DEVELOPMENT OF ONE TON CAPACITY ALL SIDE VENTILATEDIMPROVED ONION STORAGE STRUCTURE

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Abstract: *The onion storage structure was developed to provide top and bottom ventilation tocontrol humidity and temperature. The structure is made up of wood. The overall size of the structure is 1.4×1.0×1.2 m having storage capacity of 1tonne onion. The supporting frame and rollers are made from MS. The roof is made up asbestos cement sheet. Gap between wooden strips for aeration (all sides) has been maintained to 2.5 cm for creating free and faster air circulation to all space, preventing the formation of humid pockets between the onion layers and maintained quality. The performance evaluation of the developed system was carried out on the basis of onion stored up to 60 days. Comparison of the developed system was made with the conventional ambient loose storage of the onion bulbs based on quality of stored onion. The rotting per cent was observed to be minimum in improved storage structure (3.10%) which was significantly lowerthan onion stored in ambient condition (7.56%) at 60 DAS. No sprouting percentage was observed in improved storage structure recorded at 60 DAS which significantly with onion stored in ambient condition. In case of all the storage properties developed naturally ventilated storage system found superior over ambient storage.*

Key words: *onion, storage, structures.*

Introduction

Onion (*Allium cepa* L.) is one of the oldest bulb crops, known to mankind and consumed worldwide in fresh as well as in processed form. Onion is one of the most important commercial vegetable crops grown in India. Both immature and mature bulbs are used as vegetable and condiment. It contains vitamin B and a trace of vitamin C and also iron and calcium (Anuj, *et al.*, 2012). The onion bulb is very much popular for its pungency, which is due to a volatile oil known as allyl-propyl disulphide.

Onion is seasonal crop but it can utilize throughout the year for consumption. Therefore there is need for stored it properly and utilized whenever required in offseason. But there was huge storage losses of onion reported especially due to failure of maintaince of proper ventilation and temperature-humidity micro environment. Also in this process economic and technological constraints will have to be looked into. For this, two basic strategies *i.e.* high temperature dormancy of onion bulbs and maintaining storage temperature at around 30ºC need to be exploited. Ventilation is needed to maintain humidity between 65-70% and lack of this often adversely affects the quality and quantity by increase in water loss and respiration. Ventilation is also needed to dissipate heat produced by bulbs (Kerala agriculture Bulletin 2015).

The total storage losses are comprised of physiological loss in weight (PLW) *i.e.* moisture loss and shrinkage (30-40%), rotting (20-30%) and sprouting (20-40%) (Borole *et al.*, 2013). So, this huge postharvest loss of onion during storage is a cause of concern in the country. The onion produce is available in market during October-November (20%) as Kharif crop, January-February (20%) as late Kharif crop and April-May (60%) as Rabi crop. The Rabi crops produce having more ability in storage and used for domestic, export and seed bulbs purposes from June to November. This is the critical period in whole country, where there is no fresh harvest onion and hence, storage becomes paramount importance for steady supply.

The essential parameters needed for successful storage of onions are: Shade curing or artificial drying by pressure ventilation. Neck cut and onions collected without leaves, dirt or sand. A Construction of structure should lead on a raised platform to prevent moisture and dampness due to direct contact of bulbs with the soil. Use of Mangalore tile type roof or other suitable materials to prevent built up of high inside temperature. Increased centre height and more slope for better air circulation and preventing humid micro climate inside godown. The structure required bottom and side ventilations for free and faster air circulation and to avoid formation of hot and humid pockets between the onion layers. Avoid direct sunlight or rain water falling on onion bulbs to reduce sun scald, fading of colour and quality deterioration. Cost effectiveness of structures is based on utilization of locally available material for the construction (Nabard bulletin 2015).

Low cost farm level technology is, therefore, required to be developed to extend the shelf life of fresh vegetable produce, such as onion to increase its marketability and to make fresh onion available to the consumer round the year at a reasonable price (Falayi and Yusuf, 2014). Thus, the pre and post-harvest treatments that tend to improve the quality and storage life of onion would go a long way in improving the socio-economic status of the farmers. Hence, in present study effort has been made for development of low cost naturally ventilated improved storage structure and its performance evaluation of onion harvested in rabi season.

