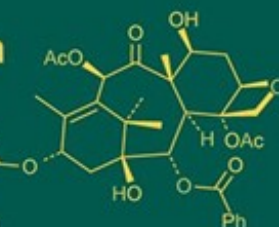
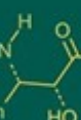
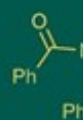
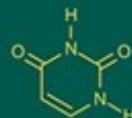


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Heterosis for seed yield, yield contributing traits and β -ODAP content in lathyrus (*Lathyrus sativus* L.)

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ABSTRACT

An investigation was conducted to assess heterosis for seed yield, yield contributing traits and β -ODAP content in *Lathyrus* (*Lathyrus sativus* L.). The experimental material comprised 39 F_1 crosses developed by crossing 13 lines with three testers in a line $\times$ tester mating design. The F_1 hybrids along with their parents were evaluated in a randomized block design with three replications during Rabi 2025–26 at the Research Farm of the Agricultural Botany Section, College of Agriculture, Nagpur. Heterosis was estimated over the better parent (heterobeltiosis) and the standard check Ratan (useful heterosis) for days to first flowering, days to 50 per cent flowering, days to maturity, plant height, branches plant-1, pods plant-1, 100-seed weight, seed yield plant-1 and β -ODAP content. Analysis of variance revealed significant differences among genotypes and crosses for all the traits studied, indicating substantial genetic variability among the experimental material. Significant positive heterobeltiosis for seed yield plant-1 was observed in four crosses, namely NLM-23 $\times$ Ratan (31.59%), NLM-12 $\times$ Ratan (25.99%), NLM-12 $\times$ Prateek (24.32%) and NLK-73 $\times$ Prateek (16.38%). These crosses also exhibited significant useful heterosis for seed yield plant-1 of 31.59%, 25.99%, 20.07% and 18.29% respectively. Significant desirable heterosis was also observed for important yield contributing traits, particularly branches plant-1 and pods plant-1. For β -ODAP content, desirable negative heterobeltiosis was recorded in several crosses, with the highest negative heterosis observed in NLK-73 $\times$ Ratan (–40.08%), followed by NLM-12 $\times$ Ratan (–29.20%) and NLM-12 $\times$ Mahateora (–28.51%). The results indicated that NLM-23 $\times$ Ratan, NLM-12 $\times$ Ratan, NLM-12 $\times$ Prateek and NLK-73 $\times$ Prateek were promising cross combinations for higher seed yield along with desirable performance for yield contributing traits. These crosses may be useful in further breeding programmes for the development of high-yielding and low- β -ODAP *Lathyrus* genotypes.

Keywords: Lathyrus, Heterosis, Heterobeltiosis, Useful heterosis, Seed yield, Yield components, β -ODAP, Line $\times$ tester

Introduction

Lathyrus (*Lathyrus sativus* L.), commonly known as grass pea, is an important food legume cultivated mainly under rainfed and marginal environments because of its ability to withstand drought and other adverse growing conditions. The crop is valued for its relatively stable performance under moisture-stressed conditions and its contribution to food and nutritional security. However, the presence of the neurotoxic non-protein amino acid β -N-oxalyl-L- α , β -diaminopropionic acid (β -ODAP) in the seed is a major limitation to its wider utilization as a food and feed crop. Therefore, simultaneous improvement of seed yield and reduction of β -ODAP content remains an important objective in *Lathyrus* breeding.

Genetic improvement of *Lathyrus* depends on the identification and utilization of genetically diverse parents and superior cross combinations. Heterosis, expressed as the superiority of F_1 hybrids over their parents or a standard check, provides useful information on the magnitude and direction of genetic variation among cross combinations. The estimation of heterosis for yield and its component traits helps in identifying crosses with desirable combinations of characters and can also provide a basis for selecting segregating populations in subsequent generations.

