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Post-harvest Storage Losses Study in Onion Genotypes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted at Vegetable Research Farm, Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur during Rabi season 2021-22 with the objective to study the storage losses in various varieties of onion and identify those varieties with a good storage life. The experimental material consisted of 15 onion genotypes from different locations in India. Observations on physiological loss in weight, rotting and sprouting percentage were recorded at fortnight level upto 90 days. Variety and storage time had significant effect on weight loss, sprouting and rotting. Overall, during the three months of storage period, minimum physiological loss in weight was observed in LC-1 (5.80%) which was statistically at par with LC-2 (6.05%), Patna Red (6.20%), Bhima Shakti (6.21%), Agrifound Light Red (6.54%) and NHRDF local (6.83%). The minimum rotting was observed in LC-1 (13.32%) which was statistically at par with LC-2 (14.73%). Sprouting was not observed throughout the storage period in any of the genotypes. LC-1, LC-2, Patna Red and Bhima Shakti had good storage as compared to other genotypes. These genotypes can be explored in the breeding programmes for production of high yielding varieties with good storage potential.

Keywords: Onion; physiological loss in weight; rotting.

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ABBREVIATIONS

CM: Centimeter
PLW: Physiological loss in weight
Trans: Transformed values

1. INTRODUCTION

Onion (*Allium cepa* L.) is an underground vegetable of the family Amaryllidaceae, having chromosome number 2n = 2x = 16. It is a widely cultivated vegetable crop in many regions of the world, both for fresh market consumption and for processing. It is known as the "Queen of Kitchen" as it is a commonly used by people all over the world. Onion bulbs are used for cooking, salad, and culinary purposes, or in preserved forms [1]. Regarding flavor or pungency, allyl propyl disulphide, a sulphur based compound is responsible for its peculiar smell[2]. It has the most important properties of anticancer, antimicrobial, antioxidant, anti-diabetic and anti-asthmatic [3]. Onion bulbs are grown in a range of climates, with mild climates being the most suitable. However, extreme climatic conditions such as heat, cold, and erratic rainfall are not conducive to the growth of onion [4]. India is the second largest onion growing country in the world. India produced 26.64 million tonnes of onion bulbs from 1.62 million hectare area in the year 2021-2022 [5]. The onion production in India is divided into three crop seasons: Kharif (October to December), late Kharif (January to March) and Rabi (April to May) [6]. Stored Rabi onion is used for domestic and export markets from June to October, making it essential for regular supply. Although onion is less perishable than other vegetables, postharvest losses are inevitable, with some estimates suggesting that 40-50% of the production is lost [7,8]. During storage conditions of onion bulbs, various abnormalities take place, which ultimately affects the quality of produce. The predominant fungal pathogens associated with the storage diseases in onions include *Aspergillus spp*., *Penicillium spp*. and *Fusarium spp*.[9,10]. About 30-50% of post-harvest losses are reported during short-term storage and sprouting and bulb rotting are the major causes of losses [11]. The total storage losses are comprised of physiological loss in weight (PLW) e.g., moisture loss and shrinkage (30-40%), rotting (20-30%) and sprouting (20-40%) [12]. In order to reduce storage losses, it is essential to select a variety with a longer storage life. Therefore, this experiment was conducted to examine the storage losses in various varieties of onion and identify those varieties with a good storage life. All management practices will only be effective in reducing the losses if the chosen variety has a high storage life.

2. MATERIALS AND METHODS

Fifteen onion genotypes were grown at Vegetable Research farm, Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur during the Rabi season of 2021-22. Bhagalpur is geographically situated between 25° 07′ to 25° 30′ N Latitude and between 86° 37′ to 87° 30' E longitude (Please correct the data) at 46 m above mean sea level. The climate of this place is tropical to sub-tropical with slight semi-arid nature and is characterized by a very dry summer, moderate rainfall and very cold winter. December and January are usually the coldest months when the mean temperature normally falls as low as 8.5^0C whereas October and April are the hottest months, having the maximum average temperature of 28.07^0C. The rainfall is mostly distributed from middle of June to middle of October. The rainfall distribution has been erratic lately, adversely affecting the crops and increasing disease and pest intensity. The bulbs were grown as per the recommended package and practices. The bulbs were harvested and cured in the field for 3 days and a week under shade. Five kilograms of bulbs were selected randomly from each replication and the initial number of bulbs of all the cultivars per 5 kg was recorded replication wise. Onions in wooden baskets of diameter 45 cm with three replications under completely randomized design was stored at room temperature in bottom and top ventilated storage house. The mean monthly temperature and relative humidity during storage period and list of different varieties is given in Table 1 and Table 2 respectively. During the storage period, the maximum and minimum temperatures were recorded to be 36^0C and 23.5^0C, respectively. Observations on physiological loss in weight, rotting and sprouting percentage were recorded from the first day of storage at fortnight interval upto 90 days. The obtained data was analyzed by statistical significant at $P<0.05$ level, S.E. and C.D. at 5 per cent level by the procedure given by Panse and Sukhatame, 1962 [13].

