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Post-harvest losses in different varieties of onion

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ABSTRACT

Onion varieties (Bhima Kiran, Bhima Raj, Bhima Red, Bhima Shakti, Bhima Shubra, Bhima Shweta and Bhima Super) were evaluated for storage losses during *rabi* season of 2013-14 and 2014-15. All the varieties were grown under similar conditions and stored at ambient conditions in a modified bottom and top ventilated storage structure. Total losses were found significantly less in B. Kiran (26.66%) and B. Shakti (35.87%) after four months of storage, whereas no significant difference was observed among these two varieties. In the year 2014-15, the bulbs were analyzed for rate of respiration and total phenol content. No significant difference was observed in rate of respiration at the beginning of storage. Total phenol content was significantly high in B. Raj (186.33 mg GAE/100g) followed by B. Kiran (138.64 mg GAE/100g), B. Shakti (137.09 mg GAE/100g), B. Shweta (114.29 mg GAE/100g) and B. Shubra (112.04 mg GAE/100g). Significantly low phenol content was observed in B. Red (35.16mg GAE/100 g). During storage, rate of respiration and total phenol content increased up to 60 days of storage and then decreased up to 90 days.

Key words: *Allium cepa*, storage, sprouting, rotting, weight loss.

INTRODUCTION

Onion is an important vegetable crop extensively grown in many parts of the world for fresh market use and for processing (Baninasab and Rahemi, 2). In India, onion is grown under three crop seasons i.e *kharif,* late *kharif* and *rabi.* Main crop is harvested in *rabi* (60%) and 20% each in *kharif* and late *kharif* . *Kharif* onion is available in the market from October to December, late *kharif* onion is available from January to March. From April to May *rabi* onion is available. Stored onion of *rabi* is used for domestic as well as export market during June to October. So, the storage of *rabi* onion is indispensible for regular supply. Onions are less perishable than many other vegetables, however losses are inevitable during storage. It has been estimated that 40 to 50% of the production never reaches to the consumers due to postharvest losses. The postharvest losses mainly consist of physiological weight loss, sprouting and decay. Onion cultivars differs in their ability to storage and this variation in the storage duration is either due to pre- and post harvest environmental conditions or due to the cultivar (Kopsell and Randle, 10). Onions are stored mostly in shelters at ambient conditions. Some of the bulb characteristics like dry matter, total soluble solids, pungency and dry scale number are associated with the storage life of onion (Ko *et al*., 9). The growth rate of the sprout inside the bulb varies according to cultivar and storage temperature (Chope *et al*., 5). By following proper pre-and post harvest management practices, storage losses can be reduced. Even after following the proper management practices, if the variety has the character of low storage life, all the practices will be futile to reduce the losses. Selection of variety that has longer storage life is one of the best practices for reducing storage losses. After choosing the variety, all the management practices will only complement in reducing the storage losses. It is imperative to choose a variety having the good storage to augment the storage life with minimum losses. Hence, the present experiment was conducted to study the storage losses in different varieties of onion and identifying the varieties having good storage life.

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MATERIALS AND METHODS

Seven onion varieties (Bhima Kiran, B. Raj, B. Red, B. Shakti, B. Shubra, B. Shweta and B. Super) were grown during *rabi* season of 2013-14 and 2014-15 under similar condition with the recommended practices. After harvesting, produce was cured for three days in field and a week under shade. Onion in plastic crates with two replicates (10 kg per each replication) was stored at ambient temperature in modified bottom and top ventilated storage structure (mean monthly temperature and relative humidity during the storage period is given in Table 1). Observations on weight loss, number of rotted bulbs and number of sprouted bulbs were recorded after 2 and 4 months of storage. Percent total weight loss, sprouting and rotting was calculated using the formulae given below. In the second year

Table 1. Mean monthly temperature and relative humidity during the storage period.

Storage Month	Temperature (ºC)				Relative Humidity (%)			
	2014		2015		2014		2015	
	Max	Min	Max	Min	Max	Min	Max	Min
May	38	20	39	20	70	44	82	35
June	35	22	32	20	89	70	89	66
July	30	39	30	20	86	73	87	73
August	29	20	28	19	90	76	92	75

(2014-15), apart from the observations on weight loss, number of rotted bulbs and number of sprouted bulbs; rate of respiration and total phenol content were also estimated at 0, 30, 60 and 90 days after storage (DAS). Data was analyzed using SAS. Square root transformation of data on storage losses was done.

