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Effect of different curing methods on storability of onion bulbs

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Abstract
The experiment on effect of different curing methods on storage life of onions was conducted at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. In the treatment T_1, field cured bulbs were kept under 50 per cent shade for 12 days and tops removed immediately after harvesting. In the treatment T_1, field cured bulbs were kept under 50 per cent shade for 12 days and tops removed immediately after harvesting. In treatments T_2, T_3, T_4 and T_5 field cured bulbs were kept under 50 per cent shade for 15 days with topping on 3rd, 5th, 10th and 15th day after harvesting, respectively. In treatment T_6, field cured bulbs were kept under 100 per cent shade for 15 days with topping on 15th day after harvest. In treatment T_7 and T_8, field cured bulbs were kept on tarpaulin under 50 per cent and 100 per cent shade for 15 days, respectively with topping on 7th day after harvest. T_9 was control (method usually adopted by the farmers).
It was found that post-harvest curing significantly reduced the storage losses. Among the different curing methods, field cured bulbs kept under 50 per cent shade for 15 days and tops removed 15 days after harvest (T_5) was found superior with minimum storage losses. The minimum physiological loss in weight (12.24%), sprouting (3.2%), rotting (6.9%) and incidence of black mould (7.80%) with maximum marketable bulbs (82.10%) was noted in this treatment. The curing operation resulted in colour development of onion bulb and highest score (7.4) was recorded in the same treatment.

Keywords: Curing, onion bulbs, storage losses, post-harvest practices

Introduction
Onion is a biennial herb which belongs to family *Amaryllidaceae*. It is one of the most important commercial vegetable crop grown in large number of countries of the world, not only for domestic consumption but also for highest foreign exchange earner amongst the fruits and vegetables. Onions are mainly characterized by odoriferous sulphur compounds. It is a good source of vitamin C and E and used as medicine for prevention of blood and heart diseases.
India is a traditional exporter of onion. It is a pride item of agricultural exports which accounts for about 70% of the total foreign exchange earnings among fresh vegetables (Sirohi and Behera, 2003) [7]. But onion is most delicate and highly perishable vegetable crop and more difficult to store for long duration at ambient temperature, especially in tropical and subtropical regions of India, due to its high water content. The storability of onion is mainly affected by sprouting, rotting, physiological loss in weight, and pathogen attack. These losses can be controlled during storage by integrating and application of post-harvest curing practices. Because curing is drying process carried out to remove excess moisture from outer skin and neck of onion bulb (Maw *et al*., 2004) [3]. It improves the keeping quality of onion bulbs and reduces post-harvest decay in storage (Thompson *et al*., 1972) [8]. But many farmers are not adopting this practice (Tripathi *et al*., 2004) [9] and storage losses could be over 66 percent (Biswas *et al.*, 2010) [1].
Keeping in view, an experiment was carried out to evaluate the effect of curing methods on storage life of onion bulbs to meet the consumer demands for extended period to catch high prices in off season.

Materials and Methods
The experimentation was initiated from May 2013 using cultivar Akola Safed at University Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Harvesting was conducted after 50% of onion tops had fallen.

Harvested bulbs were kept in field for field curing for about three days and foliage was cut leaving 2.5 cm top above the bulbs.

In the treatment T_1, field cured bulbs were kept under 50 per cent shade for 12 days and tops removed immediately after harvesting. In treatments T_2, T_3, T_4 and T_5 field cured bulbs were kept under 50 per cent shade for 15 days with topping on 3rd, 5th, 10th and 15th day after harvesting, respectively. In treatment T_6, field cured bulbs were kept under 100 per cent shade for 15 days with topping on 15th day after harvest. In treatment T_7 and T_8, field cured bulbs were kept on tarpaulin under 50 per cent and 100 per cent shade for 15 days, respectively with topping on 7th day after harvest. T_9 was control (method usually adopted by the farmers).

Each treatment containing five kg bulbs were sorted and stored at ambient storage from June 2013 and extended up to October 2013. The observation on PLW%, sprouting, rotting, black mould, colour of the bulb and marketable bulbs were recorded at 20 days interval during storage. The data recorded on various physio-chemical observations were statistically analyzed by Completely Randomized Design as suggested by Gomez and Gomez (1984) [2].