Material and Methods

Development of onion storage structure

A typical low cost storage structure was made up from locally available wooden materials. The major load bearing components of frame like plinth, vertical support, roof support, side wall support and floor supports were constructed from 0.075m × 0.035m wooden block. The side wall and floor of the structure made of the wooden strips. The wooden strip having size 0.045 m × 0.015 m was used to made side wall and floor. Asbestos cement sheet were used as roof top to protect the onions from sunshine and rain. The complete structure of 1 tonne capacity was rest on the 40mm×40 mm×5mm MS angle frame. This supporting frame was provided with small wheel at the base for easy handling from place to place. The sizes of each wheel roller were 20mm width and 40mm diameter. The side wall of wooden frame was covered with shed net after filling the onions in structure for protecting it from rains. The onion storage structure was fabricated to provide top and bottom ventilation to control humidity and temperature. This helps in prevention of development hot air pockets within the structure which causes physical loss in weight, sprouting, rotting and black mould. The main components of the onion storage structures are: base, side wall, roof, supporting frame with roller and loading/unloading window. The structure is made up of wood. The overall size of the structure is 1.4x1.0x1.2 m having storage capacity of 1tonne onion (Fig. 1). Gap between wooden battern for aeration (all sides) has been maintained to 2.5 cm creating free and faster air circulation to all space, preventing the formation of humid pockets between the onion layers and maintained quality.

Fig. 1: Developed onion storage structure

Results and Discussion

The performance of the developed structure was evaluated based on the periodical estimation of physiological weight loss, dry matter content, colour, hardness, rotting percentage and sprouting percentage of the stored onion. Also the effect of the two storage conditions i.e natural ventilation in improved structure and conventional ambient condition were evaluated in every 15 days of interval till 60 DAS. Table 1 shows the effect of said storage conditions and storage period on the quality characteristics of the stored onions.

Effect of storage conditions on PLW %

The PLW of both storage conditions i.e improved naturally ventilated storage structure and ambient were recorded separately. The mean PLW of the bulbs irrespective of storage condition increased from 0 per cent at the time of filling of bulbs in the structure to 6.99 per cent at 60 DAS. The PLW value of the bulbs were significantly differed throughout the storage period at both the storage conditions. Minimum PLW (0, 1.25, 2.50, 3.84, 5.19%) was recorded in improved onion storage structure (T_1) followed by ambient condition (T_2) (0, 3.10, 5.56, 7.72 and 8.80%) at 0, 15, 30, 45 and 60 DAS, respectively (Fig 2a). Among the two storage conditions minimum weight loss were recorded in improved storage condition and which was significantly lower than the onion stored at ambient conditions for same storage period. The reason of minimum weight loss in improved storage structure was might be due to less transpiration and respiration due to comparatively low temperature and optimum relative humidity in the storage environment (Endalew*et al.*, 2014). Tripathi et al. (2013) reported the same trend during the storage of onion in the bottom and side ventilated improved onion storage structure.

Effect of storage conditions on Dry matter content

The dry matter content of the onion bulbs was found to be continuous increased with elapsed storage duration in both the storage conditions. There was significant effect of storage time on the change in dry matter content. Maximum per cent dry matter was recorded in bulbs stored in T_1- improved storage structure i.e 10.20, 11, 11.60, 12.20 and 12.60% at 0 to 60 DAS with 15 days of interval. While with bulbs stored in T_2- ambient condition it was 9.80, 10.18, 11.09, 11.60 and 11.75% at 0, 15, 30, 45 and 60 DAS, respectively (Fig 2b). Maximum per cent dry matter was recorded in onion stored in improved storage structure. The rate of increase in dry matter content was initially high and it reduced thereafter in both the storage conditions. The maximum dry matter content during storage in improved storage structure could be reasoned due to the more decreased in moisture content of the bulbs. Similar trend was reported by Hunsan et al, 1999.

Colour of the bulbs (with scale)

The colour of the onion bulbs at different storage conditions and storage times was estimated for bulbs with scale. The colour of the stored onion bulbs was evaluated based on estimation of its 'L' and 'a' values. Here, L value represent the lightness while a value represent the darkness of the onion bulbs. The variation between the both storage conditions regarding 'L' and 'a' values was significantly affected by storage time. Maximum 'L' value was recorded in bulbs stored in T_1- improved storage structure i.e 40.30, 42.95, 44.97, 47.23 and 49.70 while it was 40.53, 42.23, 43.78, 45.29 and 47.03 in T_2- ambient condition at 0, 15, 30, 45 and 60 DAS, respectively (Fig 2c). Similarly, 'a' value of the stored onion bulbs in T_1 was 25.13, 28.74, 31.32, 34.25 and 36.20 while 25.24, 27.12, 28.03, 31.20 and 33.10 in T_2 at 0, 15, 30, 45 and 60 DAS, respectively (Fig 2d). There was no significant difference was observed in case of L values at all stages of storage, while it was significantly different in 'a' value of the onion bulb. The enhancement in both the values of colour was attributed to due to the curing process, which contributed for the colour development due to pigmentation, i.e., the change of light pink pigment to dark red colour (Ambe*et al.*, 2014).

