I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Comparative Studies of Different Pre harvest Practices and Economic Analysis of Different Low Cost Storage Structures for Reduction of Storage Losses of Onion (*Allium cepa* L.) in West Bengal Condition

S. H. Ansary, N. Mudi, A. K. Chowdhury, N. Gayen and K. Barui

ABSTRACT: *The field experiment was carried out to minimize storage losses of onion (var. Sukhsagar) in farmers' field where different pre harvest treatments like spraying of NaCl, trampling the foliage with bamboo stick were evaluated for proper curing along with natural top falling. After 180 days of storage, the lowest rotting (9.28%), sprouting (5.59%) and total storage loss (39.80%) was found with NaCl spray @ 100g/L at 10-15 days before harvest. Again three different low cost storage structures viz. racking system in well ventilated room, well spaced hanging system in well ventilated room and compact hanging system in poor ventilated room (Farmers' traditional practice) were evaluated for 180 days for reducing storage loss of onion. The well spaced hanging system was found to be more effective to reduce storage loss (total storage loss was 38.37%) and it is suitable for small individual farmer. But for commercial purpose, racking system (total storage loss was 40.94%) is most feasible as it can accommodate 30% more bulbs in same unit size. Both the structures reduced storage loss upto 10-12% mainly by reducing rotting as compared to farmers' traditional practice and increased the profitability of farmers upto 40-50% as against direct selling after harvest.*

Keywords: *Curing, onion, storage losses, storage structures.*

INTRODUCTION

Among the bulb crops onion (*Allium cepa* L.) is most economic and high export potential crop in India. India ranks second in onion production next to China. Major onion growing states are Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu, Punjab, Uttar Pradesh, Bihar, etc. In West Bengal, onion is commercially grown in some pockets of different districts producing around 3,00,000 tonnes from an area of 21,000 ha. As demand of onion remains high throughout the year, but it is produced in particular season and due to improper storage knowledge of the farmers, sometimes crisis of onion happens in the market which leads to high market price. In West Bengal, Rabi onion is generally harvested during middle of March to first week of April and thereafter the produces face hot weather condition. Farmers are compelled to sale their produces after harvest at low prices as proper storage facilities are not available with them which results lower income from the crop. Farmers generally do not follow all scientific management practices during cultivation including curing of the crop. Few farmers try to store some bulbs traditionally in low ventilated room resulting considerable storage loss. In storage generally 30-60% bulbs are damaged by means of weight loss, rotting and sprouting of bulbs. Storage losses in onion could be as high as 66% as reported by Rabbani *et al.* (1986). In ambient condition, the factors like variety, maturity of bulbs, curing technique, moisture content of bulbs, temperature, relative humidity, etc. influence storage life of onion. Improper curing of bulbs greatly affects the storage performance. Marita (2006) mentioned that curing is essential to obtain maximize storage life and have minimal decay. Again proper ventilation condition of storage room is very vital for long term low cost storage.

Realizing the problem of the farmers in the Hooghly district of West Bengal, Hooghly Krishi Vigyan Kendra (KVK), Chinsurah initiated a comprehensive programme in the farmers' field. To increase the storability of onion bulbs some pre

* Hooghly Krishi Vigyan Kendra, Chinsurah, Hooghly, West Bengal, India- 712102

harvest practices had been followed and the best practice had been identified in terms of effectiveness to reduce loss. For longer storage at ambient condition different structures were evaluated in terms of feasibility and economics.

MATERIALS AND METHODS

The experiment was carried out in farmers' field at Balagarh block of Hooghly district during the year 2010-'11 and 2011-'12 in rabi season and subsequently storage experiment was conducted during summer and rainy season using different types of structures. The soil of the experimental field was clay loam having high water holding capacity. The onion variety was a good local cultivar 'Sukhsagar'.

