



P-ISSN: 2349-8528

E-ISSN: 2321-4902

[www.chemijournal.com](http://www.chemijournal.com)

IJCS 2020; 8(2): 2201-2206

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Received: 23-01-2020

Accepted: 26-02-2020

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## Screening of red onion genotypes for selection of good keeping quality variety

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i2ag.9079>

**Abstract**

Onion is commercially cultivated and widely consumed as vegetable and as spices in India. A wide range of variability in bulb yield attributes as well as in storability is noticed. Onion is semi-perishable crop so that it cannot store for long time. Due to storage loss it cannot be guaranteed that whole amount of the total production is consumed by the people. It is estimated that about 35-40% losses are recorded in various process of handling if proper care is not taken in production and post-harvest management of onion. It is observed that losses are possible to be reduced about 15-20% if proper care is taken. The losses are on account of decay (10-12%) sprouting (4-5%) and drriage. Weight loss is 20-25% depending upon the period of storage. In storage, a heavy loss noted due to sprouting and decay and these losses varies from 5-85% depending upon the variety and weather conditions. The effect of various cultural practices though is not very clear but some of the operations like soil, irrigation, nitrogen, potash application, chemical application, time of harvesting and stage of maturity while harvesting do affect post-harvest losses. Post-harvest factors like curing, sorting, grading, packing, storage and transportation are, however, the main factors affecting the quality. The experiment conducted at Nashik and Karnal during *Rabi* 2017-18, revealed that at Nashik the lowest PLW (19.04%) and total loss (24.73%) were recorded in advance line-845 and found at par with advance lines-704, 807, 849, 852 and 873 in respect of PLW and advance lines-704, 807, 826, 849 and 852 regarding total loss, however at Karnal the lowest PLW (24.92%) and total loss (29.76%) were recorded in advance line-807 and were found at par with advance lines-703, 704, 824, 826, 844, 849, 852, 854, check varieties NHRDF Red-3 and NHRDF Red-4 in respect of PLW and advance lines-703, 704, 824 and check variety NHRDF Red-4 regarding total loss at five month after storage. It is summarized that the onion genotypes recorded minimum total losses can be utilized for good keeping quality onion variety.

**Keywords:** Onion, genotypes, storage, periodically losses

**Introduction**

Onion is one of the most important underground bulbous vegetable crops grown in India, having both the food and medicinal values. It is widely cultivated for internal consumption as well as for the export. India is the second largest producer of onion in the world after China. About 73.23 million tons of onions are produced in the world from 3.65 million ha area. India, being major onion-producing country, produces 20.13 million tons from 1.19 million ha, with a very low productivity of 16.24 t/ha. About 55-60% of onion comes from *Rabi* season and 40-45% from *Kharif* and late *Kharif* season. Because of its high export potential, it comes under cash crop apart from vegetable (Pandey, 1989) [2]. It is predominantly a *Rabi* season crop and most onion cultivars are sensitive to photo period and thus their range of adoption is limited (Gupta and Singh, 2010), however, it is to be recognized that India is the largest producer of short day onions globally, which are genetically less yielding compared to the long day types that are grown in China. The main onion growing states in India are Maharashtra, Gujarat, Karnataka, Tamil Nadu, Odisha, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Bihar and Punjab. It is used as a salad or cooked in various ways in all curies, fried or baked and also used in processed form e.g. flakes powder, paste, crush and pickle, etc. Wide range of variability in bulb yield attributes as well as in storability is noticed.

Onion is semi-perishable crop so that it cannot store for long time. Due to storage loss it cannot be guaranteed that whole amount of the total production is consumed by the people. It is estimated that about 35-40% losses are recorded in various process of handling if proper care is not taken in production and post-harvest management of onion. It is observed that

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losses are possible to be reduced about 15-20% if proper care is taken. The losses are on account of decay (10-12%) sprouting (4-5%) and drriage. Weight loss is 20-25% depending upon the period of storage (Sharma *et al.* 2012) [7]. In storage, a heavy loss noted due to sprouting and decay and these losses varies from 5-85% depending upon the variety and weather conditions (Warade *et al.* 1998) [6]. The effect of various cultural practices though is not very clear but some of the operations like soil, irrigation, nitrogen, potash application, chemical application, time of harvesting and stage of maturity while harvesting do affect post-harvest losses. Post-harvest factors like curing, sorting, grading, packing, storage and transportation are, however, the main factors affecting the quality. Therefore, for increase in self life of bulbs without deterioration in bulbs quality, selected some genotypes along with popular checks and conducted experiment to identify for good keeping quality onion.