In *Lathyrus*, information on heterosis for yield and its component characters is relatively limited compared with other pulse crops. Previous studies have demonstrated variability among *Lathyrus* crosses for yield and associated traits and have emphasized the importance of selecting suitable parental combinations for genetic improvement. Heterosis studies are particularly useful for identifying crosses that combine higher seed yield with desirable plant architecture and other agronomic traits. In addition, assessment of heterosis for β -ODAP content can help identify cross combinations showing a desirable reduction in the neurotoxic compound.

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The present investigation was therefore undertaken to estimate heterosis over the better parent and a standard check for seed yield, yield contributing traits and β -ODAP content in *Lathyrus*. The study involved 39 F_1 crosses developed through a line $\times$ tester mating design using 13 lines and three testers. The objective was to identify promising cross combinations exhibiting desirable heterosis for seed yield and its contributing traits together with reduced β -ODAP content, which could be utilized in further *Lathyrus* improvement programmes.

Material and method

The experimental material comprised thirteen lines viz., NLK-6, NLK-42, NLK-37, NLK-56, NLK-102, NLK-49, NLK-74, NLK-73, NLK-38, EC-207071, NLM-12, NLM-17 and NLM-23 and three testers viz., Ratan, Prateek and Mahateora.

During rabi 2024-25, the thirteen lines were crossed with three testers following a line $\times$ tester mating design to obtain 39 F_1 cross combinations. The resulting F_1 hybrids along with their parents and standard checks were evaluated during rabi 2025-26 at the Research Farm of the Agricultural Botany Section, College of Agriculture, Nagpur. The experiment was conducted in a randomized block design with three replications. The crop was raised following the recommended package of practices.

Observations were recorded on five randomly selected plants from each entry for days to first flowering, days to 50 per cent flowering, days to maturity, plant height (cm), number of branches plant⁻¹, number of pods plant⁻¹, 100-seed weight (g), seed yield plant⁻¹ (g) and β -ODAP content (%). β -ODAP content was estimated using the dry-seed phytochemical assessment method of Briggs *et al.* (1983) [1]. Analysis of variance for the experimental design was carried out according to Panse *et al.* (1954) [2].

Results and discussion

Analysis of variance for experimental design

The analysis of variance for the different characters studied is presented in Table 2. The mean squares due to genotypes were found to be highly significant for all the traits studied namely days to first flowering, days to 50% flowering, days to maturity, plant height, number of branches plant⁻¹, number of pods plant⁻¹, 100-seed weight, seed yield plant⁻¹ and ODAP content. The significant differences among genotypes for these characters indicated the existence of substantial genetic variability within the experimental material. The variability observed provides ample scope for effective selection and genetic improvement of these traits in lathyrus. In accordance to this results Lyngdoh *et al.* (2019) [3], Nawale *et al.* (2024) [4] and Singh *et al.* (2025) [5] also observed significant genotypic variation for important agronomic traits in lathyrus, thereby emphasizing the usefulness of available germplasm for breeding programmes.

Analysis of variance for heterosis

The mean squares due to parents were highly significant for all the characters studied except for plant height and the mean squares due to crosses were highly significant for all the nine traits studied. Further mean squares due to the interaction component of parents versus crosses was also found to be significant for all the characters, demonstrating marked differences between parental lines and their respective hybrids. This indicates the suitability of data for estimation of heterosis over better parent and useful heterosis over Ratan for all nine characters viz. days to first flower, days to 50% flowering, days to maturity, plant height, number of branches plant⁻¹, number of pods plant⁻¹, 100-seed weight, seed yield plant⁻¹ and ODAP content in lathyrus. Similar to this result, Wagh (2015) [6], Sayyad *et al.* (2017) [7], Lyngdoh *et al.* (2019) [3], and Nawale *et al.* (2024) [4] also observed significant mean squares due to parent vs. crosses interaction effect for days to first flowering, days to 50% flowering, days to ma-

turity, plant height, number of branches plant⁻¹, number of pods plant⁻¹, 100-seed weight, seed yield plant⁻¹ and ODAP content.

The results on heterosis estimation revealed that considerable heterosis was observed for all the nine characters studied. The magnitude of heterobeltiosis and useful heterosis differed for different characters.