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

Rate of Respiration

The rate of respiration was measured using head space gas analysis technique with the help of CO_2/O_2 analyzer (Model: Checkmate 9900 O_2/CO_2, PBI Dansensor, Denmark) and expressed as ml CO_2 kg^{-1} h^{-1}. Randomly selected bulbs of onion were trapped in airtight container having twist-top lid fitted with a subaseal septum at the center of the lid. The containers were kept under the same condition for 4 h for accumulation of respiratory gases at the headspace. After specified time the head space gas was sucked to the sensor of the analyzer through the hypodermic hollow needle and the displayed value of evolution rate of CO_2 concentration (%) was recorded. Rate of respiration was calculated on the basis of rate of evolution of CO_2 from the sample per unit weight per unit time.

Total Phenol content

Five onions were taken at random and crushed to paste after peeling. From the homogenized paste, 2 g sample was taken for the analysis of total phenol content. Total Phenol content of the samples was analysed using the Folin-Ciocalteau (FC) reagent by following the method of Singleton and Rossi (14). Results were expressed as mg gallic acid equivalents (GAE)/100 g of sample.

RESULTS AND DISCUSSION

Total weight loss, rotting and sprouting

Variety and storage time had significant effect on weight loss, sprouting and rotting. After two months of storage, B. Kiran and B. Shakti had showed lowest sprouting and rotting compared to other varieties. There was no significant difference between B. Kiran and B. Shakti for percent rotting and sprouting. The differences among other varieties were also not significant for sprouting and rotting (Table 2). Total weight loss was significantly less in B. Kiran (8.79%) followed by B. Shakti (11.90%). Significantly high total weight loss was observed in B. Shweta (28.03%) and B. Red (24.85%). Total weight loss was significantly less in B. Kiran (26.66%) and B. Shakti (35.87%) compared to other varieties (82-95%) after storage of four months (Table 3). No significant

Table 2. Storage losses in different varieties of onion after 60 days of storage.

Variety	Rotted bulbs (%)		Sprouted bulbs (%)		Total weight loss (%)	
	Mean values	Transformed mean values	Mean values	Transformed mean values	Mean values	Transformed mean values
Bhima Super	34.58	5.79	26.98	4.76	20.88	4.67
Bhima Red	24.07	4.97	35.44	5.79	24.85	4.99
Bhima Raj	22.98	4.69	28.92	4.83	19.33	4.46
Bhima Shweta	22.54	4.78	23.75	4.86	28.03	5.20
Bhima Shubra	29.24	5.50	26.17	4.15	20.34	4.53
Bhima Kiran	3.70	2.07	0.40	1.16	8.79	3.11
Bhima Shakti	3.49	2.07	1.67	1.57	11.90	3.57
CD(5%)	-	1.57	-	1.63	-	0.92
SE(d)	-	0.72	-	0.75	-	0.42
SE(m)	-	0.51	-	0.53	-	0.30

Table 3. Storage losses in different varieties of onion after 120 days.

Variety	Rotted bulbs (%)		Sprouted bulbs (%)		Total weight loss (%)	
	Mean values	Transformed mean values	Mean values	Transformed mean values	Mean values	Transformed mean values
Bhima Super	36.31	5.99	50.64	7.11	82.08	9.10
Bhima Red	43.36	6.57	46.04	6.69	94.79	9.79
Bhima Raj	53.03	7.24	43.15	6.44	91.48	9.61
Bhima Shweta	35.70	5.84	27.73	5.19	93.99	9.75
Bhima Shubra	50.60	7.08	39.85	5.59	86.38	9.31
Bhima Kiran	14.20	3.50	5.88	2.50	26.66	5.24
Bhima Shakti	20.07	4.19	9.46	3.00	35.87	5.94
CD(5%)	-	1.60	-	1.96	-	0.81
SE(d)	-	0.74	-	0.90	-	0.37
SE(m)	-	0.52	-	0.64	-	0.26

difference was observed for total weight loss among B. Super, B. Raj, B. Red, B. Shweta and B. Shubra. Sprouting was significantly higher in B. Super (50.64%). Similarly, rotting was significantly higher in B. Raj (53.03%) followed by B. Shubra (50.60%) and B. Red (43.36%). Baninasab and Rahemi (2) also reported a difference in the cultivars for weight loss, sprouting and decay. Ko *et al.* (9) reported mean storage losses of 21% to 99% in twelve short-day onion cultivars stored for 3 months under ambient conditions over 3 years. Physiological weight loss at the end of the 6 months of storage in all the cultivars tested was ranged 35-90% (Abbey *et al*. 1). Some of the bulb characteristics are related to the storage of onion. Cultivars with higher total soluble solids (TSS) and dry matter (DM) had better storability and were less susceptible to storage diseases (Ko *et al*. 9). Martínez *et al*. (11) also reported a positive correlation between storage quality and dry matter content. Fenwick and Hanley (6) found that different bulb skin colour contain different amounts of phenolic substances and flavonols, some of which inhibited fungal disease development. This might be the reason for changes in the rotting.