### Materials and method

The present investigation was carried out at National Horticultural Research and Development Foundation Nashik (20° N latitude and 73° E longitudes and altitude of 492.0 meter from mean sea level), Maharashtra and Karnal, Haryana during Rabi, 2017-18. Soil of the experimental block was clay loam, medium in organic carbon (0.58%), available nitrogen (385.2 kg/ha), phosphorus (45.13kg/ha) and high in available potash (291.2kg/ha). Climate of Nashik is sub-tropical with minimum and maximum temperature and humidity ranging between 10 °C to 45 °C and 48% to 80%, respectively with an annual rainfall around 881 mm. A total of 15 advance lines along with three checks i. e. NHRDF Red-2, NHRDF Red-3 and NHRDF Red-4 at Nashik, however at Karnal also 15 advance lines along with four checks such as NHRDF Red, NHRDF Red-2, NHRDF Red-3 and NHRDF Red-4 were kept in storage under ambient conditions. Harvesting was done at one week after 50-60% neck fall stage and after proper field curing and neck cutting, well cured and representative bulbs of each genotypes were kept for storage on 14/05/2018 at Nashik and at Karnal on dated 05/06/2018 under ambient conditions in perforated plastic crates in randomized block design with three replications to identify good keeping quality variety for the period of five months. The observations on storage losses due to sprouting, physiological loss of weight (PLW), rotting and total loss were made at monthly interval. The data obtained during storage period are presented in Table-1 and 2 for Nashik and Karnal, respectively. Data were analyzed to find out the superior genotypes for development of good keeping quality onion varieties.

### Results and discussion

At Nashik (Table-1), data revealed that the highest gross yield (453.79 qt/ha) and marketable yield (297.95 qt/ha) were recorded in advance line-824 and 807, respectively, and was found at par with advance lines-811, 824, 852, check varieties NHRDF Red-3 and NHRDF-4 in respect of marketable yield. After one and two months of storage PLW and total loss exhibited non-significant differences. After three months of storage sprouting and decay loss exhibited non-significant differences. Lowest PLW (7.02%) and total loss (7.38%) were recorded in advance line-704 and 845, respectively, and was at par with advance line-703, 800, 825, 826, 845, 849, 852, 873, check varieties NHRDF Red-2 and NHRDF Red-4 in respect of PLW and advance line-703, 704, 800, 825, 826, 849, 852, 873, check varieties NHRDF Red-2 and NHRDF Red-3 regarding total loss. After four months of storage PLW

exhibited non-significant differences. Nil sprouting was recorded in advance line-854. Lowest decay loss (2.14%) was recorded in advance line-800 and it found at par with advance lines-704, 807, 826, 845, 849 and check variety NHRDF Red-2. Lowest total loss (19.73%) was recorded in advance line-807 and found at par with advance lines-703, 704, 800, 826, 845, 849, 852 and 854.

After five months of storage nil sprouting was recorded in advance line-854. Lowest decay loss (2.14%) was recorded in advance line-800 and found at par with advance lines-704, 807, 826, 845 and 849. Lowest PLW (19.04%) and total loss (24.73%) were recorded in advance line-845 and was at par with advance lines-704, 807, 849, 852 and 873 in respect of PLW and advance lines-704, 807, 826, 849 and 852 regarding total loss. The highest bulb recovery (220.07 qt/ha) was recorded in advance line-807.

The data of Karnal presented in Table-2, revealed that the highest gross yield (365.51 qt/ha) and marketable yield (333.47 qt/ha) were recorded in advance line-844 and found at par with the advance line-807 in respect of marketable yield. After one month of storage nil sprouting was recorded in all advance lines. Lowest decay loss (0.67%) was recorded in advance line-811 and it was found at par with advance line-807 and 824. Lowest PLW (3.52%) and total loss (5.09%) were recorded in advance line-824 and found at par with advance lines-704 and 807 in respect of PLW and advance lines-807 and 811 regarding total loss. After two months of storage nil sprouting was recorded in all advance lines. Lowest decay loss (2.09%) was recorded in advance line-807 and found at par with advance lines-811 and 824. Lowest PLW (9.20%) and total loss (11.33%) were recorded in advance line-824 and 807, respectively, and was at par with advance lines-703, 704, 807, 849 and check variety NHRDF Red-4 in respect of PLW and advance line-824 regarding total loss. After three months of storage nil sprouting was recorded in advance lines-745, 807, 824, 873, check varieties NHRDF Red-2 and NHRDF Red-4 and found at par with advance lines-703, 704, 800, 811, 826, 844, 845 and 849. Lowest decay loss (3.14%) was recorded in advance line-807 and was at par with advance line-811, 824 and 825. Lowest PLW (12.87%) and total loss (17.28%) were recorded in advance line-824 and 807, respectively, and was at par with advance lines-703, 704, 826, 849, 852 and check variety NHRDF Red-4 in respect of PLW and advance lines-811, 824 and check variety NHRDF Red-4 regarding total loss.

