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Short communication

Seed storability behaviour of Lathyrus (*Lathyrus sativus* L.) genotypes

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ABSTRACT

The present investigation was conducted to understand the storability behaviour of the lathyrus which has received very little research attention till date. Therefore, 360 accessions of lathyrus were stored at medium term storage and the viability was monitored after 10 years of storage. The result indicated that out of 360 accessions 320 accessions recorded 0% viability, 30 accessions recorded < 5% viability; 1 accession (EC 329738) recorded 50-60% viability; 5 accessions (RLK 552, RLK 1208, IC 120449, RLK 1159, KH 1) recorded 80-90% viability and 4 accessions (RLK 1054, RLK 287, RLK 1191, RLK 84) recorded > 90% viability after 10 years of storage. Therefore, the best performing accessions (RLK 1054, RLK 287, RLK 1191, RLK 84) which recorded viability of > 90% even after 10 years of storage were identified as the good storer genotypes which can be utilised in improving storability in lathyrus.

Key words: Good storer, Lathyrus, Storage, Viability

Grass pea (*Lathyrus sativus* L.) is the climate-resilient cool-season legume crop mainly cultivated for food, fodder and feed (Lambein *et al.,* 2019). It is being cultivated for more than 8000 years owing to its ability to tolerate various stresses like heat, drought, salinity, flooding, along with its ability of fixing atmospheric nitrogen (Dixit *et al.,* 2016). Such traits endorsed it as an 'insurance crop' that can perform exceptionally well under marginal land with low input and ensure economic, social and nutritional security to the resource poor farmers' of developing nations (Mahapatra *et al.,* 2020). Among the Lathyrus species, grass pea is the most cultivated one, predominantly grown for food, feed and fodder in India, Bangladesh, Nepal, Pakistan and Ethiopia. Broadly, grass pea may be classified into two groups: one from the Indian sub-continent and second from the Mediterranean group with higher yield potential (Hillocks and Maruthi, 2012). This crop is regarded as a perfect candidate crop of rice fallows of South East Asia where it holds immense potential by thriving well on residual soil moisture, providing additional income to the farmers.

Lathyrus seeds are particularly interesting because they are high in protein (18 to 49.0%) and can be a good source of nutrition in areas where other sources of protein are scarce (Pastor-Cavada *et al.,* 2011). However, they also contain a neurotoxin called ODAP (β-N-oxalyl-L-α,β-diaminopropionic acid), which can cause a condition called lathyrism if consumed in large amounts over a prolonged period (Kushwah *et al.,* 2022; Parihar *et al.,* 2023). For this reason, Lathyrus seeds are not widely consumed as a staple food, but are instead used in small quantities as a supplement to other grains and legumes. However, grass pea has received very little research attention especially in the area of seed science research in general and seed longevity in particular. Till date there are very few reports on seed longevity of lathyrus stored for an extended period either at ambient or at controlled condition (Deshava, 2016). Therefore, in the present investigation an attempt was made to understand the long term storability of large number of lathyrus germplasm stored at medium term storage and to identify genotypes (if any) exhibiting good longevity behaviour.

The pure seeds of 360 accessions of lathyrus were stored at medium term storage (4^{o}C) of ICAR-Indian Institute of Pulses Research, Kanpur during 2011-12. The list of the accessions used in the experiment is given in Table 1. The viability of these accessions were checked before storing and all the accessions recorded an initial viability of >90%. For assessing viability, 25 seeds in three replicates were placed in a petri plates lined with two pre-soaked whatman number 1 filter paper and incubated in a germinator for 14 days (ISTA, 2015).

