining ability analysis was carried out by the procedure giving by Griffing (1956) as per the method II (Model II). This is applied for the set of data involving parents and F_1's excluding reciprocals. Components of variance estimates of genotypic and phenotypic coefficient of variation (GCV and PCV) were evaluated as per Burton (1952). Heritability in the broad sense was calculated following Hanson (1963) and expected genetic advance was estimated as per Johnson *et al.* (1955) and Kempthorne (1957).

RESULT AND DISCUSSION

Genetic variability

The mean values, coefficient of variability are presented in Table 1. Number of pods plant^{-1} showed the maximum genotypic variability and Pod length showed the minimum genotypic variability. For all traits, phenotypic coefficient of variation was higher than the genotypic coefficient of variation. Coefficients of genotypic and phenotypic variation suggest that there is good scope for yield

improvement through selection for pods plant^{-1}, seeds plant^{-1} and yield plant^{-1}.

Combining ability

The table showing estimates of gca effects revealed that parent Ratan besides being the best general combiner for 100 seed weight and protein content. Mahateora being the best general combiner for no. of primary branches per plant and good for days to flower initiation, days to 50 % flowering, days to pod initiation, days to 50 % pod formation and days to maturity. RLS-3004 being the best general combiner for pod length and days to maturity and good general combiner for harvest index, 100 seed weight and protein content. Siraha Local being the best general combiner for days to maturity and good general combiner for no. of seeds pod^{-1}. Prateek being best general combiner for days to flower initiation, days to 50 % flowering, days to pod initiation and days to 50 % pod formation and good general combiner for biological yield plant^{-1} and protein content. Pusa-24 being good general combiner for days to flower initiation, days to 50 % flowering, days to pod initiation, days to 50 % pod formation and days to maturity.

The cross Pusa-24 x Ratan proved to be the best specific combiner for no. of seeds plant^{-1} and ODAP content. Pusa-24 x Mahateora proved to be the best specific combiner for no. of pods plant^{-1}. Pusa-24 x RLS-3004 proved to be the best specific combiner for protein content. Prateek x RLS-3004 proved to be the best specific combiner for 100 seed weight. Prateek x Siraha Local proved to be the best specific combiner for no. of seeds pod^{-1} and seed yield plant^{-1}. Ratan x Mahateora proved to be the best specific combiner for pod length.

Table 1. Genetic parameters of variation for seed yield, its components and Neurotoxin (ODAP) content in grasspea

S. No.	Characters	Mean	Range		Coefficient of variation		h^2_{bs}(%)	Genetic advance (GA)	Genetic advance as % of mean
			Minimum	Maximum	Genotypic	Phenotypic			
1.	Days to flower initiation	48.71	45	59.66	7.54	7.69	96.12	7.38	15.15
2.	Days to 50% flowering.	55.42	51.33	65.67	6.47	6.64	94.84	7.17	12.93
3.	Days to pod initiation	56.46	52.33	66.67	6.49	6.62	96.16	7.35	13.03
4.	Days to 50% pod formation	62.90	58.33	72.67	5.54	5.69	94.66	6.99	11.11
5.	Days to maturity	106.15	98.67	110.67	4.02	4.12	94.98	8.65	8.15
6.	Plant height (cm)	58.77	47.93	67.93	4.59	18.61	6.09	1.35	2.30
7.	Number of primary branches plant^{-1}	3.87	3.33	6.13	11.71	20.10	33.92	0.54	14.16
8.	Number of pods plant^{-1}	60.59	31.47	101.53	27.78	46.94	35.02	21.79	35.96
9.	Pod length (cm)	3.08	2.95	3.35	2.28	5.96	14.70	0.06	2.01
10.	Number of seeds pod^{-1}	3.07	2.53	3.73	5.80	15.05	14.88	0.14	4.64
11.	Number of seeds plant^{-1}	129.54	74.40	226.20	23.16	34.24	45.77	43.60	33.65
12.	Seed yield plant^{-1} (g)	7.81	4.68	13.92	22.46	47.15	22.70	1.83	23.46
13.	Biological yield plant^{-1} (g)	19.10	11.82	28.45	18.34	44.60	16.91	3.06	16.03
14.	Harvest index (%)	43.17	26.76	63.37	11.17	39.65	7.94	2.79	6.47
15.	100 seed weight (g)	6.99	6.13	8.45	8.52	8.96	90.49	1.16	16.59
16.	Protein content (%)	21.12	11.27	27.02	22.04	22.66	94.58	9.26	43.85
17.	ODAP content (%)	0.02	0.01	0.03	18.19	22.02	68.28	0.006	31.28

Table 2. Estimates of General Combing ability effect (GCA) for seed yield, its components and Neurotoxin (ODAP) content in 6-parent half diallel genotypes of grasspea

Characters	Parents					
	Pusa-24	Prateek	Ratan	Mahateora	RLS-3004	Siraha-Local
Days to flower initiation	-1.97**	-0.60**	-0.06	-1.22**	1.15**	2.69*
Days to 50% flowering	-2.00**	-0.62**	-0.17	-1.08**	1.50**	2.38**
Days to pod initiation	-1.99**	-0.61**	-0.07	-1.24**	1.22**	2.68**
Days to 50% pod formation	-2.13**	-0.54**	0.00	-0.75**	1.29**	2.13**
Days to maturity	-1.68**	3.53**	1.61**	-1.72**	-0.93**	-0.81**
Plant height (cm)	0.53	1.14	1.60	0.74	-1.86	-2.13
Number of primary branches plant^{-1}	-0.08	-0.03	-0.08	0.46**	-0.09	-0.17
Number of pods plant^{-1}	1.07	4.82	3.61	-3.91	-2.91	-2.68
Pod length (cm)	-0.08*	0.05	-0.02	-0.05	0.09**	0.01
Number of seeds pod^{-1}	-0.13	-0.06	0.04	0.08	-0.09	0.16*
Number of seeds plant^{-1}	4.62	4.52	7.46	-11.05	-3.00	-2.55
Seed yield plant^{-1} (g)	-0.18	0.09	0.91	-0.09	-0.05	-0.68
Biological yield plant^{-1}	0.69	2.96*	0.87	-1.16	-1.71	-1.66
Harvest index (%)	-4.94	-6.13	3.36	0.65	7.39*	-0.32
100 seed weight (g)	-0.06	-0.04	0.11**	-0.08*	0.09*	-0.02
Protein content (%)	-3.97**	1.89**	2.43**	-0.17**	1.01**	-0.65**
ODAP content (%)	0.00	0.00	0.00	0.00	0.00	0.00