After four months of storage sprouting was exhibited non-significant differences. Lowest decay (3.94%) was recorded in advance line-807 and found at par with advance lines-811, 824, 825, check varieties NHRDF Red-2 and NHRDF Red-4. Lowest PLW (18.23%) and total loss (22.18%) were recorded in advance line-807 and found at par with advance lines-703, 704, 745, 824, 826, 849, 852, 854, check varieties NHRDF Red-2 and NHRDF Red-4 in respect of PLW and advance lines-811, 824, check varieties NHRDF Red-2 and NHRDF Red-4 regarding total loss. After five month of storage nil sprouting was recorded in advance line-873. Lowest decay loss (4.72%) was recorded in advance line-807 and found at par with advance lines-703, 704, 811, 824, 825, check varieties NHRDF Red-2 and NHRDF Red-4. Lowest PLW (24.92%) and total loss (29.76%) were recorded in advance line-807 and found at par with advance lines-703, 704, 824, 826, 844, 849, 852, 854, check varieties NHRDF Red-3 and NHRDF Red-4 in respect of PLW and advance lines-703, 704, 824 and check variety NHRDF Red-4 regarding total loss. The highest bulb recovery (220.69 qt/ha) were recorded

in advance line-807. It is noted that comparatively lower losses than Madgum (1981) <sup>[1]</sup>, Saimbhi and Randhawa (1982) <sup>[4]</sup> and Singh *et. al.* (2010) <sup>[5]</sup>, they reported 50%

storage loss due to physiological loss of weight. The major total loss occurred during after four months of storage. The result is in consonance with Patil and Kale (1989) <sup>[3]</sup>.

**Table 1:** Storage performance of red onion advance lines at Nashik during *Rabi*, 2017-18

Lines	Gross Yield q/ha	Market able Yield q/ha	After one month of storage							
			Sprouting %		Decay Loss %		PLW %		Total Loss %	
L-703	243.40	186.87	0.00	(0.71)	0.00	(0.71)	2.79	(1.80)	2.79	(1.80)
L-704	259.25	222.42	0.00	(0.71)	0.00	(0.71)	3.76	(2.06)	3.76	(2.06)
L-745	285.58	229.06	0.00	(0.71)	0.00	(0.71)	4.02	(2.12)	4.02	(2.12)
L-800	292.14	236.15	0.00	(0.71)	0.00	(0.71)	2.57	(1.72)	2.57	(1.72)
L-807	355.08	297.95	0.00	(0.71)	0.00	(0.71)	3.46	(1.99)	3.46	(1.99)
L-811	348.55	266.19	0.00	(0.71)	0.00	(0.71)	4.54	(2.20)	4.54	(2.20)
L-824	453.79	297.86	0.00	(0.71)	0.00	(0.71)	3.36	(1.92)	3.36	(1.92)
L-825	207.29	187.28	0.00	(0.71)	0.00	(0.71)	3.77	(2.07)	3.77	(2.07)
L-826	243.62	203.77	0.00	(0.71)	0.00	(0.71)	3.83	(2.08)	3.83	(2.08)
L-844	250.65	196.43	0.00	(0.71)	0.00	(0.71)	7.10	(2.69)	7.10	(2.69)
L-845	295.30	238.06	0.00	(0.71)	0.00	(0.71)	3.70	(2.05)	3.70	(2.05)
L-849	310.11	259.81	0.00	(0.71)	0.00	(0.71)	4.19	(2.16)	4.19	(2.16)
L-852	350.52	274.76	0.00	(0.71)	0.00	(0.71)	2.74	(1.80)	2.74	(1.80)
L-854	306.27	233.41	0.00	(0.71)	0.00	(0.71)	3.44	(1.98)	3.44	(1.98)
L-873	320.70	232.65	0.00	(0.71)	0.00	(0.71)	2.78	(1.78)	2.78	(1.78)
NHRDF Red-2 (C)	262.87	198.37	0.00	(0.71)	0.00	(0.71)	3.68	(2.04)	3.68	(2.04)
NHRDF Red-3 (C)	323.33	275.67	0.00	(0.71)	0.00	(0.71)	4.72	(2.27)	4.72	(2.27)
NHRDF Red-4 (C)	332.43	268.72	0.00	(0.71)	0.00	(0.71)	3.46	(1.99)	3.46	(1.99)
SEm±	21.71	16.88	-	-	-	-	-	0.28	-	0.28
CD at 5%	44.12	34.30	-	-	-	-	-	NS	-	NS
CV %	8.80	8.64	-	-	-	-	-	16.60	-	16.60