The extent of heterosis gives clue of the type of genetic control in the characters. Heterosis by itself, whether over the mid-parent and better parent cannot tell us much about the superiority of the hybrid over the check, which is of practical value for plant breeding and therefore, useful heterosis should be given more emphasis. In this study, significant useful heterosis in the desirable direction was observed for days to maturity in seventeen crosses, plant height in seventeen crosses, number of branches plant⁻¹ in four crosses, number of pods plant⁻¹ in four crosses, seed yield per plant⁻¹ in four crosses, and ODAP content in ten crosses.

Seed yield plant⁻¹, being the most important economic character, showed substantial variation among the crosses. Significant positive heterobeltiosis for seed yield was recorded in only four crosses, namely NLM-23 $\times$ Ratan (31.59%), NLM-12 $\times$ Ratan (25.99%), NLM-12 $\times$ Prateek (24.32%) and NLK-73 $\times$ Prateek (16.38%). These crosses also exhibited significant positive useful heterosis over the standard check Ratan, with values of 31.59%, 25.99%, 20.07% and 18.29% respectively. The superior performance of these crosses was accompanied by favourable heterosis for important yield components, particularly branches and pods plant⁻¹. The results therefore suggest that heterotic expression for seed yield was largely associated with improvement in its component characters. Similar importance of heterosis for yield and associated traits has been reported in *Lathyrus* by Wagh (2015) [6], Sayyad *et al.* (2017) [7] and Lyngdoh *et al.* (2019) [3].

An important feature of the present investigation was the estimation of heterosis for β -ODAP content along with yield traits. Since lower β -ODAP content is desirable, negative heterosis was considered favourable. Significant negative heterobeltiosis was recorded in five crosses, with the highest reduction observed in NLK-73 $\times$ Ratan (-40.08%), followed by NLM-12 $\times$ Ratan (-29.20%) and NLM-12 $\times$ Mahateora (-28.51%). Significant negative useful heterosis was observed in ten crosses, indicating substantial scope for reducing β -ODAP content through appropriate hybridization. The occurrence of favourable heterosis for both seed yield and β -ODAP content in selected combinations is particularly important because simultaneous improvement of productivity and reduction of the antinutritional/toxic compound is a major breeding objective in *Lathyrus*.

Considering seed yield together with its component traits and β -ODAP content, NLM-23 $\times$ Ratan, NLM-12 $\times$ Ratan, NLM-12 $\times$ Prateek and NLK-73 $\times$ Prateek emerged as the most notable crosses on the basis of significant positive heterosis for seed yield and favourable expression for important yield components. Among these, NLM-23 $\times$ Ratan was particularly noteworthy because it recorded the highest heterobeltiosis and useful heterosis for seed yield (31.59%) and also showed positive heterotic expression for branches and pods plant⁻¹. NLM-12 $\times$ Ratan and NLM-12 $\times$ Prateek likewise combined high positive heterosis for seed yield with favourable expression of yield components. These results indicate that selection of suitable parental combinations is essential for obtaining heterotic expression for complex quantitative traits.

The crosses NLM-23 $\times$ Ratan, NLM-12 $\times$ Prateek, NLM-12 $\times$ Ratan, and NLK-73 $\times$ Prateek were found to exhibit positive significant heterosis for seed yield plant⁻¹, number of pods plant⁻¹ and number of branches plant⁻¹ and negative significant heterosis for days to maturity, plant height and ODAP content.

Hence, these four crosses can be identified as promising crosses for further exploitation. The above four crosses recorded high mean performance along with positive significant sca effects, indicating the presence of dominance gene action, which can be exploited for the commercial utilization of heterosis.