After 14 days, the viability percent was calculated based on the number of seeds germinated (radicle > 2mm) (Lamichaney *et al.*, 2023). After 10 years of storage, during the rabi season of 2021-2022, the seeds of 360 accessions were rejuvenated in the main farm of ICAR-Indian Institute of Pulses Research (ICAR-IIPR), Kanpur under field condition to check the ability of the seeds to maintain viability. ICAR-IIPR is situated in Kanpur city of state Uttar Pradesh (26°27′ N latitude, 80°14′ E longitude and 152 m above mean sea level) and experiences a sub-tropical humid climate with cool winter while summer is dry and hot. The soil is sandy loam with electrical conductivity of 0.342 dS m^{-1}, pH 7.98, soil organic carbon 4.3 g kg^{-1}, potassium 113 mg kg^{-1}, phosphorus 7.1 mg kg^{-1} and available nitrogen 102 mg kg^{-1}. 100 seeds of each accession were sown in a row of 4 m length in three replications following plant geometry of 60 cm and 5 cm between rows and plants, respectively. After 21 days of sowing, number of seedling emerged successfully was counted and computed as the final viability percentage.

The result indicated that out of 360 accessions, 320 accessions had completely lost its viability as they failed to germinate and recorded 0% viability, 30 accessions recorded < 5% viability; 1 accession (EC 329738) recorded 50-60% viability; 5 accessions (RLK 552, RLK 1208, IC 120449, RLK 1159, KH 1)

Table 1. List of 360 lathyrus accessions used in the study

S.N.	Genotype	S.N.	Genotype	S.N.	Genotype	S.N.	Genotype	S.N.	Genotype
1.	RLK 1152	73.	13/47101	145.	BOIL 208	217.	SEL 311	289.	JBT 34/92
2.	RLK 1218	74.	AKP/NP/8/39	146.	VKS/SSC-17/25	218.	VKG 20/9	290.	JBT 38/48
3.	PBJ/SSC-2/62	75.	SEL 475	147.	KH 16	219.	IC 120438	291.	JBT 38/159
4.	RLK 1115	76.	IFLS 226SEL377	148.	EC 315524	220.	DL 257	292.	VKS 14/27
5.	ET 42460	77.	DL 242	149.	EC 315526	221.	LSD 3F	293.	VKS 13/14
6.	LS 6	78.	ET 42451	150.	DL 265	222.	ET 42448	294.	VKS 16/22
7.	RLK 117	79.	RLK 1120	151.	RLK 1277	223.	SEL 516	295.	VKS 14/2
8.	RLK 911	80.	RLK 905	152.	RLK 1191	224.	AKP 6/27	296.	VKG 28/52
9.	RLK 1155	81.	RLK 1284	153.	BIOR 219	225.	RLK 597	297.	VKG 28/115
10.	RLK 18	82.	RLK 1159	154.	LSD 3C	226.	RLK 1219	298.	VKG 13/57
11.	VKG 20/2	83.	RLK 18	155.	DL 244	227.	VKG 28/68	299.	SEL 439
12.	PBJ/SSS-2/72	84.	RLK 1238	156.	EC 315527	228.	JBT 38/226	300.	SEL 554
13.	RLK 1065	85.	BIOR 239	157.	DL 247	229.	VKG 28/54	301.	IC 296745A
14.	SEL 587	86.	BIOR 202	158.	DL 239	230.	VKG 28/125	302.	EC 539038
15.	DL 251	87.	VKS/SSC-7/46	159.	RLK 247	231.	VKG 29/77	303.	EC 540961
16.	VKG 17/5	88.	VKS/SSC-10/22	160.	RLK 903	232.	KC 2/34	304.	EC 540936
17.	EC 328629	89.	VKG 21/211	161.	SEL 471	233.	JBT 36/138	305.	EC 539030
18.	RLK 1278	90.	SEL 505	162.	JBT 30/82	234.	VKS 13/4	306.	SEL 504
19.	RLK 1224	91.	IC 120440A	163.	PUSA 24B	235.	VKS 17/16	307.	SEL 510A
20.	DL 245	92.	IC 120524	164.	VKS/SSC-7/64	236.	EC 539037	308.	SEL 520
21.	RLK 602	93.	IC 120435	165.	200 SEL 453	237.	EC 539039	309.	KG 2/17
22.	RLK 116	94.	RLK 1153	166.	SEL 529	238.	EC 540935	310.	IC 296745
23.	RLK 1132	95.	LSD 3	167.	SEL 334	239.	EC 520243	311.	ET 4
24.	RLK 1054	96.	RLK 195	168.	RLK 383	240.	VKG 29/63	312.	VKG 29/11
25.	RLK 457	97.	RLK 1203	169.	RLK 1167	241.	VKG 28/104	313.	VKG 28/131
26.	RLK 1047	98.	RLK 1274	170.	RLK 1098	242.	JBT 41/93	314.	VKG 31/64
27.	RLK 552	99.	RLK 1116	171.	RLK 398	243.	JBT 38/168	315.	JBT 34/91
28.	RLK 568	100.	SEL 508	172.	DL 259	244.	JBT 38/144	316.	JBT 38/79
29.	RLK 945	101.	SEL 530	173.	VKS/SSC-10/27	245.	JBT 34/98	317.	JBT 37/55