Lines	After two months of storage							
	Sprouting %		Decay Loss %		PLW %		Total Loss %	
L-703	0.00	(0.71)	0.00	(0.71)	6.90	(2.66)	6.90	(2.66)
L-704	0.00	(0.71)	0.00	(0.71)	4.91	(2.32)	4.91	(2.32)
L-745	0.00	(0.71)	0.00	(0.71)	7.88	(2.89)	7.88	(2.89)
L-800	0.00	(0.71)	0.00	(0.71)	3.98	(2.09)	3.98	(2.09)
L-807	0.00	(0.71)	0.00	(0.71)	5.78	(2.50)	5.78	(2.50)
L-811	0.00	(0.71)	0.00	(0.71)	5.76	(2.47)	5.76	(2.47)
L-824	0.00	(0.71)	0.00	(0.71)	5.56	(2.42)	5.56	(2.42)
L-825	0.00	(0.71)	0.00	(0.71)	5.67	(2.47)	5.67	(2.47)
L-826	0.00	(0.71)	0.00	(0.71)	5.02	(2.34)	5.02	(2.34)
L-844	0.00	(0.71)	0.15	(0.80)	7.87	(2.85)	8.02	(2.88)
L-845	0.00	(0.71)	0.00	(0.71)	4.78	(2.29)	4.78	(2.29)
L-849	0.00	(0.71)	0.00	(0.71)	5.12	(2.37)	5.12	(2.37)
L-852	0.00	(0.71)	0.00	(0.71)	4.07	(2.13)	4.07	(2.13)
L-854	0.00	(0.71)	0.00	(0.71)	4.56	(2.25)	4.56	(2.25)
L-873	0.00	(0.71)	0.00	(0.71)	5.11	(2.29)	5.11	(2.29)
NHRDF Red-2 (C)	0.00	(0.71)	0.00	(0.71)	4.44	(2.22)	4.44	(2.22)
NHRDF Red-3 (C)	0.00	(0.71)	0.23	(0.84)	5.79	(2.50)	6.02	(2.55)
NHRDF Red-4 (C)	0.00	(0.71)	0.00	(0.71)	4.53	(2.24)	4.53	(2.24)
SEm±	-	-	-	-	-	0.30	-	0.30
CD at 5%	-	-	-	-	-	NS	-	NS
CV %	-	-	-	-	-	15.37	-	15.16

Lines	After three months of storage							
	Sprouting %		Decay Loss %		PLW %		Total Loss %	
L-703	0.00	(0.71)	0.63	(1.04)	9.18	(3.11)	9.81	(3.21)
L-704	0.36	(0.91)	0.25	(0.85)	7.02	(2.74)	7.63	(2.84)
L-745	0.29	(0.88)	0.29	(0.88)	12.66	(3.63)	13.24	(3.70)
L-800	0.00	(0.71)	0.27	(0.85)	7.44	(2.80)	7.71	(2.85)
L-807	0.00	(0.71)	0.23	(0.84)	10.87	(3.37)	11.10	(3.41)
L-811	0.00	(0.71)	0.00	(0.71)	10.94	(3.38)	10.94	(3.38)
L-824	0.00	(0.71)	0.00	(0.71)	13.13	(3.69)	13.13	(3.69)
L-825	0.21	(0.83)	0.21	(0.83)	8.23	(2.95)	8.65	(3.02)
L-826	0.00	(0.71)	0.19	(0.82)	7.60	(2.83)	7.79	(2.86)
L-844	0.31	(0.87)	0.63	(1.03)	11.64	(3.42)	12.59	(3.56)
L-845	0.26	(0.85)	0.00	(0.71)	7.13	(2.76)	7.38	(2.81)
L-849	0.00	(0.71)	0.23	(0.84)	7.52	(2.83)	7.75	(2.87)
L-852	0.00	(0.71)	0.48	(0.94)	10.17	(3.27)	10.65	(3.34)
L-854	0.00	(0.71)	0.84	(1.12)	14.19	(3.83)	15.03	(3.93)
L-873	0.83	(1.05)	0.00	(0.71)	9.39	(3.11)	10.22	(3.22)
NHRDF Red-2 (C)	0.15	(0.80)	0.17	(0.81)	7.92	(2.90)	8.24	(2.95)

NHRDF Red-3 (C)	0.33	(0.88)	0.47	(0.93)	11.28	(3.43)	12.07	(3.55)
NHRDF Red-4 (C)	0.00	(0.71)	0.17	(0.81)	9.58	(3.17)	9.75	(3.20)
SEm±	-	0.16	-	0.20	-	0.24	-	0.26
CD at 5%	-	NS	-	NS	-	0.49	-	0.53
CV %	-	25.22	-	28.09	-	9.31	-	9.69

