



## Pattern of seed longevity during storage of lentil (*Lens culinaris*) cultivars

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Lentil (*Lens culinaris* Medikus) is an important winter (*rabi*) season legume, globally grown in about 6.58 mha area with 7.6 million tonnes (mt) and 1153 kg/ha production and productivity (Parihar *et al.* 2018). In India, lentil is being cultivated in an area of about 1.5 mha with a production of around 1.6 mt (Kumar and Gupta 2019). The average productivity of lentil in India is 847 kg/ha which is relatively low as compared to the average productivity of world (Sharma *et al.* 2018, PC report AICRP MullaRP 2019–20), which could be owing to scantiness of quality seed of improved varieties, use of farmers' saved seed, poor crop management etc. Quality seed production and maintenance of its quality during storage till further utilization for sowing purpose is quintessential for sustaining lentil production. The duration of storage may vary from months to year, while the carryover seeds need to be stored for more than a year. In addition, the prevailing temperature, nature of the seeds, seed moisture content, the relative humidity during storage affects the seed longevity (Khalequzzaman *et al.* 2012). Likewise, if the seeds are to be conserved in a genebank, the storage period last for many years to reduce the cost of rejuvenation process. Therefore, it becomes very important to understand the exact period when the cultivar could be stored with minimum loss in viability. As per the Indian Minimum Seed Certification Standard (IMSCS), the minimum requirement of germination for a lentil seed lot is 75% (Trivedi and Gunasekaran 2013). Therefore, the present investigation was executed to assess the effect of the storage period on the viability of lentil cultivars.

The present study was carried out at ICAR-Indian Institute of Pulse Research (IIPR), Kanpur, Uttar Pradesh during the winter (*rabi*) seasons of 2017–20 to assess the effect of the storage period (under ambient conditions) on the viability of 36 lentil released cultivars. The seeds of 36 different varieties of lentil were produced at IIPR, Kanpur, Uttar Pradesh. After observing the initial viability

percentage, the seeds of all the varieties were kept inside a cloth bag and stored at laboratory conditions. After 1 (2016–17), 2 (2017–18), 3 (2018–19) and 4 (2019–20) years, the seeds from each of the varieties were tested for its viability. Viability was tested through germination test following top of the paper protocol. Briefly, 25 seeds of each cultivar in 4 replications were placed in petri plates lined with two wet filter paper. After placing the seeds, the petri plates were kept in germinator at 20°C for 10 days (ISTA 2015). On 11<sup>th</sup> day, the viability percentage was recorded on the basis of per cent normal seedlings developed.

In general, storing seeds for 3 years under ambient laboratory condition had no effect on viability of lentil varieties (Table 1), however, genotypic variability was observed. The viability percentage of fresh seed (before storage) of 36 lentil varieties varied between 71% (DPL 81) to 92% (HUL 57, VL 126, PL5) with a mean value of 85%. All the varieties after first year of storage demonstrated a mean per cent viability of about 94%, and the value ranged between 74% (Asha, JL 3) to 100% (VL 4, LH 84-8). While, after 2 years of storage, the viability value fluctuated between 82% (PL 24) to 100% (LL 699), with a mean value of 94%. Likewise, after 3 years of storage, the viability value ranged between 68% (VL 507) to 100% (K 75, IPL 315), with a mean value of 93%. The low mean viability recorded in fresh seed (85%) as compared to one year stored seeds (94%) was owing to the presence of hard seeds in the freshly harvested seed and the value of which was not included in the germination value. After one year of storage, the percentage of hard seeds declined, and hence viability percentage increased. The occurrence of hard seeds in lentil has been reported (Ladizinsky 1985). Notably, the viability of seeds was drastically reduced when stored for 4 years with a mean value of 50%. The germination value oscillated between 0% (DPL 15, DPL 62) to 94% (WBL 77, KLS 216). Most interestingly, after 3 years of storage, all the varieties except VL 507 had viability more than 75% which is a minimum seed germination standard as per IMSCS. These findings demonstrate that all these varieties could be safely stored at ambient laboratory condition for 3