Experiment I: The treatments of the first part of the experiment consisted of –

T_1- Trampling the foliage with bamboo stick at 10-15 days before harvesting

T_2- Spraying of common salt (NaCl) @100g/L at 10-15 days before harvesting

T_3- Natural top falling (50-60%) without any treatment

Seedlings were transplanted during second week of November and fertilizers were applied @ $N:P_2O_5:K_2O:S$ :: 125:100:100:30 kg per ha. 1/2 N, full P_2O_5 and $3/4^{th}$ K_2O were applied as basal and rest N & K_2O were applied twice equally as top dressing at 30 DAT and 60 DAT. The experiment was laid out in a Complete Randomized Block Design with five replications. The unit plot size was 10m X 10m. The crops were harvested during second week of March when bulbs were fully matured. The treatments were followed at 10-15 days before harvesting. Harvested crops were sun dried along with foliage at field separately for 3-4 days for curing. After cutting the foliage, 50 kg selected bulbs from each treatment and each replication were taken and stored on bamboo racks in a ventilated room at ambient condition for 180 days. The observations like physiological weight loss (PWL), rotting and sprouting were recorded at 30, 60, 90, 120, 150, and 180 days of storage. The recorded data of different parameters were statistically analyzed.

Experiment II: This experiment was carried out for evaluation of different low cost storage structures. The treatments consisted of-

TS_1- Storing of onion in racking system in a well ventilated room (Model developed by NHRDF, Nashik and introduced by KVK, Hooghly).

TS_2- Storing of onion in well spaced hanging system in a well ventilated room. (Improvement over local existing system)

TS_3- Storing of onion in compact hanging system in a poor ventilated room (Farmers' traditional practice).

The experiment was laid out in a Complete Randomized Block Design with five replications. In each replication 200 kg matured, sorted bulbs were stored. In racking system (TS_1), the bulbs after cutting of leaves were stored in racks made with split bamboo at an interval of two feet height where four ways ventilation was allowed. In well spaced hanging system (TS_2) the bulbs after curing with foliage intact were stored by hanging from bamboo stick with a vertical gap of one feet in every rows where cross ventilation was allowed. In traditional farmers' practice (TS_3) bulbs with foliage were closely hanged with no space between vertical rows where ventilation is restricted. The bulbs were stored from last week of March onwards. In all cases, bulbs were produced with common management practices including spraying of NaCl @ 100g/L at 10-15 days before harvesting. The observations like physiological weight loss (PWL), rotting, sprouting and total storage loss were recorded at 30, 60, 90, 120, 150, and 180 days of storage. The recorded data of different parameters were statistically analyzed.

Table 1
Month wise average temperature and relative humidity during storage

		April	*May*	*June*	*July*	*August*	*September*
Temperature (^OC)	Max.	36.8	35.1	34.5	32.8	32.3	32.3
	Min.	26.8	26.2	27.1	26.7	26.6	26.0
Relative humidity (%)	Max.	87	86	89	91	92	95
	Min.	54	59	69	73	74	82

RESULTS AND DISCUSSION

Experiment 1

Physiological Weight Loss (PWL)

After 180 days of storage, it was observed that highest PWL (28.13%) was obtained in T_3, whereas PWL was lowest (24.93%) in T_2 where spraying of NaCl was done (Table 2). Again, Fig. 1a indicates that during initial months PWL was higher in all the cases. Physiological weight loss is a common phenomenon during storage of onion due to transpiration and respiration from living tissues. Higher PWL in the early months might be due to high initial moisture content in the bulbs (Biswas *et al.*, 2010) and due to

high temperature coupled with low relative humidity (RH). In T_2, proper maturity and curing of bulbs making neck portion tight with the help of NaCl spray which might resulted lower moisture loss. Proper dried skin also makes surface barrier to water loss. Storability of onion bulbs was slightly improved with increasing maturity stages from 30% to 50% tops down at any bulb sizes comparing to field curing (Abd El Rahman and Ebeaid, 2009).

Table 2
Effect of pre harvest treatments on different storage losses in onion after 180 days of storage

Treatments	*Physiological weight loss (%)*	*Rotting (%)*	*Sprouting (%)*	*Total storage loss (%)*
T_1	26.55	11.73	6.92	45.20
T_2	24.93	9.28	5.59	39.80
T_3	28.13	16.33	7.54	52.00
SEm (±)	0.229	0.257	0.226	
CD (at 5%)	0.705	0.791	0.697	