Lines	After four months of storage							
	Sprouting %		Decay Loss %		*PLW %		*Total Loss %	
L-703	0.64	(1.07)	5.61	(2.47)	18.04	(25.00)	24.28	(29.45)
L-704	0.85	(1.16)	2.87	(1.83)	16.53	(23.97)	20.25	(26.72)
L-745	2.66	(1.78)	7.80	(2.88)	22.70	(28.27)	33.17	(35.09)
L-800	4.31	(2.18)	2.14	(1.62)	17.53	(24.63)	23.98	(29.23)
L-807	1.87	(1.53)	2.78	(1.79)	15.09	(22.73)	19.73	(26.30)
L-811	1.88	(1.53)	5.86	(2.52)	21.97	(27.94)	29.71	(33.01)
L-824	1.44	(1.39)	5.13	(2.37)	25.90	(30.44)	32.46	(34.66)
L-825	12.88	(3.65)	15.33	(3.98)	29.51	(32.87)	57.72	(49.46)
L-826	0.26	(0.85)	2.34	(1.68)	20.50	(26.91)	23.10	(28.72)
L-844	3.21	(1.92)	7.87	(2.85)	22.62	(28.22)	33.70	(35.31)
L-845	1.59	(1.44)	3.33	(1.96)	15.71	(23.33)	20.62	(27.00)
L-849	0.22	(0.83)	2.86	(1.83)	18.40	(25.36)	21.48	(27.58)
L-852	0.67	(1.08)	5.56	(2.46)	16.78	(23.98)	23.01	(28.58)
L-854	0.00	(0.71)	5.84	(2.48)	22.75	(28.48)	28.59	(32.31)
L-873	4.96	(2.34)	6.22	(2.54)	18.86	(25.32)	30.05	(32.95)
NHRDF Red-2 (C)	2.72	(1.79)	4.14	(2.12)	22.27	(28.14)	29.13	(32.61)
NHRDF Red-3 (C)	3.21	(1.92)	6.31	(2.50)	21.22	(27.36)	30.75	(33.55)
NHRDF Red-4 (C)	1.48	(1.41)	6.34	(2.61)	23.22	(28.74)	31.05	(33.84)
SEm±	-	0.14	-	0.30	-	2.77	-	3.00
CD at 5%	-	0.28	-	0.61	-	NS	-	6.10
CV %	-	10.78	-	15.54	-	12.67	-	11.47

Lines	After five months of storage								(q/ha) Good bulb recovery after 5 Months
	Sprouting %		Decay Loss %		*PLW %		*Total Loss %		
L-703	1.26	(1.32)	6.21	(2.57)	25.59	(30.34)	33.06	(35.05)	125.09
L-704	1.14	(1.27)	3.24	(1.85)	23.57	(29.02)	27.94	(31.89)	160.28
L-745	3.19	(1.91)	8.09	(2.93)	27.72	(31.65)	38.99	(38.59)	139.75
L-800	5.36	(2.42)	2.14	(1.61)	25.99	(30.63)	33.49	(35.34)	157.06
L-807	2.00	(1.57)	3.28	(1.94)	20.87	(27.13)	26.14	(30.71)	220.07
L-811	2.02	(1.58)	6.26	(2.60)	26.77	(31.15)	35.05	(36.29)	172.89
L-824	2.53	(1.74)	5.13	(2.37)	33.69	(35.43)	41.35	(40.00)	174.69
L-825	14.93	(3.93)	15.33	(3.98)	33.67	(35.46)	63.93	(53.11)	67.55
L-826	0.32	(0.90)	2.99	(1.86)	25.48	(30.31)	28.79	(32.45)	145.10
L-844	3.93	(2.07)	8.13	(2.93)	28.27	(32.03)	40.34	(39.38)	117.19
L-845	1.95	(1.53)	3.74	(2.06)	19.04	(25.84)	24.73	(29.78)	179.19
L-849	0.23	(0.86)	3.11	(1.89)	22.03	(27.97)	25.37	(30.22)	193.90
L-852	0.80	(1.14)	6.04	(2.55)	23.67	(29.05)	30.50	(33.48)	190.96
L-854	0.00	(0.71)	6.32	(2.60)	28.00	(31.94)	34.32	(35.86)	153.30
L-873	5.80	(2.50)	6.81	(2.70)	19.14	(25.94)	31.74	(34.29)	158.81
NHRDF Red-2 (C)	2.93	(1.85)	5.07	(2.34)	26.18	(30.77)	34.17	(35.76)	130.59
NHRDF Red-3 (C)	3.63	(2.02)	6.68	(2.68)	28.67	(32.33)	38.97	(38.62)	168.24
NHRDF Red-4 (C)	1.63	(1.38)	6.62	(2.65)	27.83	(31.79)	36.07	(36.91)	171.79
SEm±	-	0.20	-	0.23	-	1.89	-	2.03	-
CD at 5%	-	0.41	-	0.47	-	3.84	-	4.13	-
CV %	-	14.64	-	11.75	-	7.58	-	6.90	-