Table 1. Analysis of variance for different characters in lathyrus

Sources of variation	D.F	Mean squares								
		Days to first flowering	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches plant ⁻¹	Number of pods plant ⁻¹	100 seed weight (g)	Seed yield plant ⁻¹ (g)	ODAP content (%)
Replications	2	2.44	1.17	3.02	24.99	0.05	35.77	0.024	0.9	0.0003
Genotypes	54	3.58**	4.32**	7.44**	70.59**	0.36**	176.92**	0.241**	12.187**	0.0540**
Error	108	1.12	0.55	1.66	28.25	0.03	22.29	0.121	2.05	0.0002

Note *, ** = Significant at 5% and 1% level, respectively

Table 2. Analysis of variance for heterosis in lathyrus for different characters

Sources of variation	D.F	Mean squares								
		Days to first flowering	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches plant ⁻¹	Number of pods plant ⁻¹	100 seed weight (g)	Seed yield plant ⁻¹ (g)	ODAP content (%)
Replications	2	2.44	1.17	3.02	24.99	0.05	35.77	0.02	19.78	0.0003
Genotypes	54	3.58**	4.31**	7.44**	70.59**	0.36**	176.92**	0.24**	8.02**	0.0540**
Parents	15	5.37**	4.67**	7.48**	25.45	0.3**	122.55**	0.14**	6.77**	0.0774**
Crosses	38	2.79**	4.23**	6.92**	87.02**	0.38**	194.57**	0.27**	14.42**	0.0413**
Parents vs Crosses	1	6.69*	2.4*	26.73**	123.43*	0.21*	322.08**	0.6**	8.17*	0.1852**
Error	108	1.12	0.55	1.66	28.25	0.03	22.29	0.121	2.05	0.0002

Note: *, ** = Significant at 5% and 1% level, respectively

Sr. No.	Crosses	Days to first flowering		Days to 50 % flowering		Days to maturity	
		H1	H2	H1	H2	H1	H2
1	NLK-6 × Ratan	0.6471	0.6471	-0.6107	-0.6107	1.3689	-1.0640
2	NLK-6 × Prateek	2.6078	2.6078	1.7963	1.7963	1.9098*	-0.5360
3	NLK-6 × Mahateora	0.0001	0.0003	0.0012	0.0001	2.4590**	0.0002
4	NLK-42 × Ratan	0.6471	0.6471	1.1856	1.1856	1.0726	0.2640
5	NLK-42 × Prateek	-0.6335	4.5686**	4.1854**	4.1854**	-0.2698	-2.4000**
6	NLK-42 × Mahateora	0.6346	2.6078	4.7782**	4.7782**	-1.8790*	-2.6640**
7	NLK-37 × Ratan	0.0000	0.0000	1.1856	1.1856	-2.1360*	-2.1360*
8	NLK-37 × Prateek	3.8707*	5.2353**	1.1687	4.1854**	-0.8175	-2.9360**
9	NLK-37 × Mahateora	-1.2967	0.0002	-0.6107	-0.6107	-1.5958	-1.3360
10	NLK-56 × Ratan	3.9216*	3.9216*	4.7782**	4.7782**	0.5389	0.0005
11	NLK-56 × Prateek	1.2642	5.2353**	3.5292**	5.3889**	-0.5395	-2.6640**
12	NLK-56 × Mahateora	0.6346	2.6078	2.9819**	2.9819**	0.5389	0.0000
13	NLK-102 × Ratan	1.3137	1.3137	0.5928	0.5928	0.5492	-1.8640*
14	NLK-102 × Prateek	-1.2484	3.9216*	0.5931	3.5926**	2.7295**	0.2640
15	NLK-102 × Mahateora	0.6346	2.6078	2.9819**	2.9819**	0.5492	-1.8640*
16	NLK-49 × Ratan	-0.6471	-0.6471	-1.7963	-1.7963	0.8000	0.8000
17	NLK-49 × Prateek	0.6471	0.6471	0.0005	0.0001	-0.2698	-2.4000**
18	NLK-49 × Mahateora	-1.3137	-1.3137	1.1856	1.1856	0.0001	0.0001
19	NLK-74 × Ratan	1.9608	1.9608	1.1856	1.1856	0.2735	-0.2640
20	NLK-74 × Prateek	-2.4967	2.6078	-1.7144	2.9819**	-0.8175	-2.9360**
21	NLK-74 × Mahateora	0.0003	1.9608	2.9819**	2.9819**	0.5389	0.0000
22	NLK-73 × Ratan	0.0004	0.0012	0.0012	0.0001	-2.1360*	-2.1360*
23	NLK-73 × Prateek	0.0001	4.5686**	0.0001	4.7782**	-1.3570	-3.4640**
24	NLK-73 × Mahateora	-0.6346	1.3137	2.9819**	2.9819**	-2.9203**	-2.6640**
25	NLK-38 × Ratan	0.6471	0.6471	0.6145	0.0000	-0.8000	-0.8000
26	NLK-38 × Prateek	5.2353**	5.2353**	5.4220**	4.7782**	2.7303**	0.5360
27	NLK-38 × Mahateora	4.5686**	4.5686**	3.6147**	2.9819**	-1.0612	-0.8000