1. Physiological loss in weight (%)= (Initial weight-Final weight) x 100/ Initial weight
2. Rotting (%) = (Number of bulbs rotted till the date of recording × 100)/ Initial number of bulbs stored
3. Sprouting (%) = (Number of bulbs sprouted till the date of recording × 100)/ Initial number of bulbs stored

Table 1. Meteorological data during storage period

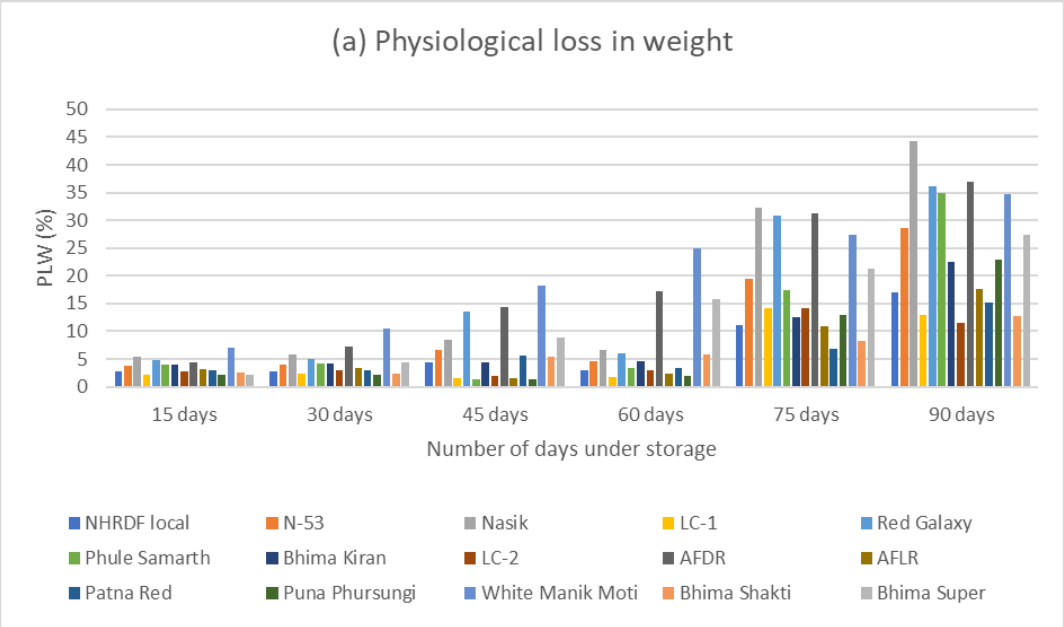
Month (2021-22)	Maximum temperature	Minimum temperature	Relative humidity		Rainfall (mm)
			7.00 AM	2.00 PM	
May	35.4	23.5	82.3	48.9	68.6
June	35.8	25.3	84.9	55.3	161.0
July	36.0	26.1	85.0	58.7	42.6
August	33.7	25.9	87.2	63.7	77.0

Table 2. Genotypes of Onion used under investigation

Sr.No	Onion Genotype	Source
1)	Local collection 1	Locally grown variety
2)	Local collection 2	Locally grown variety
3)	AFLR	Collected from DOGR, Pune and maintained at BAU, Sabour
4)	Red Galaxy	Yogesh Onion Seeds, Pune, Maharashtra
5)	Patna Red	ICAR Research Complex, Patna Bihar
6)	White Manik Moti	Yogesh Onion Seeds, Pune, Maharashtra
7)	Poona Fursungi	Yogesh Onion Seeds, Pune, Maharashtra
8)	Bhima Kiran	Collected from DOGR, Pune and maintained at BAU, Sabour
9)	Phule Samarth	Yogesh Onion Seeds, Pune, Maharashtra
10)	NHRDF	Collected from DOGR, Pune and maintained at BAU, Sabour
11)	N-53	Yogesh Onion Seeds, Pune, Maharashtra
12)	Nasik	Yogesh Onion Seeds, Pune, Maharashtra
13)	AFDR	Collected from DOGR, Pune and maintained at BAU, Sabour
14)	Bhima Shakti	Collected from DOGR, Pune and maintained at BAU, Sabour
15)	Bhima Super	Collected from DOGR, Pune and maintained at BAU, Sabour