*, ** significant at 5% and 1% levels, respectively

Table 3. Estimates of Specific Combing ability effects (SCA) for seed yield, its components and Neurotoxin (ODAP) content in 6-parent half diallel genotypes of grasspea

Characters / Crosses	Days to flower initiation	Days to 50% flowering	Days to pod initiation	Days to 50% pod formation	Days to maturity	Plant height (cm)	No. of primary branches plant^{-1}	Number of pods plant^{-1}
Pusa-24 x Prateek	-1.21**	-1.14**	-1.20**	-1.57**	0.61	4.90	0.04	-12.25
Pusa-24 x Ratan	-2.08**	-1.93**	-2.07**	-2.45**	-0.47	7.04	0.23	35.43**
Pusa-24 x Mahateora	0.08	0.65	0.10	1.64**	-1.47**	3.46	-0.05	36.88**
Pusa-24 x RLS-3004	3.71**	3.40**	3.64**	3.26**	-4.26**	-8.91	-0.23	-6.11
Pusa-24 x Siraha Local	-3.50**	-4.14**	-3.49**	-4.24**	0.61	-9.24	-0.29	-6.15
Prateek x Ratan	3.54**	3.70**	3.55**	2.97**	-1.68**	-9.77	0.05	-7.32
Prateek x Mahateora	-0.96**	-0.39	-0.95*	-0.28	2.65**	-5.49	-0.97**	11.06
Prateek x RLS-3004	2.33**	2.03**	2.26**	2.35**	1.86**	7.75	-0.01	15.47
Prateek x Siraha Local	0.13	-0.51	0.14	-0.49	1.74**	4.79	-0.04	28.90*
Ratan x Mahateora	4.50**	4.15**	4.51**	4.18**	-0.76	5.09	-0.88**	-3.33
Ratan x RLS-3004	-2.87**	-3.10**	-2.95**	-2.53**	1.78**	5.76	-0.10	30.28*
Ratan x Siraha Local	0.25	0.03	0.26	0.30	2.65**	-7.31	0.38	19.31
Mahateora x RLS-3004	-2.04**	-2.51**	-2.11**	-3.11**	6.45**	-9.65	-0.34	-9.87
Mahateora x Siraha Local	1.75**	1.95**	1.76**	1.72**	1.32*	1.49	-0.43	-2.57
RLS-3004 x Siraha Local	6.38**	6.36**	6.30**	6.35**	4.20**	-5.38	-0.08	-0.43

*, ** significant at 5% and 1% levels, respectively

Table 4.

Characters / Crosses	Pod length (cm)	Number of seeds pod^{-1}	Number of seeds plant^{-1}	Seed yield plant^{-1}(g)	Biological yield plant^{-1}	Harvest index (%)	100 seed weight (g)	Protein content (%)	ODAP content (%)
Pusa-24 x Prateek	0.09	0.05	-24.62	-1.85	-9.08*	10.18	-0.51**	2.38**	0.00
Pusa-24 x Ratan	-0.07	0.15	82.83**	5.28**	6.09	10.00	0.09	4.65**	-0.01**
Pusa-24 x Mahateora	0.00	-0.42	25.35	2.86	6.51	1.22	0.31**	-4.16**	0.00
Pusa-24 x RLS-3004	-0.04	-0.38	-8.70	0.34	-1.38	-0.02	-0.83**	4.91**	0.00
Pusa-24 x Siraha Local	-0.11	-0.04	3.25	-2.17	-2.89	-7.32	-0.33**	-3.25**	0.00
Prateek x Ratan	-0.12	-0.38	-18.20	-1.61	0.46	-7.10	-0.18	-0.04	0.00
Prateek x Mahateora	-0.17*	-0.02	28.65	1.94	5.85	-2.70	0.40**	-4.18**	0.00
Prateek x RLS-3004	-0.07	0.02	9.07	0.17	6.70	-14.40	1.29**	-1.14**	0.00
Prateek x Siraha Local	0.06	0.49*	45.88**	5.42**	7.71	11.53	-0.71**	4.31**	0.00
Ratan x Mahateora	0.19*	0.28	17.04	-1.01	-1.30	-3.99	-0.25*	-1.33**	0.00
Ratan x RLS-3004	0.04	-0.08	50.73**	2.17	7.05	-10.93	-0.08	0.04	0.00
Ratan x Siraha Local	0.02	-0.47*	11.21	1.91	2.76	0.32	-1.07**	0.56	0.00
Mahateora x RLS-3004	0.02	0.08	-19.89	0.78	-3.84	11.65	-0.41**	3.69**	0.00
Mahateora x Siraha Local	0.01	-0.25	-7.07	-0.36	-1.75	0.83	-0.09	1.95**	0.00
RLS-3004 x Siraha Local	-0.01	0.13	-18.92	-1.88	-0.10	-8.92	0.78**	-8.33**	0.00

*, ** significant at 5% and 1% level, respectively

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