30.	RLK 574	102.	JRL 115	174.	RLK 278	246.	JBT 41/40	318.	RLK 1229
31.	RLK 152	103.	VKS 12/8	175.	ET 42450	247.	JBT 38/71	319.	RLK 538
32.	RLK 1208	104.	VKS 12/19	176.	JRL 41	248.	JBT 41/96	320.	SEL 527
33.	RLK 932	105.	S 44	177.	EC 329738	249.	JBT 36/74	321.	SEL 533
34.	RLK 1205	106.	DL 255	178.	4/48116	250.	ET 11	322.	SEL 519
35.	RLK 532	107.	RLK 1121	179.	PUSA 24C	251.	ET 1	323.	DL 256
36.	RLK 1119	108.	RSR/SSC-1/12	180.	RLK 1171	252.	ET 3	324.	IC 120534
37.	RLK 553	109.	EC 32864	181.	RLK 1111	253.	ET 9	325.	VKS/SSC7/33
38.	RLK 533	110.	11/48107	182.	RLK 1158	254.	VKG 28/16	326.	VKS/SSC7/53
39.	RLK 427	111.	PUSA 24A	183.	RLK 331	255.	VKG 28/128	327.	DL 248
40.	RLK 1125	112.	PBJ/SSC-2/54	184.	RLK 1161	256.	VKG 29/86	328.	VKG 21/105
41.	IC 120528	113.	EC 329741	185.	RLK 750	257.	VKG 30/83	329.	VKG 21/64
42.	SEL 510	114.	5/46102	186.	RLK 488	258.	EC 540981	330.	SEL 504A
43.	SEL 531	115.	14/46101	187.	DL 229	259.	EC 541913	331.	ET 42462
44.	ICAR 10/46116	116.	DL 246	188.	DL 250	260.	VKS 17/23	332.	EC 200324
45.	SSC 11	117.	DL 253	189.	AKP/KR/5/29	261.	MK 2/VK15212	333.	AKP AA/5/58
46.	LSD 3D	118.	DL 254	190.	DL 241	262.	MK 2/ VK15/391	334.	VKS 11/45
47.	IC 120449	119.	RLK 1051	191.	IC 120436	263.	SEL 508A	335.	RLK 1058
48.	EC 42459	120.	RLK 1050	192.	VKS/SSC-7/18	264.	SEL 528	336.	RLK 888A
49.	RLK 266	121.	RLK 1233	193.	RLK 1310	265.	SEL 553	337.	RLK 259
50.	RLK 287	122.	RLK 960	194.	RLK 1110	266.	SEL 481	338.	RLK 301
51.	PUSA 24	123.	RLK 684	195.	RLK 379	267.	ET 12	339.	RLK 208
52.	LSD 3B	124.	RLK 1280	196.	RLK 1206	268.	ET 14	340.	RLK 1177
53.	VKG 18/74	125.	RLK 1212	197.	RLK 1188	269.	EC 539014	341.	RLK 1045
54.	EC 200322	126.	LSD 3E	198.	RLK 1289	270.	EC 539036	342.	RLK 1242
55.	ET 42453	127.	LSD 3A	199.	RLK 1139	271.	EC 539013	343.	RLK 430
56.	KH 2	128.	IFLS SEL 54	200.	RLK 888	272.	VKG 30/58	344.	RLK 281
57.	AKP 6/30	129.	PS 6	201.	RLK 558	273.	VKG 31/118	345.	RLK 84
58.	JRL 16	130.	VKS 12/14	202.	RLK 1131	274.	VKG 28/43	346.	RLK 1165
59.	RLK 298	131.	VKG 21/187	203.	RLK 94	275.	VKG 28/118	347.	EC 329739
60.	RLK 539	132.	IC 120446	204.	RLK 400	276.	VKG 28/47	348.	SEL 459
61.	VKG 21/153	133.	DL 257A	205.	RLK 1140	277.	VKS 17/8	349.	DL 450
62.	DL 258	134.	ET 42456	206.	EC 208952	278.	JBT 46/17	350.	VKG 16/169
63.	ET 42458	135.	PUSA 534	207.	EC 333908	279.	JBT 41/12	351.	JBT 29/99
64.	PUSA 505	136.	273 SEL 481	208.	EC 329742	280..	JBT 37/21	352.	PBJ/SSC 2/25
65.	RLK 1156	137.	IFLS 340SEL 484	209.	KH 1	281.	JBT 38/42	353.	VKS/SSC 7/2
66.	RLK 1143	138.	RLK 471	210.	VKS 11/37	282.	JBT 38/117	354.	VKS 12/36
67.	RLK 1059	139.	RLK 240	211.	AKP-NIV/5/63	283.	JBT 38/98	355.	ET 42449
68.	RLK 597-3	140.	RLK 1217	212.	AKP/NP/8/36	284.	JBT 38/35	356.	JRL 47
69.	VKG 19/126	141.	RLK 990	213.	PBJ/SSC-2/66	285.	JBT 38/66	357.	EC 315525
70.	VKG 21/112	142.	RSR/SSC-1/52	214.	VKG-21/57	286.	JBT 46/39	358.	EC 200333
71.	SEL 462	143.	RLK 854	215.	BIOR 234	287.	JBT 34/49	359.	VKG 18/42
72.	EC 292755	144.	RLK 457A	216.	IC 120529	288.	JBT 38/164	360.	RLK 648