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Sr. No.	Crosses	Days to first flowering		Days to 50 % flowering		Days to maturity	
28	EC207071 × Ratan	-1.3137	-1.3137	-0.6107	-0.6107	0.5447	-1.0640
29	EC207071 × Prateek	-3.1509	0.6471	-5.1432**	-0.6107	2.4524**	0.2640
30	EC207071 × Mahateora	0.6346	2.6078	0.5928	0.5928	0.8130	-0.8000
31	NLM-12 × Ratan	2.6624	1.3137	4.7782**	4.7782**	-1.3577	-2.9360**
32	NLM-12 × Prateek	1.9869	0.6471	-2.9469**	-1.7963	0.8175	-1.3360
33	NLM-12 × Mahateora	1.9869	0.6471	0.0001	0.0005	1.6260	0.0004
34	NLM-17 × Ratan	0.0012	0.0015	1.1856	1.1856	-0.5418	-1.6000
35	NLM-17 × Prateek	-1.2642	2.6078	-4.5603**	0.0002	-0.2698	-2.4000**
36	NLM-17 × Mahateora	1.9231	3.9216*	4.7782**	4.7782**	-1.0835	-2.1360*
37	NLM-23 × Ratan	-0.6471	-0.6471	4.1854**	4.1854**	-0.5360	-0.5360
38	NLM-23 × Prateek	1.2773	2.6078	-4.0172**	0.0003	0.2779	-1.8640*
39	NLM-23 × Mahateora	-0.6580	0.6471	0.5928	0.5928	-2.9360**	-2.9360**
	S.E (d)	0.86	0.86	0.60	0.60	1.05	1.05

Table 3. Estimation of heterobeltiosis (H1) and useful heterosis (H₂) in percentage for different characte