Rate of respiration

At the beginning of storage, no significant difference was observed in respiration rate for all the varieties. It was ranged from 5.84 to 10.72 ml CO_2/kg/h. However, at 30 days of storage respiration rate was significantly higher in B. Red than all other varieties which were at par. On 90 days of storage rate of respiration was significantly low in B. Kiran (11.24 ml CO_2/kg/h) and B. Shakti (12.33 ml CO_2/kg/h) and the highest respiration rate was observed in B. Red (19.22 ml CO_2/kg/h). The rate of respiration in the varieties during storage showed an increasing and then decreasing trend. In general, the respiration rate increased up to 60 days of storage and decreased at 90 days (Fig. 1). Sixty days storage was the trigger point for rotting and sprouting also. The increase in respiration rate of onions might be the consequence of physiological changes including break of dormancy and sprouting (Salama and Hicks, 12). Kiviranta *et al*. (8) reported an increase in respiration rate of onions during storage for 24 weeks at 20°C. Benkeblia *et al*. (4) also reported an increase in respiration rate when the bulbs sprouted.

Total Phenol content

Before the storage, the total phenol content was significantly high in B. Raj (186.33 mg GAE/100g) followed by B. Kiran (138.64 mg GAE/100g), B. Shakti (137.09 mg GAE/100g), B. Shweta (114.29 mg GAE/100g) and B. Shubra (112.04 mg GAE/100g) where as phenol content was significantly low in B. Red (35.16)(Table 3).Yang *et al*. (15) reported a 6-fold difference in the onion varieties when compared to the variety with the lowest phenolic content. The phenolic contents of onions were reported to vary widely in different cultivars of onions, ranging from 41.74 to 146.90 mg GAE/100 g (Kaur *et al*.7). B. Kiran and B. Shakti, which showed highest total phenol content followed by B. Raj has also showed less sprouting during storage. In the present study, though the phenol content was more in B. Raj, the higher rate of sprouting was observed in B. Raj than B. Kiran and B. Shakti.

During storage, the phenol content increased up to 60 days and then started decreasing in almost all the varieties (Fig. 2). Benkeblia and Shiomi (3) reported a slight increase in the total phenolics

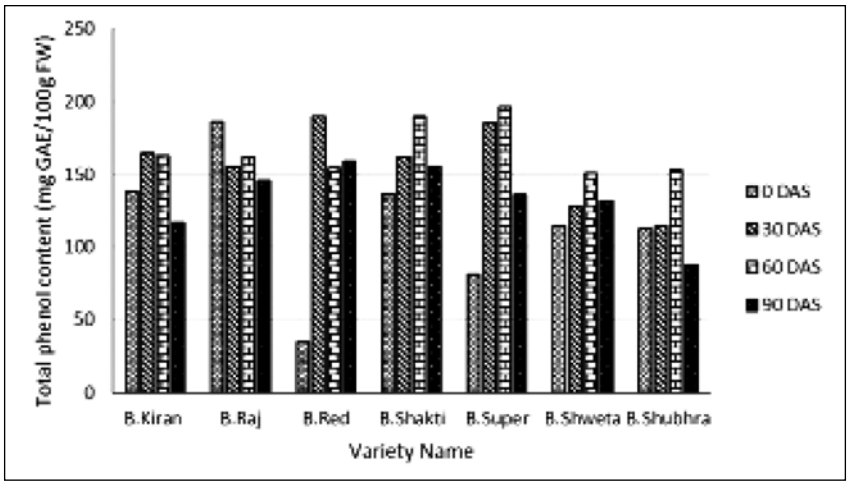

Fig. 1. Rate of respiration during storage of onion.

DAS: Days after storage

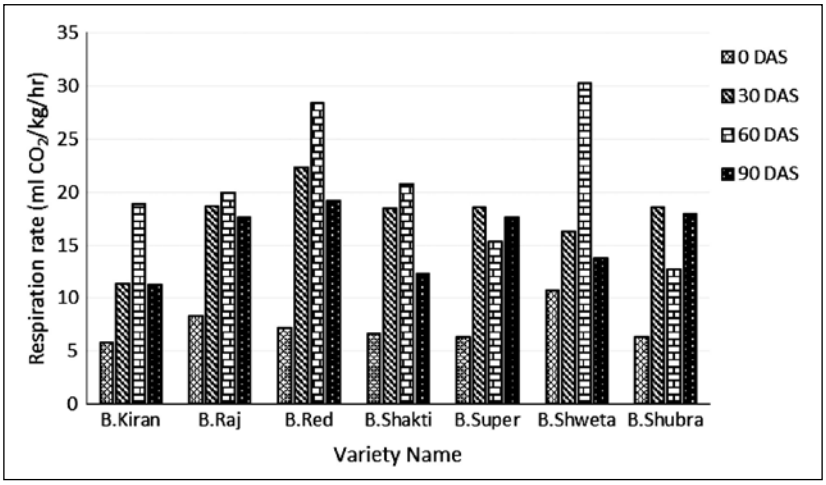

Fig. 2. Total phenol content during storage of onion.