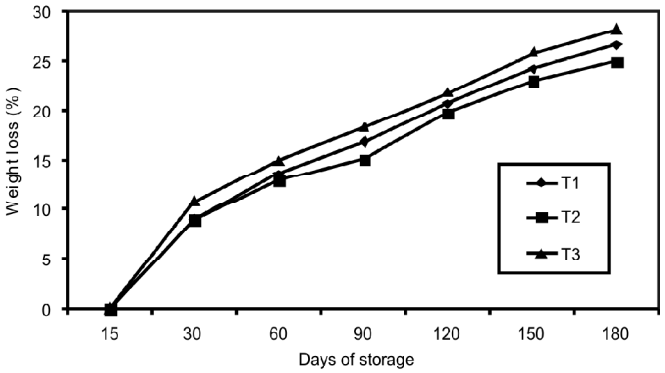


Figure 1a: Physiological weight loss of onion during storage

Rotting Loss

Stored bulbs were generally started rotting after two months of storage. Initially extent of rotting is nominal, but after middle of June when rain started rotting percentage was gradually increased (Fig. 1b). The pre harvest treatments significantly influenced the rotting of bulbs. At 180 days of storage, T_2 recorded lowest rotting (9.28%), whereas T_3 (without treatment) resulted highest rotting (16.33%) as shown in Table 2. In later stage of storage, higher rotting might be due to favourable condition of fungal growth in higher relative humidity in the atmosphere coupled with high temperature. In T_2 comparatively lower rotting might be due to proper curing of bulbs (proper dried skin and tight neck) which prevent entry of pathogen in the storage. Shippers (1968) reported that although high humidity effectively reduced weight loss, it favoured fungal development, especially at high temperature. Aoyagi *et al.* (1977) described that decay of bulbs is increased with increase in temperature. Again, remarkable losses in storage had been observed due to black mould diseases at temperature above 30°C and 90-100% RH (El-Nagerabi and Ahmed, 2003).

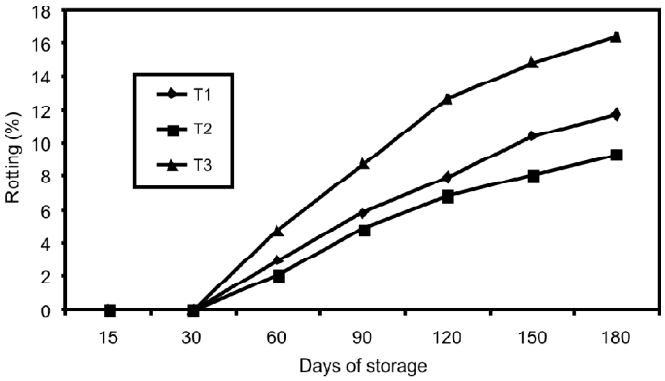


Figure 1b: Losses of onion due to rotting during storage

Sprouting Loss

Sprouting of onion bulbs was noticed during later stage of storage as shown in Fig. 1c. From Table 2, it is found that T_2 resulted lowest sprouting (5.59%) followed by T_1 (6.92%) and T_3 (7.54%). In early stage, no sprouting was happened due to high temperature (>30°C) and low relative humidity (70-80%). During August- September, moderate temperature (around 30°C) and high humidity (85-95%) initiated sprouting of bulbs. Thompson *et al.* (1972) reported that onion bulbs are naturally dormant at maturity and the duration of this dormancy varies with the cultivar, conditions under which bulbs are grown and stored. Salunkhe and Desai (1984) described sprouting as a normal physiological change in stored bulbs that develops reproductive shoots in the second year.

Consisting of PWL, rotting and sprouting, the total storage loss was lowest (39.80%) under T_2 and highest (52.00%) under T_3 as given in Table 2.