Sr. No.	Crosses	Plant height (cm)		No of branches plant ⁻¹	
		H1	H ₂	H1	H ₂
1	NLK-6 × Ratan	-7.7763	-12.0417*	-7.3529 *	-7.3529 *
2	NLK-6 × Prateek	-3.0926	-12.9583*	-2.05e-14	-4.4118
3	NLK-6 × Mahateora	-0.5425	-13.4306*	-11.1111 **	-17.6471 **
4	NLK-42 × Ratan	2.9412	-2.7778	-7.3529 *	-7.3529 *
5	NLK-42 × Prateek	7.7316	-3.2361	-4.6154	-8.8235 **
6	NLK-42 × Mahateora	2.6488	-10.6528	-6.3492	-13.2353 **
7	NLK-37 × Ratan	-9.5807	-20.0417**	-13.2353 **	-13.2353 **
8	NLK-37 × Prateek	-10.9942	-21.2917**	-21.5385 **	-25.0000 **
9	NLK-37 × Mahateora	4.2445	-9.2639	-6.3492	-13.2353 **
10	NLK-56 × Ratan	-5.7793	-17.1250**	-16.1765 **	-16.1765 **
11	NLK-56 × Prateek	-2.7159	-14.4306*	-9.2308 **	-13.2353 **
12	NLK-56 × Mahateora	-5.8561	-18.0556**	-1.5873	-8.8235 **
13	NLK-102 × Ratan	-3.7581	-17.1250**	-7.3529 *	-7.3529 *
14	NLK-102 × Prateek	9.6774	-5.5556	-13.8462 **	-17.6471 **
15	NLK-102 × Mahateora	3.2258	-11.1111	-6.3492	-13.2353 **
16	NLK-49 × Ratan	0.0000	-7.4028	-10.2941 **	-10.2941 **
17	NLK-49 × Prateek	-1.5463	-11.5694	-10.7692 **	-14.7059 **
18	NLK-49 × Mahateora	7.4358	-6.4861	-1.5873	-8.8235 **
19	NLK-74 × Ratan	12.1112	-1.3889	-13.2353 **	-13.2353 **
20	NLK-74 × Prateek	6.8530	-6.0139	-10.7692 **	-14.7059 **
21	NLK-74 × Mahateora	7.4358	-6.4861	-1.5873	-8.8235 **
22	NLK-73 × Ratan	-17.8696**	-21.2917**	-13.2353 **	-13.2353 **
23	NLK-73 × Prateek	-3.6184	-13.4306*	12.3077 **	7.3529 *
24	NLK-73 × Mahateora	6.3826	-7.4028	3.1746	-4.4118
25	NLK-38 × Ratan	-2.5026	-10.1806	-13.2353 **	-13.2353 **
26	NLK-38 × Prateek	-14.4426*	-23.1528**	-21.5385 **	-25.0000 **
27	NLK-38 × Mahateora	-11.7121	-23.1528**	0.0008	-7.3529 *
28	EC207071 × Ratan	-15.9420*	-19.4444**	-10.2941 **	-10.2941 **
29	EC207071 × Prateek	3.0926	-7.4028	-6.1538	-10.2941 **
30	EC207071 × Mahateora	-6.9252	-18.9861**	-15.6250 **	-20.5882 **
31	NLM-12 × Ratan	15.1094*	2.3194	8.8235 **	8.8235 **
32	NLM-12 × Prateek	22.3906**	8.7917	12.3077 **	7.3529 *
33	NLM-12 × Mahateora	-4.2604	-16.6667**	1.5873	-5.8824
34	NLM-17 × Ratan	-6.8006	-11.1111	-13.2353 **	-13.2353 **
35	NLM-17 × Prateek	-4.1287	-13.8889*	-9.2308 **	-13.2353 **
36	NLM-17 × Mahateora	16.4832*	1.3889	-12.3077 **	-16.1765 **
37	NLM-23 × Ratan	4.4333	-1.8472	8.8235 **	8.8235 **

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Sr. No.	Crosses	Plant height (cm)		No of branches plant ⁻¹	
38	NLM-23 × Prateek	5.6595	-5.0972	-1.5385	-5.8824
39	NLM-23 × Mahateora	6.9092	-6.9444	-3.1746	-10.2941 **
	S.E (d)	4.34	4.34	0.14	0.14

Continued.....