Results and Discussion

Storage losses

Curing methods showed significant effect on percentage of sprouting and rotting of the bulbs. Sprouting as well as rotting is one of the major reasons for qualitative and quantitative deterioration of stored onion bulbs. There was no sprouting observed up to 60th days of the storage in all the treatments. At the time of sprouting, sucrose was synthesized and transported to the sprout and basal plate for growth. Minimum sprouting (3.2%) was found in treatment T_5 and maximum (9.9%) in treatment T_9 (Table 1). Curing treatments allowed bulbs to develop tough skin that limit exchange of gas within the external environment.

Also by shrinking and closing neck of the bulb minimized the shoot growth and emergence due to inadequate supply of oxygen. Pandey *et al*. (1992) [4] reported that thin neck of bulb results in suppressed growth of sprout which is in agreement with current result.

Post-harvest rot of onion is a major cause of bulb losses in storage. Significantly minimum rotting loss (6.9%) was observed in treatment T_5 while maximum (12.1%) in treatment T_9 (Table 1). Percent loss of bulb due to rotting was increased progressively with the advancement of storage period. During curing excess moisture from the bulb was removed, made outer layer dry with closed neck so, pathological decay was lower down. Similar findings were also reported by Sidhu and Chadha (1986) [6] in onion curing methods.

Incidence of mould in storage is mainly due to *Aspergillus niger* that affects the marketable quality of onion bulbs. Curing methods showed statistical difference among the treatments during storage. Mould infection was increased with advancement of storage period. Minimum mould attack (7.80%) was observed in treatment T_5 and maximum (9.80%) in treatment T_9 (Table 1). This might be due to the fact that the entry of micro-organism into the bulbs were restricted as the neck of the bulb was completely dried and closed. Similar results were also reported by Sidhu and Chadha (1986) [6] in onion.

Physiological loss in weight

The minimum loss in weight of onion bulbs during storage is one of the desirable factor to extend the storage life. A significant difference in physiological loss in weight due to curing methods was noticed. The rate of physiological loss in weight was increased significantly with increasing storage period in all the treatments. The minimum physiological loss in weight (12.24%) was observed in treatment T_5 and maximum loss (15.42%) was noticed in treatment T_9 (Table 2). During curing, thin outer layer of the bulbs were dried to form complete dry skin which act as a barrier to water loss during the storage. It also helps to dry the neck of the bulbs and make them tightly closed. The present investigations are in conformity with the results reported by Thompson *et al*. (1972) [8] in onion curing methods and its storability in ambient storage.

Table 1: Effect of curing methods on storage losses (sprouting, rotting and black mould) of onion bulbs

Treatment	Sprouting (%)			Rotting (%)						Incidence of mould (%)					
	80 DAS	100 DAS	120 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
T1	2.1	4.0	5.8	3.2	5.8	7.5	7.1	8.4	9.8	3.80	4.20	5.30	6.90	8.00	9.10
T2	1.7	2.9	5.1	3.1	4.1	6.2	6.3	7.9	8.7	3.21	3.80	5.10	6.90	7.80	8.50
T3	1.7	2.8	4.8	2.8	4.3	6.3	6.2	7.9	8.4	2.90	3.50	4.90	6.40	8.30	8.48
T4	1.6	3.6	4.8	2.4	4.5	5.7	5.7	7.6	8.0	2.60	3.50	3.70	6.25	8.31	8.36
T5	0.0	1.1	3.2	1.7	3.1	4.8	4.5	6.1	6.9	1.20	1.80	2.40	4.30	6.10	7.80
T6	1.5	2.7	4.6	2.0	4.1	5.7	5.7	7.5	7.8	1.50	2.80	3.20	6.10	8.10	8.30
T7	1.9	2.9	5.2	3.6	4.8	6.7	6.5	8.1	8.7	3.57	3.88	6.10	7.50	8.10	9.00
T8	2.1	3.8	5.5	3.8	5.5	7.1	7.0	8.4	9.6	3.40	3.80	5.25	7.00	8.00	8.90
T9	4.1	6.7	9.9	5.1	6.9	7.8	8.1	8.8	12.1	4.80	5.30	7.40	8.90	9.10	9.80
SE (m ±)	0.48	0.51	0.40	0.30	0.31	0.37	0.29	0.34	0.37	0.08	0.10	0.09	0.09	0.07	0.05
CD 5%	1.44	1.53	1.19	0.90	0.94	1.11	0.87	1.01	1.10	0.25	0.30	0.28	0.28	0.21	0.17