**Note:** Data in the parenthesis shows square root & \*arcsin transformed values.

**Table 2:** Storage performance of red onion advance lines at Karnal during *Rabi*, 2017-18

Lines	Gross Yield q/ha	Market-able Yield q/ha	After one month of storage							
			Sprouting %		Decay Loss %		PLW %		Total Loss %	
L-703	316.04	283.38	0.00	(0.71)	8.44	(2.99)	6.47	(2.64)	14.91	(3.92)
L-704	323.13	301.37	0.00	(0.71)	3.64	(2.04)	4.62	(2.26)	8.27	(2.96)
L-745	299.05	274.17	0.00	(0.71)	6.64	(2.65)	7.09	(2.75)	13.73	(3.75)
L-800	254.40	231.94	0.00	(0.71)	5.52	(2.45)	6.13	(2.57)	11.65	(3.48)
L-807	330.63	314.19	0.00	(0.71)	2.09	(1.51)	4.71	(2.28)	6.80	(2.69)
L-811	288.66	256.71	0.00	(0.71)	0.67	(1.00)	5.82	(2.51)	6.49	(2.63)
L-824	327.08	300.28	0.00	(0.71)	1.56	(1.36)	3.52	(2.01)	5.09	(2.35)
L-825	247.50	232.27	0.00	(0.71)	2.80	(1.82)	5.44	(2.44)	8.24	(2.96)
L-826	301.97	286.46	0.00	(0.71)	4.13	(2.15)	5.44	(2.43)	9.58	(3.17)
L-844	365.51	333.47	0.00	(0.71)	7.05	(2.75)	5.93	(2.54)	12.98	(3.67)
L-845	301.18	272.01	0.00	(0.71)	6.62	(2.67)	7.56	(2.83)	14.18	(3.82)

L-849	332.80	300.02	0.00	(0.71)	3.43	(1.97)	4.99	(2.34)	8.42	(2.98)
L-852	287.62	256.13	0.00	(0.71)	9.87	(3.21)	5.55	(2.46)	15.41	(3.98)
L-854	316.20	291.78	0.00	(0.71)	6.22	(2.59)	6.24	(2.59)	12.47	(3.60)
L-873	265.05	214.35	0.00	(0.71)	8.80	(3.03)	7.07	(2.75)	15.87	(4.03)
NHRDF Red (C)	348.94	260.07	0.00	(0.71)	2.36	(1.68)	6.48	(2.63)	8.84	(3.05)
NHRDF Red-2 (C)	269.19	234.24	0.00	(0.71)	4.32	(2.13)	6.05	(2.55)	10.37	(3.26)
NHRDF Red-3 (C)	328.56	302.64	0.00	(0.71)	4.98	(2.34)	6.63	(2.67)	11.62	(3.48)
NHRDF Red-4 (C)	241.74	204.12	0.00	(0.71)	4.55	(2.21)	5.52	(2.45)	10.07	(3.23)
SEm±	7.80	9.71	-	-	-	0.30	-	0.14	-	0.25
CD at 5%	15.82	19.69	-	-	-	0.61	-	0.28	-	0.51
CV %	3.16	4.39	-	-	-	16.15	-	6.79	-	9.05