Sr. No.	Crosses	No of pods plant ⁻¹		100 seed weight (g)	
		H1	H2	H1	H2
1	NLK-6 × Ratan	-11.2808	-11.2808	1.2766	1.2766
2	NLK-6 × Prateek	-0.8717	-6.4630	-4.4643	-8.9362 **
3	NLK-6 × Mahateora	-5.4775	-20.9166 **	0.8929	-3.8298
4	NLK-42 × Ratan	-10.8108	-10.8108	3.4043	3.4043
5	NLK-42 × Prateek	-20.5479 **	-25.0294 **	-2.2624	-8.0851 **
6	NLK-42 × Mahateora	-4.7753	-20.3290 **	0.0001	-4.6809 *
7	NLK-37 × Ratan	-23.0317 **	-23.0317 **	-1.7021	-1.7021
8	NLK-37 × Prateek	-27.3973 **	-31.4924 **	2.1552	0.8511
9	NLK-37 × Mahateora	0.5618	-15.8637 *	-3.4483	-4.6809 *
10	NLK-56 × Ratan	-24.7944 **	-24.7944 **	-1.7021	-1.7021
11	NLK-56 × Prateek	-19.8007 **	-24.3243 **	4.4248	0.4255
12	NLK-56 × Mahateora	-6.8820	-22.0917 **	-4.8673 *	-8.5106 **
13	NLK-102 × Ratan	-25.2644 **	-25.2644 **	1.7021	1.7021
14	NLK-102 × Prateek	-9.8381	-14.9236 *	0.0008	-8.0851 **
15	NLK-102 × Mahateora	-18.3989 *	-31.7274 **	0.0004	-4.6809 *
16	NLK-49 × Ratan	-27.1445 **	-27.1445 **	-1.7021	-1.7021
17	NLK-49 × Prateek	-24.2839 **	-28.5546 **	-0.4405	-3.8298
18	NLK-49 × Mahateora	-9.9719	-24.6769 **	-4.4053	-7.6596 **
19	NLK-74 × Ratan	-14.2186 *	-14.2186 *	-0.8511	-0.8511
20	NLK-74 × Prateek	-24.2839 **	-28.5546 **	-4.4643	-8.9362 **
21	NLK-74 × Mahateora	-11.5169	-25.9694 **	5.3571 *	0.4255
22	NLK-73 × Ratan	-29.7297 **	-29.7297 **	-7.6596 **	-7.6596 **
23	NLK-73 × Prateek	23.0386 **	16.0987 *	6.4815 **	-2.1277
24	NLK-73 × Mahateora	6.2252	-5.7579	2.6786	-2.1277
25	NLK-38 × Ratan	-26.0870 **	-26.0870 **	-3.8298	-3.8298
26	NLK-38 × Prateek	-26.0274 **	-30.1998 **	0.0005	-8.0851 **
27	NLK-38 × Mahateora	-11.9382	-26.3220 **	-3.5714	-8.0851 **
28	EC207071 × Ratan	-27.8496 **	-27.8496 **	-5.5319 *	-5.5319 *
29	EC207071 × Prateek	-21.5442 **	-25.9694 **	0.0009	-3.8298
30	EC207071 × Mahateora	-27.8772 **	-33.7250 **	6.6372 **	2.5532
31	NLM-12 × Ratan	17.6263 *	17.6263 *	-8.5106 **	-8.5106 **
32	NLM-12 × Prateek	23.0386 **	16.0987 *	0.0006	-8.0851 **
33	NLM-12 × Mahateora	-13.4831	-27.6146 **	-0.4464	-5.1064 *
34	NLM-17 × Ratan	-28.5546 **	-28.5546 **	2.9787	2.9787
35	NLM-17 × Prateek	-4.7323	-10.1058	0.9259	-7.2340 **
36	NLM-17 × Mahateora	1.4045	-15.1586 *	2.2321	-2.5532
37	NLM-23 × Ratan	20.5640 **	20.5640 **	0.4255	0.4255
38	NLM-23 × Prateek	-10.9589	-15.9812 *	2.6316	-0.4255
39	NLM-23 × Mahateora	-8.9888	-23.8543 **	-3.9474	-6.8085 **
	S.E (d)	3.85	3.85	0.17	0.17

Continued....

Sr. No.	Crosses	Seed yield plant ⁻¹ (g)		ODAP Content (%)	
		H1	H2	H1	H2
1	NLK-6 × Ratan	-10.7811	-10.7811	55.2000**	55.2000**
2	NLK-6 × Prateek	6.2550	-4.9136	78.8732**	103.2000**

(continued on next page)