Table 2: Effect of different curing methods on physiological loss in weight, colour of bulb and marketable onion bulb at storage

Treatment	Physiological loss in weight (%)						Colour of bulb						Marketable bulbs (%)					
	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
T1	4.22	7.18	10.80	10.92	11.01	13.93	7.1	6.7	6.3	5.8	4.9	4.5	93.00	90.00	87.20	83.90	79.60	75.30
T2	3.15	5.82	9.76	9.90	10.64	13.17	8.0	7.3	7.0	6.6	6.2	5.8	93.69	92.10	88.70	85.10	81.40	77.70
T3	2.86	5.43	9.38	9.68	10.49	12.97	8.0	8.0	7.5	7.0	6.4	6.1	94.30	92.20	88.80	85.70	81.40	78.32
T4	2.25	4.74	7.50	9.03	10.38	12.80	8.3	8.1	7.8	7.3	7.1	6.7	95.00	92.00	90.60	86.45	80.49	78.84
T5	1.84	4.16	6.80	8.78	10.10	12.24	9.0	8.8	8.5	8.3	7.9	7.4	97.10	95.10	92.80	91.20	86.10	82.10
T6	2.06	4.45	6.98	8.96	10.25	12.53	7.4	7.0	6.8	6.2	5.7	5.2	96.50	93.10	91.10	86.70	81.70	79.30

T7	3.48	6.94	10.40	10.63	10.89	13.72	7.9	7.3	7.1	6.8	6.1	5.4	92.83	91.32	87.20	84.10	80.90	77.10
T8	3.36	6.18	9.88	9.96	10.80	13.48	7.4	6.9	6.5	6.0	5.4	5.1	92.80	90.70	90.65	83.90	79.80	76.00
T9	5.12	7.35	10.82	12.33	13.35	15.42	7.0	6.4	6.3	5.3	4.4	4.0	90.10	87.80	84.80	78.90	75.40	68.20
SE (m ±)	0.03	0.04	0.03	0.09	0.08	0.11	0.24	0.22	0.23	0.31	0.19	0.23	0.35	0.26	0.35	0.46	0.55	0.58
CD 5%	0.11	0.12	0.11	0.29	0.25	0.34	0.72	0.67	0.69	0.94	0.58	0.69	1.06	0.78	1.05	1.37	1.65	1.74

Colour of bulbs

Marketable quality of onion bulbs depends on external appearance of bulbs and colour is the prime factor. Highly significant difference was observed among the all treatments during storage (Table2).

Significantly highest score (7.4) was registered in treatment T_5 and this may be attributed to the curing process, which contributed to the colour development. Because curing process helps to develop better skin colour of bulb (Thompson *et al*., 1972) [8] and may be achieved by exposure to high temperature for sufficient period. The result was supported with findings of Satish and Ranganna (2002) [5] and Wright and Grant (1997) [10] in onion. The sensory score found to decrease continuously with the advancement in storage period. Temperature might be played an important role for certain biochemical changes in the bulb which leads to decline the bulb colour score during the storage.

Marketable bulbs

The maximum numbers of good marketable bulbs (82.10%) were found in treatment T_5 (Table 2). This may be attributed to the minimum loss due to rotting and sprouting percentage and lowest physiological loss in weight of onion bulbs during storage. While highest weight loss, percent rotting and sprouting at storage mainly responsible for least marketable bulbs and minimum percentage of marketable bulbs (68.20%) were found in treatment T_9.

Conclusion

The experimental result concluded that, substantial losses of onion that occur during storage can be greatly reduced by curing methods immediately after harvest. If these methods could be integrated and applied, problems of market glut could be stabilized with balanced cost. Therefore, post-harvest curing could be helpful for minimum storage losses and successful storage of onion bulbs.

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