Lines	After two months of storage								
	Sprouting %		Decay Loss %		PLW %		Total Loss %		
L-703	0.00	(0.71)	8.80	(3.05)	11.53	(3.47)	20.33	(4.56)	
L-704	0.00	(0.71)	8.69	(3.00)	10.09	(3.25)	18.78	(4.38)	
L-745	0.00	(0.71)	9.36	(3.12)	13.51	(3.73)	22.87	(4.82)	
L-800	0.00	(0.71)	8.27	(2.96)	13.63	(3.76)	21.89	(4.73)	
L-807	0.00	(0.71)	2.09	(1.51)	9.24	(3.12)	11.33	(3.43)	
L-811	0.00	(0.71)	3.69	(2.04)	12.11	(3.55)	15.80	(4.04)	
L-824	0.00	(0.71)	4.42	(2.21)	9.20	(3.11)	13.62	(3.76)	
L-825	0.00	(0.71)	5.20	(2.38)	12.00	(3.54)	17.20	(4.21)	
L-826	0.00	(0.71)	9.04	(3.09)	11.82	(3.51)	20.87	(4.62)	
L-844	0.00	(0.71)	11.97	(3.53)	14.18	(3.81)	26.15	(5.15)	
L-845	0.00	(0.71)	7.80	(2.84)	13.29	(3.71)	21.09	(4.64)	
L-849	0.00	(0.71)	6.80	(2.70)	10.95	(3.38)	17.75	(4.27)	
L-852	0.00	(0.71)	16.13	(4.06)	12.13	(3.55)	28.27	(5.36)	
L-854	0.00	(0.71)	8.22	(2.92)	12.71	(3.63)	20.93	(4.61)	
L-873	0.00	(0.71)	14.57	(3.88)	15.60	(4.01)	30.17	(5.54)	
NHRDF Red (C)	0.00	(0.71)	4.99	(2.30)	11.91	(3.51)	16.89	(4.15)	
NHRDF Red-2 (C)	0.00	(0.71)	5.72	(2.48)	12.76	(3.64)	18.48	(4.35)	
NHRDF Red-3 (C)	0.00	(0.71)	9.25	(3.07)	13.07	(3.68)	22.32	(4.75)	
NHRDF Red-4 (C)	0.00	(0.71)	6.23	(2.54)	11.53	(3.47)	17.77	(4.26)	
SEm±	-	-	-	0.35	-	0.18	-	0.29	
CD at 5%	-	-	-	0.71	-	0.37	-	0.59	
CV %	-	-	-	15.19	-	6.18	-	7.94	

Lines	After three months of storage								
	Sprouting %		Decay Loss %		PLW %		Total Loss %		
L-703	0.44	(0.97)	10.13	(3.26)	15.31	(3.98)	25.89	(30.58)	
L-704	0.39	(0.90)	10.24	(3.27)	15.64	(4.01)	26.28	(30.79)	
L-745	0.00	(0.71)	11.19	(3.42)	17.70	(4.26)	28.89	(32.51)	
L-800	0.60	(1.05)	10.07	(3.24)	18.47	(4.35)	29.13	(32.63)	
L-807	0.00	(0.71)	3.14	(1.91)	14.13	(3.83)	17.28	(24.56)	
L-811	0.50	(0.99)	5.24	(2.39)	17.42	(4.23)	23.17	(28.76)	
L-824	0.00	(0.71)	5.37	(2.42)	12.87	(3.65)	18.24	(25.28)	
L-825	3.33	(1.79)	6.07	(2.54)	17.67	(4.26)	27.07	(31.35)	
L-826	0.28	(0.88)	10.71	(3.34)	16.29	(4.09)	27.28	(31.46)	
L-844	0.50	(0.99)	16.80	(4.14)	20.45	(4.54)	37.75	(37.80)	
L-845	0.56	(1.02)	10.02	(3.20)	20.37	(4.56)	30.94	(33.74)	
L-849	0.38	(0.92)	9.23	(3.09)	16.34	(4.10)	25.95	(30.58)	
L-852	1.60	(1.44)	17.40	(4.22)	16.33	(4.10)	35.33	(36.45)	
L-854	0.83	(1.15)	12.67	(3.59)	18.17	(4.29)	31.67	(34.15)	
L-873	0.00	(0.71)	18.57	(4.33)	24.68	(5.02)	43.25	(41.10)	
NHRDF Red (C)	0.83	(1.15)	9.59	(3.18)	18.18	(4.32)	28.60	(32.32)	
NHRDF Red-2 (C)	0.00	(0.71)	7.52	(2.82)	17.01	(4.18)	24.53	(29.68)	
NHRDF Red-3 (C)	1.71	(1.48)	11.04	(3.37)	18.42	(4.34)	31.17	(33.88)	
NHRDF Red-4 (C)	0.00	(0.71)	6.86	(2.66)	13.77	(3.77)	20.63	(26.89)	
SEm±	-	0.21	-	0.35	-	0.24	-	2.38	
CD at 5%	-	0.43	-	0.71	-	0.49	-	4.83	
CV %	-	26.10	-	13.34	-	7.05	-	9.16	

Lines	After four months of storage								
	Sprouting %		Decay Loss %		PLW %		Total Loss %		
L-703	1.22	(1.31)	10.41	(3.21)	19.57	(4.48)	31.20	(33.89)	
L-704	0.39	(0.94)	10.73	(3.23)	22.46	(4.77)	33.58	(35.39)	
L-745	0.36	(0.89)	13.08	(3.66)	22.54	(4.80)	35.98	(36.82)	
L-800	0.81	(1.11)	10.88	(3.36)	23.27	(4.87)	34.96	(36.22)	
L-807	0.00	(0.71)	3.94	(2.07)	18.23	(4.33)	22.18	(28.08)	
L-811	0.88	(1.06)	5.89	(2.52)	23.52	(4.90)	30.29	(33.37)	
L-824	0.32	(0.88)	6.44	(2.59)	18.51	(4.36)	25.28	(30.17)	
L-825	1.71	(1.38)	6.72	(2.67)	25.93	(5.13)	34.36	(35.87)	

