

Study on underground storage of potato (*Solanum tuberosum*) during winter in Ladakh

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The passive underground storage of potato (*Solanum tuberosum*) was designed and potato tubers of Kufri Jyoti, Kufri Himalini and Kufri Girdhari were stored in passive underground storage during November 2022 - April 2023 at Defense Institute of High-Altitude Research, Leh Ladakh. Of three cultivars, tubers of Kufri Girdhari showed lowest total weight loss as compared to other varieties.

Potato is most valued non cereal crop in Ladakh. It is consumed by the locals as well as the army deployed here, all through the season. The crop is multiplied vegetatively using tuber as seed material usually (Paul *et.al.*, 2022). The crop is cultivated in May and harvested in September. During the harsh cold winter, continuous supply of fresh vegetables is not possible as the region remains landlocked during November - May. Transport of vegetables through air route is expensive as it charges around Rs 130/kg. In such cases, storage of potato for long period of winter becomes essential (Singh and Srivastava, 2012). Moreover, to address food insecurity, it is crucial to boost productivity and expand the area dedicated to potato production (Jatav *et.al.*, 2023)

The study was carried out in underground passive storage located at Leh (77.57298° E; 34.13298° N; elevation 11482 ft) during November - April (Fig 1). Potato tubers of Kufri Jyoti, Kufri Himalini and Kufri Girdhari were used for study. Potatoes were properly cured, free from damages and stored in perforated leno bags (35kg each). The observation for weight loss and rotting were done monthly. Temperature and humidity were also recorded during the storage period with testo 175 H1 data logger.

In potato tubers, physiological processes such as respiration and transpiration occur even after harvesting. These processes cause physiological changes and leads to water loss. The process of heat transfer is dependent on various factors such as

temperature, humidity, and physical properties of tuber (GolMohammadi and Sayyah, 2013). The temperature and humidity recorded during the storage period is given in Table 1. The temperature in storage fluctuates with fluctuation in ambient temperature. During the storage period maximum ambient temperature was recorded as 22.6° C, whereas maximum temperature in underground passive storage was 7.60° C. Also, it was observed that during peak January when minimum temperature 4.05° C was recorded inside the underground passive storage while the ambient temperature was -21.1° C.



Fig 1: Underground passive storage of potato.

Evaporation losses from tuber surface (skin) leads to reduction in weight of tubers which is considered as physiological weight loss. Excessive evaporative losses not only cause reduction in weight but also cause shrinkage on tuber skin and consequently affect the market value of tubers (Sudha *et al.*, 2017). At the end of storage period, it was observed that physiological weight loss was observed as 1.88%, 2.35% and 2.04 % in Kufri Jyoti, Kufri Himalini and Kufri Girdhari respectively (Table 2). The minimum weight loss was recorded in Kufri Jyoti (1.88%) and maximum weight loss in Kufri Himalini (2.35%). The difference in weight losses may be due to variable respiration and transpiration processes occurring in the different cultivars. Also, continuous physiological process of respiration and transpiration after harvesting of tubers leads to dehydration and leads to weight loss (Ozturk and Polat, 2016). The weight loss is related with periderm thickness, number of cell layers

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Table 1: Monthly average maximum and minimum temperature of underground passive storage

Month	Maximum		Minimum		Humidity (%)	
	Open	Store	Open	Store	Open	Store
November	22.6° C	7.60° C	13.7° C	6.6° C	30.5	80
December	5.40° C	5.90° C	-18.90° C	5.20° C	32.10	76.27
January	0.12° C	5.58° C	-21.1° C	4.05° C	46.74	84.67
February	3.58° C	5.54° C	-19.5° C	4.00° C	47.99	86.73
March	22.4° C	8.16° C	-8.3° C	5.65° C	40.46	81.78
April	20.4° C	10.50° C	-6.90° C	8.23° C	26.51	66.94

Table 2: Physiological weight loss and percentage loss due to rotting and total weight loss of different potato cultivar in underground passive storage

Variety	Physiological weight loss (%)	Loss due to rotting (%)	Total weight loss (%)
Kufri Jyoti	1.88	8.49	10.37
Kufri Himalini	2.35	5.98	8.33
Kufri Girdhari	2.04	5.74	7.78

in periderm and number of lenticels on tuber surface (Ezekiel *et al.*, 2004).

The percentage loss due to rotting in underground passive storage was observed as 8.49 %, 5.98% and 5.74% in Kufri Jyoti, Kufri Girdhari and Kufri Himalini respectively (Table 2). Minimum percentage loss due to rotting was observed in Kufri Girdhari (5.74%) and maximum was observed in Kufri Jyoti (8.49 %). The lower rate of rotten percentage of potato tubers is influenced by the environment, under which genotypes were grown and stored (Bhutani and Khurana, 2005).

Total weight loss in potato varieties determines the longevity of their storage and their shelf- life. Total weight loss (including physiological weight loss and weight loss due to rotting) at 180 days of storage showed large variation between varieties in the study. Total weight loss was lowest in Kufri Girdhari (7.78%) and highest in Kufri Jyoti (10.37 %). Sudha *et al.* (2017) studied the storage behaviour of 5 different potato cultivars under ambient storage conditions of Nigiri region and reported lowest total weight loss observed in Kufri Girdhari (15%) as compared to other varieties. Based on the findings, it can be concluded that Kufri Girdhari is the best variety for storage at high altitude. Also, the underground passive storage provides a favourable environment for potato storage during the peak winter month.

Thus, it is concluded that potato tubers were found suitable for consumption at the end of storage period demonstrating that potatoes can be stored successfully during winter period in passive underground store in Ladakh.

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