recorded 80-90% viability and 4 accessions (RLK 1054, RLK 287, RLK 1191, RLK 84) recorded > 90% viability after 10 years of storage. Therefore, the best performing accessions (RLK 1054, RLK 287, RLK 1191, RLK 84) which recorded viability of > 90% even after 10 years of storage were identified as the good storer genotypes, which can be used in lathyrus improvement (Table 2).

The seed longevity refers to viability of the seeds after storage, and therefore, describes the total life span of a seed or a seed lot. During this period of storage, the seed undergoes vital physiological and biochemical processes leading to its deterioration, loss in vigour, and ultimately becomes sensitive to various stresses during germination, and finally die. However, how fast a seed deteriorates/ages depends on various factors such as initial seed quality, temperature, seed moisture content etc. The longevity of lathyrus seeds varies depending on the species, storage conditions, and other factors. Generally, lathyrus seeds have a moderate to high potential for long-term storage, with some species retaining their viability for up to several years. However, it's important to note that the longevity of lathyrus seeds can be affected by a number of factors, including seed quality, storage temperature, relative humidity, and the presence of pests or diseases. Seeds that are harvested from healthy, disease-free plants and stored in cool, dry conditions are more likely to remain viable for longer periods of time. Deshava (2016) observed a 10% reduction in viability of lathyrus seeds stored in a hermetically sealed containers with at 5±2% moisture content stored at the national gene bank of Bulgaria maintained at -18°C after 20-24 years. Amin *et al.* (2008) studied the effect of initial seed moisture content and packaging material on storability of lathyrus and concluded that the germination potential was affected when stored at higher moisture content. With respect to packaging material, the seeds stored at sealed container recorded higher germination followed by seeds stored in polythene bags and gunny bags. Seed deterioration is a complex process that can be caused by a variety of factors, including environmental conditions, genetic factors, and the inherent properties of the seed itself (Lamichaney *et al.*, 2019; Lamichaney *et al.*, 2021; Zhang *et al.*, 2021). At the cellular and molecular level, seed deterioration can involve a number of physiological mechanisms, such as oxidative damage due to presence of high levels of unsaturated fatty acids and reactive oxygen species (ROS). This can cause lipid peroxidation, protein oxidation, and DNA damage, all of which can impair seed viability and germination (Kurek *et al.*, 2019). The integrity of the cell membrane is critical for maintaining seed