Sr. No.	Crosses	Seed yield plant ⁻¹ (g)		ODAP Content (%)	
3	NLK-6 × Mahateora	3.8692	-3.3657	57.5540**	75.2000**
4	NLK-42 × Ratan	-6.8934	-6.8934	65.2000**	65.2000**
5	NLK-42 × Prateek	-5.4684	-15.3708 *	92.9577**	119.2000**
6	NLK-42 × Mahateora	-8.7251	-15.0828 *	70.1439**	89.2000**
7	NLK-37 × Ratan	-12.3110	-12.3110	45.2000**	45.2000**
8	NLK-37 × Prateek	-4.9313	-11.5191	71.8310**	95.2000**
9	NLK-37 × Mahateora	-3.0168	-9.7372	43.1655**	59.2000**
10	NLK-56 × Ratan	-9.8092	-9.8092	5.2000	5.2000
11	NLK-56 × Prateek	-3.0571	-13.2469 *	45.4225**	65.2000**
12	NLK-56 × Mahateora	-5.9393	-12.4910 *	16.1871**	29.2000**
13	NLK-102 × Ratan	-3.3297	-3.3297	57.2000**	57.2000**
14	NLK-102 × Prateek	-2.0314	-12.3290	84.1549**	109.2000**
15	NLK-102 × Mahateora	-10.7371	-16.9546 **	59.3525**	77.2000**
16	NLK-49 × Ratan	-6.8215	-6.8215	-2.8000	-2.8000
17	NLK-49 × Prateek	-4.1834	-14.2549 *	38.3803**	57.2000**
18	NLK-49 × Mahateora	-3.8305	-10.5292	8.9928*	21.2000**
19	NLK-74 × Ratan	-15.1548 *	-15.1548 *	3.2000	3.2000
20	NLK-74 × Prateek	-2.3934	-12.6530 *	43.6620**	63.2000**
21	NLK-74 × Mahateora	3.1728	-4.0137	14.3885**	27.2000**
22	NLK-73 × Ratan	-11.3689	-9.9172	-40.0810**	-40.8000**
23	NLK-73 × Prateek	16.3804 **	18.2865 **	-7.6923	-8.8000
24	NLK-73 × Mahateora	-3.1875	-1.6019	-13.7652**	-14.8000**
25	NLK-38 × Ratan	-15.0648 *	-15.0648 *	33.2000**	33.2000**
26	NLK-38 × Prateek	-4.3443	-14.3988 *	66.5493**	89.2000**
27	NLK-38 × Mahateora	2.0120	-5.0936	41.3669**	57.2000**
28	EC207071 × Ratan	-17.8186 **	-17.8186 **	25.2000**	25.2000**
29	EC207071 × Prateek	-8.9159	-12.2930	63.0282**	85.2000**
30	EC207071 × Mahateora	-17.7009 **	-20.7523 **	34.1727**	49.2000**
31	NLM-12 × Ratan	25.9899 **	25.9899 **	-29.2000**	-29.2000**
32	NLM-12 × Prateek	24.3198 **	20.0684 **	-19.5313**	-17.6000**
33	NLM-12 × Mahateora	-7.4357	-10.6012	-28.5156**	-26.8000**
34	NLM-17 × Ratan	-19.6904 **	-19.6904 **	-8.4270	-34.8000**
35	NLM-17 × Prateek	-8.3534	-10.7451	33.7079**	-4.8000
36	NLM-17 × Mahateora	-4.2136	-6.7135	-11.2360	-36.8000**
37	NLM-23 × Ratan	31.5875 **	31.5875 **	-5.8824	-36.0000**
38	NLM-23 × Prateek	-0.0805	-10.5832	31.1765**	-10.8000*
39	NLM-23 × Mahateora	-9.8859	-16.1627 *	-12.9412	-40.8000**
	S.E (d)	1.17	1.17	0.0101	0.0101

Continued....

Conclusion

The present investigation demonstrated considerable genetic variability and differential heterotic expression among the 39 *Lathyrus* crosses for flowering, maturity, plant architecture, yield components, seed yield and β -ODAP content. Significant positive heterosis for seed yield was identified in NLM-23 × Ratan, NLM-12 × Ratan, NLM-12 × Prateek and NLK-73 × Prateek, which also showed favourable heterosis for important yield contributing characters, particularly branches and pods plant⁻¹. Significant negative heterosis for β -ODAP content was observed in several crosses, indicating the possibility of combining higher productivity with reduced β -ODAP content. Among the evaluated combinations, the above crosses may therefore serve as useful breeding material for further generation advancement and selection. The results emphasize the importance of appropriate parental selection for generating useful variability and superior recombinants in *Lathyrus* improvement programmes.

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