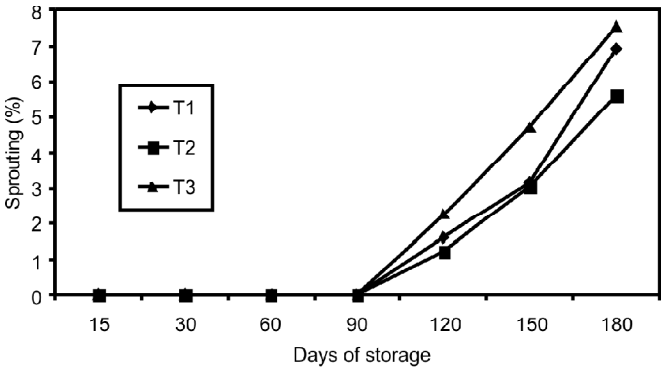


Figure 1c: Losses of Onion due to sproting during storage

Experiment II

Physiological weight loss (PWL), rotting, sprouting and total storage loss

After 180 days of storage the different losses under three storage system is given in Table 3. It was found that in traditional farmers' practice (TS_3), though PWL and sprouting loss were comparatively lesser, but significantly higher rotting loss (20.44%) resulted highest total loss (49.72%). In other two systems (TS_1 & TS_2), the total loss was low and due to slightly higher PWL (26.09%) and sprouting loss (5.78%) in TS_1, the total loss is slightly higher (40.94%) than TS_2 (38.37%). The lowest storage loss in TS_2 might be due to bulbs kept with intact dry foliage resulting lower PWL & sprouting and well spaced arrangement allowed proper cross ventilation resulting lower rotting. Whereas TS_1 system allowed four ways ventilation to bulbs which reduced fungal attack resulting lower rotting. The total storage losses pattern under different structures at different days is given in Fig. 2. Pandey *et al.* (1993) described that percentage of total loss was lowest in bulbs cured in sun with foliage attached and stored with dry foliage. In West Bengal condition, during middle of June onwards the RH remains high along with high temperature. Higher RH may prevents weight loss but favours fungal infection resulting rotting loss. Diseases were the major causes of storage losses, with black mold and bacterial soft rot being the most predominant as reported by Ko *et al.* (2002). El-Nagerabi and Ahmed (2003) reported that temperature in the range of 20-25°C and 70-80% RH greatly reduced the infection rate.

Table 3
Effect of storage structures on different storage losses in onion after 180 days of storage

Treatments	*Physiological weight loss (%)*	*Rotting (%)*	*Sprouting (%)*	*Total storage loss (%)*
TS_1	26.09	9.07	5.78	40.94
TS_2	25.30	8.38	4.69	38.37
TS_3	24.57	20.44	4.71	49.72
SEm (±)	0.185	0.166	0.173	
CD (at 5%)	0.569	0.511	0.533	

It was observed that though total storage loss was lowest in TS_2, the capacity of storage remained 30% higher in TS_1 system than TS_2 under same unit size structure. Borole *et al.* (2013) reported that the losses were found high in storage structure developed by NHRDF as compared to domestic storage structure which was cost effective also.

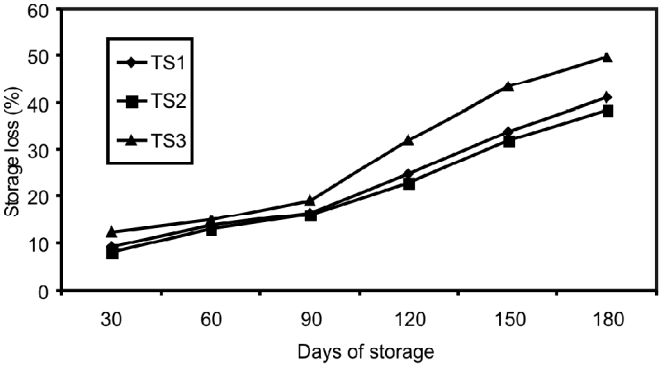
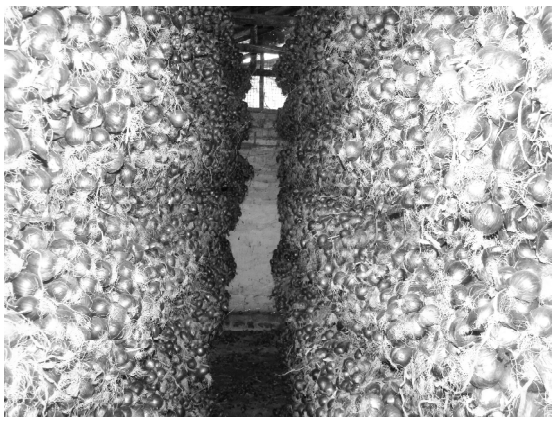


Figure 2: Total storage losses under different structures during storage period

Picture 1: Bamboo racking system

Picture 2: Well spaced hanging system



Picture 3: Compact hanging system (Farmers' practice)