Table 1 Germination of 36 lentil varieties stored for 0, 1, 2, 3 and 4 years at ambient laboratory conditions

Variety	Storage period (year)				
	0 (fresh)	1	2	3	4
DPL 15	83	98	94	97	0
DPL 62	88	93	98	93	0
K 75	81	81	96	100	2
PL 5	92	99	85	89	6
LL 56	89	97	90	98	16
Barahia Local	88	88	98	92	16
LL 147	87	97	94	94	20
JL 3	74	74	98	88	26
DPL 81	71	97	97	94	29
LL 699	82	99	100	98	32
L 4076	91	97	98	92	34
PL 4	82	99	98	96	36
VL 4	91	100	92	96	36
SSI 5	85	85	94	76	36
HUL 57	92	92	96	98	38
IPL 315	81	93	86	100	39
PL 24	74	93	82	87	40
LH 84-8	80	100	96	98	44
PL 406	85	97	98	98	54
L 4147	76	98	96	94	54
Subrita	84	84	98	96	54
VL 126	92	98	98	94	58
JL 1	91	91	98	94	60
PL 63	88	97	93	91	68
VL 1	89	99	96	86	68
VL 507	85	98	96	68	70
PL 234	90	99	94	98	72
IPL 406	81	95	93	91	75
PL 639	87	98	94	98	76
ASHA	74	74	94	92	82
PL 77-12	87	97	94	86	88
Ranjan	91	91	90	98	88
NDL 1	88	94	93	87	90
VL 103	90	98	90	90	92
WBL 77	81	96	96	92	94
KLS 218	86	86	96	96	94
Average	84.89	93.67	94.42	92.64	49.64

Table 2 Different categories of the lentil genotypes based on the storage ability

Category	Genotypes
Poor storer (<40%)	DPL 15, DPL 62, K 75, PL 5, LL 56, Barahia Local, LL 147, JL 3, DPL 81, LL 699, L 4076, PL 4, VL 4, SSI 5, HUL 57, IPL 315, PL 24 (17)
Medium storer (41–74%)	LH 84-8, PL 406, L 4147, Subrita, VL 126, JL 1, PL 63, VL 1, VL 507, PL 234(10)
Good storer (≥75%)	IPL 406, PL 639, ASHA, PL 77-12, Ranjan, NDL 1, VL 103, WBL 77, KLS 218 (9)

years. Conversely, after four years of storage, 27 varieties had viability of less than 75%, indicating unsuitability of these varieties to store beyond 3 years; while other nine varieties recorded viability of ≥75%, indicating appropriateness of storing them for 4 years. The varieties like NDL 1, VL 103, WBL 77 and KLS 218 recorded >90% viability even after 4 years of storage, indicating a possibility of storing them for few more years (Table 1). While, varieties like DPL 15, DPL 62, K 75 and PL 5 had 0–6% viability after 4 years of storage (Fig 1). Significant reduction in the germination of lentil seed is reported when stored at 75% relative humidity and 35°C for 1, 2 and 3 months (Assefa and Srinivasan 2016). Considering the ability of these varieties to maintain seed germination after four years of storage the tested varieties were distributed in three categories, i.e. poor storer (17), medium storer (10) and good storer (9) varieties (Table 2). The good storer varieties could be stored for more than 4 years.