DAS: Days after storage

during the 5 week of storage and a decrease after 7 weeks of storage, when internal sprouting began. During storage, the total phenolic content increased regularly until the 8th week and later started decreasing. Benkeblia and Shiomi (3) observed that, the total phenolic content of inner buds for control sample (stored at 18°C) increased during 5th week of storage and then decreased progressively during last 3 weeks of storage. During the eight months of post-storage of onions under ambient conditions, continuous evolution of total phenolics was recorded and reduction after the 8th week was due to the complete decay of the onion and at this stage the only option was to discard it as waste (Sharma *et al*., 13).

CONCLUSION

B. Kiran and B. Shakti had good storage compared to other five onion varieties tested. These varieties may be considered for long term storage of onion and also to minimize the post harvest losses. The differences in the biochemical characteristics that are contributing to the longer storage of these varieties compared to the other should be studied. These varieties can also be explored in the breeding programme for production of high yielding varieties with good storability.

REFERENCES

1. Abbey, L., Danquah, O.A., Kanton, R.A.L. and Olympio, N.S. 2000. Characteristics and storage

performance of eight onion cultivars. *Ghana J. Sci*. **40**: 9-13.

2. Baninasab, B. and Rahemi, M. 2006. The effect of high temperature on sprouting and weight loss of two onion cultivars. *Am. J. Plant Physiol.* **1**: 199-204.

3. Benkeblia, N. and N. Shiomi. 2004. Chilling effect on soluble sugars, respiration rate, total phenolics, peroxidase activity and dormancy of onion bulbs. *Sci. Agric*. **61**: 281-85.

4. Benkeblia, N., Varoquaux, P., Shiomi, N., Sakai, H. 2002. Storage technology of onion bulbs C.V. Rouge Amposta: effects of irradiation, maleic hydrazide and carbamate isopropyl, N- phenyl (CIP) on respiration rate and carbohydrates. *Int. J. Food Sci. Tech.* **37**: 169-75.

5. Chope, G.A., Terry, L.A. and White, P.J. 2006. Effect of controlled atmosphere storage on abscisic acid concentration and other biochemical attributes of onion bulbs. *Postharvest Bio. Technol*. **39**: 233-42.

6. Fenwick G.R. and Hanley A.B. (1990) Chemical composition. In Alliums and Allied Crops (eds H. Rabinowitch & J. Brewster) Vol. III, pp. 18–31. CRC Press, Boca Raton, FL , USA.

7. Kaur, C., Joshi, S. and Kapoor, H. C. 2009. Antioxidants in onion (*Allium cepa* L.) cultivars grown in India. *J. Food Biochem*. **33**: 184-200.

8. Kiviranta, J., Huovinen, K. and P. Hiltunen. 1988. Variation of phenolic substances in onion. *Acta Pharm. Fenn.* **91**: 67-72.

9. Ko, S.S., Chang, W.N., Wang, J.F., Cherng, S.J. and Shanmugasundaram, S. 2002. Storage Variability among Short-day Onion Cultivars under High Temperature and High Relative Humidity, and its Relationship with Disease Incidence and Bulb Characteristics. *J. American Soc. Horti. Sci.* **127**: 848-54.

10. Kopsell, D.E. and Randle W.M. (1997). Onion cultivars differ in pungency and bulb quality changes during storage. *HortSci.* **32**: 1260-63.

11. Martinez, A.R., Fernandez-Paz, J. and Andres-Ares, J.L. 2005. Evaluation of local onion lines from northwest Spain. *Spanish J. Agric. Res*. **3**: 90-97.

12. Salama, A.M. and Hicks, J.R (1987). Respiration rate and fresh weight of onion bulbs as affected by storage temperature, humidity and maleic hydrazide. *Trop. Sci.* **27**: 233-38.

13. Sharma, K., Assefa, A.D., Kim, S., Ko, E.Y. and Park, S.W. 2014. Change in chemical composition of onion (*Allium cepa* L. cv. Sunpower) during post-storage under ambient conditions. *New Zeal. J. Crop Hort.* **42**: 87-98.

14. Singleton, V.L. and Rossi, J.A. 1965. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. *American J. Enol. Vitic.* **16**: 144-58.

15. Yang, J., Meyers, K.J., van der Heide J. and Liu, R.H. 2004. Varietal differences in phenolic content and antioxidant and antiproliferative activities of onions. *J. Agric. Food Chem*. **52**: 6787-93.

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