Table 4
Increase in profit under three different storage system

Storage Structures	*Total storage loss after six months (%)*	*Quantity of bulbs after six months (q)*	*Price after six months (@ Rs. 28/kg)*	*Extra Income after six months* (Rs.)*	*Increase in profit (%)*
TS_1	40.94	29.53	82,684.00	22,684.00	41.24
TS_2	38.37	30.82	86,296.00	26,296.00	47.81
TS_3	49.72	25.14	70,392.00	10,392.00	18.89

* Extra income = (Price after six months– Initial selling price) – Labour and handling charges

Economics of Different System

Profit gained after six months as compared to direct selling after harvest of the crop considering 50 quintal bulbs is given in Table 4.

Initial selling price of 50q bulbs @ Rs. 11/kg = Rs. 55,000.00

Labour and handling charges in each system = Rs. 5,000.00

CONCLUSION

From the first part of experiment it is concluded that proper maturity and curing of bulbs are very vital for long term ambient storage of onion. Spraying of NaCl @100g/L at 10-15 days before harvest leads to proper maturity and curing of bulbs which helps to decrease the losses during storage. During later stage of storage the losses may be high due to prevailing of high temperature and relative humidity. Again storage structure system is also very important for low cost storage of onion where proper ventilation plays the main role. Though lowest storage loss was obtained in well spaced hanging system, but it takes somewhat larger space and may be feasible for individual small farmers but for commercial purpose, the racking system is more feasible as it accommodates at least 30% more bulbs than well spaced hanging system and management is also easier. Therefore, cultivating onion with proper scientific management practices and storing in well ventilated structure can reduce storage loss upto 10-12% for six months as compared to farmers' traditional practice and thereby to increase the profitability of onion growers by about 40-50% as against direct selling after harvest.

REFERENCES

Abd El- Rahman, M.M. and Ebeaid, M.T. (2009), Some factors affecting artificial curing of onion bulbs and its effects on the storability. *Misr J. Ag. Eng.*, **26** (2): 905-921.

Aoyagi, M., Makio, H., and Sato, T. (1977), The effect of storage temperature on the keeping quality of onion bulbs. *Res. Bull. Aichiken Agric. Res. Cen. B.* (Horticulture). No. **7**: 54-60.

Biswas, S.K., Khair, A., Sarker, P.K. and Alom, M.S. (2010), Yield and storability of onion (*Allium cepa* L.) as affected by varying levels of irrigation. *Bangladesh, J. Agril. Res.* **35** (2): 247-255.

Borole, S.T., Burbade, R. and Shinde, A. (2013), Comparative losses and economic feasibility of the improved onion storage with low cost of onion storage structure. *Int. J. of Mod. Eng. Res.* **3** (5): 2656-2661.

El-Nagerabi, S.A.F. and Ahmed, A.H.M. (2003), Storability of onion bulbs contaminated by *Aspergillus niger* mold. *Phytoparasitica* **31**(5): 515-523.

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. Amer. Soc. Hort. Sci.* **127** (5): 848-854.

Marita, C. (2006), Recommendations for maintaining postharvest quality. Postharvest Technology Research Information Centre. Deptt. of Plant Sciences, University of California, Davis, CA 95616.

Pandey, U.B., Bhonde, S.R. and Mishra, V.K. (1993), Shelf life of kharif onion as influenced by curing and storage with foliage. News letter Associated Agricultural Development Foundation. **13**: (1) 5-8.

Rabbani, M.G., Hussain, A., Siddique, M.A. and Faruque, A.H.M. (1986), Yield and storability of seven onion (*Allium cepa* L.) cultivars. *Bangladesh J. Agric.* **11** (4): 1-7.

Salunkhe, D.K. and Desai, B.B. (1984), Post harvest biotechnology of vegetables. Vol. **II,** CRC Press, Inc. Boca Raton, Florida. pp. 23-34.

Shippers, P.A. (1968), A preliminary experiment for weight loss in onions. *N.Z. Comm. Grow.* **23** (10): 23-29.

Thompson, A.K., Booth, R.H., and Proctor, F.L. (1972), Onion storage in the tropics. *Tropical Science* **14** (1): 19.