3. RESULTS AND DISCUSSION

Bulb storage quality is an important parameter, which ultimately decides the demand and premium price of onions in the market. The characteristics like percent of sprouting bulbs, percent of rotten bulbs and total loss in weight decide the storage quality of bulbs. Variety and storage time had significant effect on weight loss, sprouting and rotting. The physiological loss in weight (%) and rotting (%) during storage upto 90 days has been shown in Fig. 1(a) and 1(b) respectively.



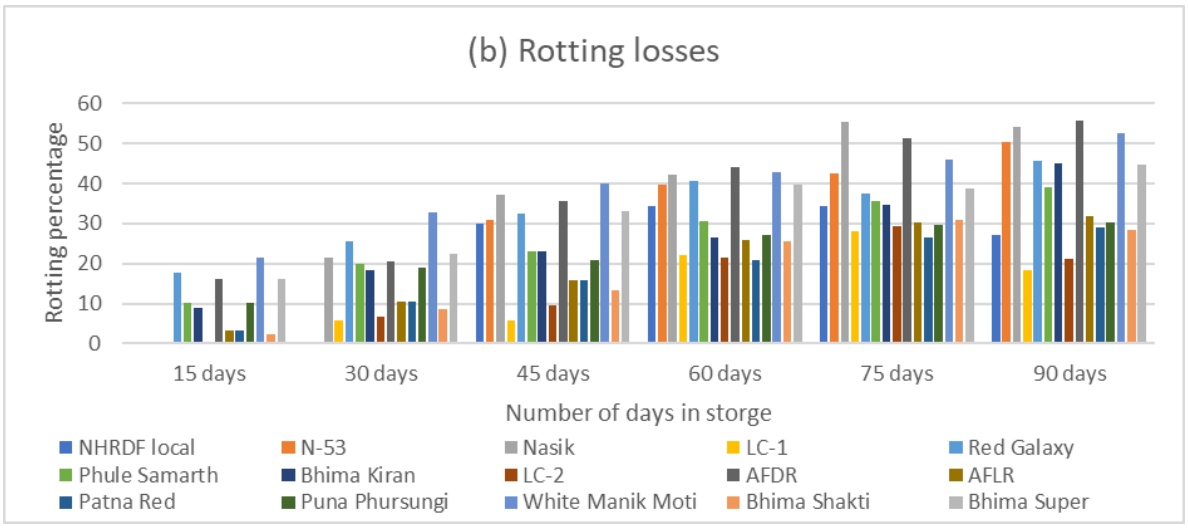


Fig. 1 (a). Physiological loss in weight (b) rotting losses in onion under the storage upto 90 days

During first thirty days of storage, Puna Phursungi (2.26%) and LC-1 (2.29%) had shown the lowest physiological loss in weight compared to other varieties. However, White Manik Moti (32.67%) and Red Galaxy (25.67%) genotypes exhibited highest rotting percentage. Therefore, these genotypes would not be suitable for long term storage and should be marketed as early as possible. Physiological weight loss was significantly lower in LC-1 (1.83%) followed by Puna Phursungi (1.93%) on two months of storage. Significantly high rotting loss was observed in Agrifound Dark Red (44.19%) and White Manik Moti (42.98%). After three months of storage, LC-2 and Bhima Shakti exhibited minimal physiological loss in weight i.e. 11.53% and 12.65% respectively which implied that these genotypes were fit for long term storage. Compared to other genotypes, highest rotting losses were recorded in Nasik (54.22%) and N-53 (50.44) genotypes.

Analysis of variance indicated that all the genotypes under study were highly significant for physiological loss in weight and rotting (Table 3). Overall during the three months of storage period, as shown in Table 4, the maximum physiological loss in weight was observed in White Manik Moti (20.45 %) followed by Agrifound Dark Red (18.60%) and Nasik (17.16%). Minimum physiological loss in weight wasobserved in LC-1 (5.80%) which was statistically at par with LC-2 (6.05%), Patna Red (6.20 %), Bhima Shakti (6.21 %), Agrifound Light Red (6.54 %) and NHRDF local (6.83%),which may be attributed to higher TSS in these genotypes. The maximum rotting was observed in White Manik Moti (39.26 %) followed by Agrifound Dark Red (37.26 %) and Nasik (35.12 %). This implicated that these genotypes were prone to storage diseases like *Aspergillus* rot and Basal rot. Minimum rotting was observed in LC-1 (13.32 %) which was statistically at par with LC-2 (14.73 %), which might be attributed to high TSS and dry matter content along with greater pungency in the bulbs. Sprouting was not observed throughout the storage period in any of the genotypes. Earlier studies also reported a significant difference with respect to storage loss in weight among the different onion genotypes by Shanmugasundaram [14,15,16] and Trivedi and Dhumal [17].