L-826	0.59	(1.02)	11.40	(3.32)	20.94	(4.63)	32.93	(34.91)
L-844	1.90	(1.46)	17.90	(4.27)	24.87	(5.01)	44.67	(41.89)
L-845	0.96	(1.20)	10.44	(3.27)	25.02	(5.05)	36.42	(37.09)
L-849	0.69	(1.06)	10.56	(3.28)	20.10	(4.54)	31.35	(33.99)
L-852	1.60	(1.37)	18.31	(4.33)	18.49	(4.36)	38.40	(38.28)
L-854	2.97	(1.69)	13.67	(3.73)	23.17	(4.85)	39.80	(39.07)
L-873	0.00	(0.71)	20.45	(4.55)	29.65	(5.49)	50.10	(45.06)
NHRDF Red (C)	2.05	(1.57)	11.29	(3.43)	24.75	(5.02)	38.09	(38.11)
NHRDF Red-2 (C)	0.21	(0.83)	8.03	(2.91)	22.19	(4.76)	30.43	(33.48)
NHRDF Red-3 (C)	2.24	(1.52)	12.56	(3.59)	24.00	(4.94)	38.80	(38.47)
NHRDF Red-4 (C)	0.62	(0.98)	7.49	(2.77)	19.71	(4.49)	27.82	(31.73)
SEm±	-	0.38	-	0.52	-	0.26	-	2.69
CD at 5%	-	NS	-	1.05	-	0.53	-	5.46
CV %	-	41.01	-	19.27	-	6.54	-	9.18

Lines	After five months of storage								(q/ha) Good bulb Recovery after 5 Months
	Sprouting %		Decay Loss %		PLW %		Total Loss %		
L-703	2.13	(1.61)	10.41	(3.21)	25.30	(30.19)	37.84	(37.93)	176.15
L-704	1.12	(1.26)	10.84	(3.25)	25.81	(30.51)	37.78	(37.91)	187.51
L-745	2.69	(1.73)	15.28	(3.93)	30.12	(33.29)	48.09	(43.90)	142.32
L-800	1.88	(1.52)	11.65	(3.47)	30.07	(33.23)	43.60	(41.30)	130.81
L-807	0.11	(0.78)	4.72	(2.28)	24.92	(29.95)	29.76	(33.06)	220.69
L-811	1.77	(1.49)	7.04	(2.74)	30.86	(33.74)	39.67	(39.03)	154.87
L-824	1.35	(1.29)	7.01	(2.70)	25.31	(30.18)	33.68	(35.46)	199.15
L-825	3.63	(2.02)	7.52	(2.81)	31.20	(33.95)	42.35	(40.59)	133.90
L-826	1.54	(1.42)	11.71	(3.35)	28.41	(32.21)	41.67	(40.17)	167.09
L-844	2.30	(1.55)	18.58	(4.36)	29.63	(32.91)	50.52	(45.29)	165.00
L-845	1.47	(1.38)	11.13	(3.37)	31.67	(34.24)	44.27	(41.69)	151.59
L-849	1.70	(1.46)	11.54	(3.45)	25.50	(30.33)	38.74	(38.48)	183.79
L-852	3.60	(2.02)	19.21	(4.44)	24.63	(29.75)	47.44	(43.53)	134.62
L-854	5.12	(2.33)	15.49	(3.96)	29.39	(32.78)	50.00	(45.00)	145.89
L-873	0.00	(0.71)	21.75	(4.70)	35.15	(36.36)	56.90	(48.97)	92.38
NHRDF Red (C)	3.47	(1.99)	13.79	(3.78)	32.91	(34.99)	50.17	(45.10)	129.59
NHRDF Red-2 (C)	0.75	(1.07)	9.71	(3.19)	30.59	(33.58)	41.04	(39.84)	138.11
NHRDF Red-3 (C)	3.03	(1.68)	13.91	(3.78)	29.12	(32.60)	46.05	(42.72)	163.27
NHRDF Red-4 (C)	1.72	(1.46)	7.86	(2.84)	25.68	(30.43)	35.25	(36.37)	132.17
SEm±	-	0.36	-	0.50	-	1.52	-	2.65	-
CD at 5%	-	0.73	-	1.01	-	3.08	-	5.37	-
CV %	-	28.73	-	17.65	-	5.74	-	7.94	-

**Note:** Data in the parenthesis shows square root & \*arcsin transformed values.

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