Table 2. Viability percentage of 360 lathyrus accessions after 10 years of medium term storage

Viability (%)	0	< 5%	50-60%	80-90%	90-100%
Number of accessions	320	30	1 (EC 329738)	5 (RLK 552, RLK 1208, IC 120449, RLK 1159, KH 1)	4 (RLK 1054, RLK 287, RLK 1191, RLK 84)

Table 3. Agro-morphological observations of the good storer lathyrus genotypes

Genotypes	Origin	DF	DM	PH (cm)	PPP	Seed/pod	100 seed weight (g)	PL (cm)	PW (g)	Yield/plant (g)
RLK 1054	Durg, MP	78	136	47.8	63.00	4.00	5.8	3.13	0.73	8.60
RLK 552	Durg, MP	67	119	48.4	37.00	3.33	7.0	2.73	0.53	7.53
RLK 1208	Raipur, MP	81	134	63	72.00	3.67	4.8	2.83	0.60	7.60
IC 120449	NBPGR	77	134	53.8	50.67	4.33	8.6	3.13	0.68	12.33
RLK 287	Rajnadgaon, MP	78	136	53	98.67	4.33	6.4	3.13	0.73	15.70
RLK 1159	Raipur, MP	83	132	60.2	59.67	3.67	6.0	2.87	0.55	7.23
RLK 1191	Raipur, MP	77	139	57.4	65.00	4.33	6.9	3.00	0.55	9.87
RLK 84	Raipur, MP	89	134	64.8	43.33	3.33	7.0	3.03	0.63	7.87
EC 329738	Syria	85	139	63.8	43.00	3.33	9.3	3.07	0.70	7.83
KH 1	NBPGR	89	136	58.8	48.00	3.33	6.1	2.73	0.58	10.47

DF, days to 50% flowering; DM, days to maturity; PH, plant height; PPP, pods/plant; PL, pod length; PW, pod width viability, and damage to the membrane can occur due to factors such as dehydration, freezing, or exposure to high temperatures. This can lead to leakage of cellular contents and loss of membrane function, which can impair seed germination and vigour (Golovina *et al.,* 2010). Proteins are critical components of seed cells, and denaturation of proteins can occur due to factors such as high temperature, aging, or exposure to toxins. This can impair the function of enzymes and other proteins, leading to decreased seed viability and germination (Ogé *et al.,* 2010; Lamichaney *et al.,* 2019).

The best performing 10 genotypes which recorded a viability of >50% after 10 years of storage took 67 days (RLK 552) to 89 days (RK 84, KH 1) for achieving 50% flowering. Likewise, the days to maturity in these accessions ranged between 119 days (RLK 552) to 139 days (EC 329738, RLK 1191). These 10 accessions recorded a plant height between 47.8 cm (RLK 1054) and 64.8 cm (RLK 84). Highest number of pods plant^{-1} (98.67) and seed pod^{-1} (4.33) was observed in RLK 287 and IC 120449, RLK 287, RLK 1191 respectively. The 100-seed weight of these accessions ranged between 4.8 g (RLK 1208) and 9.3 g (EC 329738). The pod length varied between 2.73 cm (RLK 552) - 3.13 cm (RLLK 1054, IC 120449, RLK 287). Likewise, the seed weight plant^{-1} in these 10 accessions ranged between 7.23 g (RLK 1159) and 15.70 g (RLK 287) (Table 3).

The lathyrus accessions RLK 1054, RLK 287, RLK 1191, RLK 84 were identified as the good storer genotypes as they were able to maintain >90% viability even after 10 years of storage. These accessions could be utilised in improving storability of lathyrus. Understanding the physiological, biochemical and molecular mechanism will provide insights behind such contrasting storability behaviour of different lathyrus genotypes.

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