Table 3. Analysis of variance for storage parameters under study

	Mean sum of squares	
Characters	**Genotypes**	**Error**
	df=14	**df=30**
Physiological loss in weight (%)	79.1508**	0.3648
Rotting (%)	208.878**	1.87834

**Sprouting was not observed in any of the genotypes throughout the storage period*

Table 4. Mean performance of 15 genotypes for storage parameters

	PLW		Rotting	
	(%)	(Trans.)	(%)	(Trans.)
NHRDF local	6.83	15.14	21.00	27.26
N-53	11.19	19.53	27.34	31.51
Nasik	17.16	24.46	35.12	36.33
LC-1	5.80	13.93	13.32	21.40
Red Galaxy	16.09	23.63	33.30	35.23
Phule Samarth	10.87	19.24	26.43	30.92
Bhima Kiran	8.72	17.17	26.12	30.72
LC-2	6.05	14.23	14.73	22.55
AFDR	18.60	25.53	37.26	37.60
AFLR	6.54	14.81	19.61	26.27
Patna Red	6.20	14.41	17.66	24.83
Puna Phursungi	7.24	15.60	22.83	28.52
White Manik Moti	20.45	26.87	39.26	38.78
Bhima Shakti	6.21	14.42	18.22	25.26
Bhima Super	13.28	21.36	32.47	34.72
Mean	10.75	18.69	25.64	30.13
C.V.	5.62	2.76	5.34	2.92
S.E.	0.35	0.30	0.79	0.51
C.D. 1%	1.36	0.86	3.08	1.47

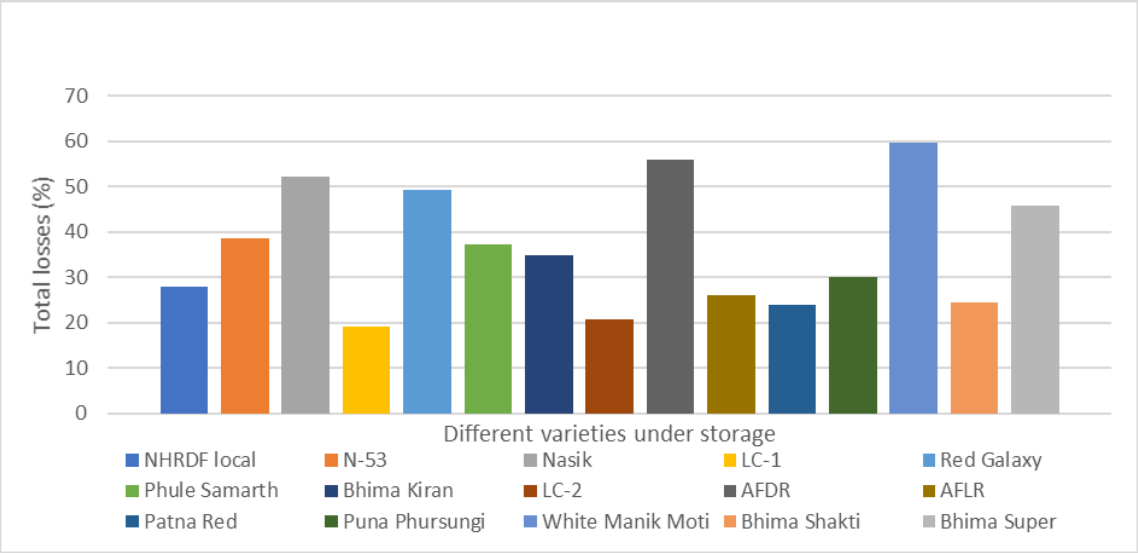


Fig. 2. Graph showing total storage losses in different varieties over a period of 90 days

4. CONCLUSION

LC-1, LC-2, Patna Red and Bhima Shakti had longer shelf life as compared to other genotypes as depicted in Fig. 2. These genotypes may be considered for long-term storage of onion and for minimising the post-harvest storage losses. These genotypes can also be explored in the breeding programmes for production of high yielding varieties with good storage potential and resistance to storage disorders.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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