The process of seed deterioration, though, is reported to start as early as its development and maturation period (McDonald 2004), lentil fresh seeds usually records more than 90% seed germination (including hard seeds). Seed longevity is mainly influenced by the genotype and environment. Seed deterioration is an irreversible process, but the rate of its deterioration could be managed to a larger extent by making modifications in the storage condition (Lamichaney *et al.* 2019). Lamichaney *et al.* (2021) suggested that using of aged seeds could cause poor field emergence, along with non-uniform and delayed germination. During storage, per-oxidation of the lipids resulted into development and accumulation of reactive oxygen species (ROS) or free radicals which in turn negatively affects the viability and vigour of the seed (Corbineau *et al.* 2002). By scavenging the ROS, cell maintains its integrity and thus protects itself. The antioxidants like vitamin E, isoflavones and antioxidant enzymes like super oxide dismutase, catalase, peroxidase, glutathione reductase are known as ROS scavengers, which reduce the content of ROS and prolong seed longevity during storage.

#### SUMMARY

In the present study, the viability of 36 high yielding lentil cultivars were tested at an interval of 0 (before storage), 1, 2, 3 and 4 years of storage. In all the tested varieties, the

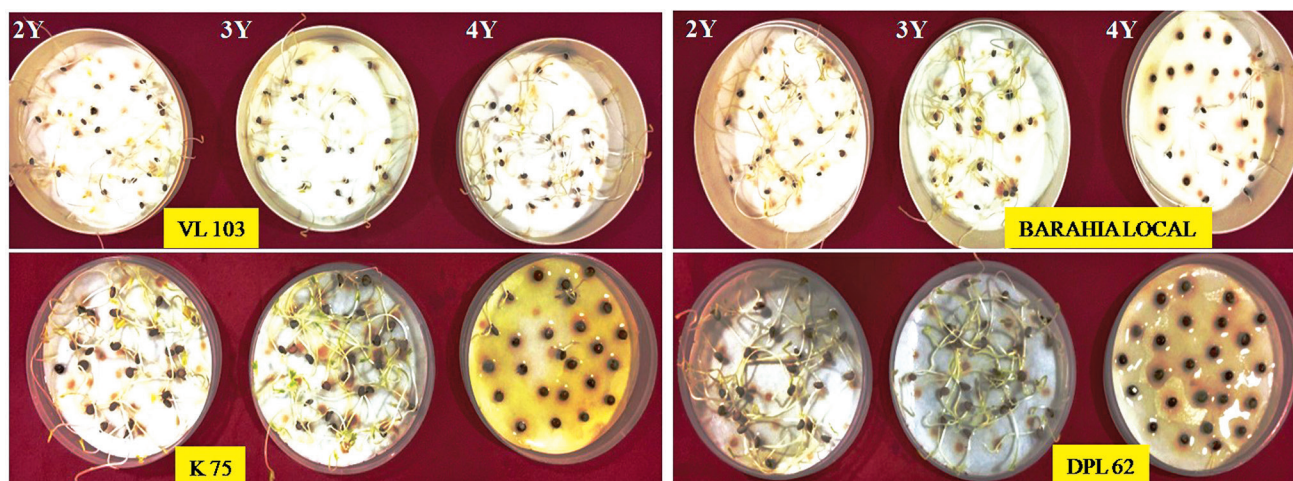


Fig 1 Germination pattern of good (VL 103), intermediate (Barahia Local) and poor storer (K 75, DPL 62) varieties stored for 2, 3 and 4 years. VL 103 showing profuse germination even after 4 years of storage while poor storer K 75 and DPL 62 demonstrating complete loss of germination after 4 years of storage.

mean viability was 85, 94, 94, 93 and 50% when stored for 0, 1, 2, 3 and 4 years, respectively. Lentil being an orthodox seed can be stored well up to three years maintaining viability above the minimum requirement (75%) as per Indian Minimum Seed Certification Standards (IMSCS). Therefore, it is recommended to store the seeds of these varieties up to three years, except for VL 507, under ambient conditions. Notably, the seeds of nine varieties namely IPL 406, PL 639, Asha, PL 77-12, Ranjan, NDL 1, VL 103, WBL 77 and KLS 218 could be stored for more than 4 years. These varieties are identified with better storage ability and could be embraced as donors in lentil breeding program for developing cultivars with better storage efficiency

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