Hardness of the bulb

In improved ventilated storage conditions as well as ambient storage conditions hardness of the bulbs were goes on increasing with increase in storage duration. In case of compression, the hardness of bulbs stored in T_1- improved storage structure was found to be 22.96, 25.07, 27.04, 30.14 and 33.48 kg at 0, 15, 30, 45 and 60 DAS. While the hardness of the bulbs stored in T_2- ambient condition was 22.43, 24.32, 26.58, 28.20 and 31.36 at 0, 15, 30, 45 and 60 DAS, respectively (Fig 2e).The hardness of the bulb stored in ventilated storage condition was higher than the onion stored in ambient condition during all respective DAS. But there was no any significant effect of the storage conditions on the compression hardness of the stored bulbs.Similarlyin cutting position the hardness of bulbs stored in T_1- improved storage structure was 19.63, 21.13, 22.19, 25.54 and 26.27 kg at 0, 15, 30, 45 and 60 DAS while 19.54, 20.98, 21.53, 23.72 and 24.86 kg at 0, 15, 30, 45 and 60 DAS respectively at ambient storage condition. Exactly similar trend likewise compression was found in cutting conditions.

Effect of storage conditions on rotting percentage

The growth of the black mould is mainly responsible for the rotting of onion bulbs during storage. Therefore periodical checking for incidence of presence of black mould is very important. There was significant increase in rotting percentage to with respect to time were found in both the storage conditions. Figure 2F depicts that, there was no any incidence of rotting was found till 15 DAS in both the conditions. After 15 DAS at ambient condition 2.89, 4.80 and 7.56% rotting of bulbs were found on 30, 45 and 60 DAS respectively. Similarly in improved naturally ventilated condition 1.2, 2.3 and 3.1% rotting of bulbs were found on 30, 45 and 60 DAS respectively (Fig 2f). The rotting of the onion bulbs was found significantly lower in onion stored in improved naturally ventilated onion storage structure. Similar trend was reported by Tripathi *et al.* (2013) in improved storage structure with bottom and side.The situation might be happen due to proper ventilation as well as minimum fluctuation in storage temperature and the reason was well supported byTripathi and Lawande, 2007.

Effect of storage conditions on sprouting percentage

The sprouting of the onion bulbs were started when the favourable temperature and humidity gets accumulated inside the micro environment of the stored onion (Tripathi and Lawande, 2007). Table-1 represent the percentage of sprouting initiated in stored onion bulbs with respective to time. There was no any incidence of sprouting in improved naturally ventilated storage structure till 60 DAS similarly, there was no sprouting till 30 days in case of ambient storage condition. The visual sprout appearance were found at 45 DAS and onwards and it was 2.87 and 3.64% with 1.30 and 2.40 cm of sprout length at 45 and 60 DAS respectively (Fig 2g). No any incidence of sprouting in improved storage structure might be due to the proper aeration cum ventilation prevents the accumulation of humidity and efficient removal of respiratory heat generated by stored bulbs. The reason also in accordance with the Tripathi et al, 2013. Also, Bonde, 1988, reported that lower sprouting per cent and sprout length in the well ventilated storage was due to the low relative humidity and also to the increased ventilation rates result in the reduced sprouting and sprout length and prolongs the dormancy period.

Conclusions

The physiological loss in weight was minimum when the bulbs stored in improved storage structure (5.19%) and significant higher with bulbs stored in ambient condition (8.80%) at 60 DAS.The change in dry matter was found to similarly be maximum 2.40 % in improved onion storage whereas it was 1.95 % observed at ambient condition after 60 DAS. Both increase in 'L' and 'a' colour values of the onion bulbs were found in T_1 as well asT_2.The hardness (compression) and hardness (cutting) of the bulbs was significantly influenced by both storage conditions during different days of storage. The rotting per cent was observed to be minimum in improved storage structure with bottom and side ventilation (3.10%) which was significant with onion stored in ambient condition (7.56%) at 60 DAS. Similarly, no sprouting percentage was observed in improved storage structure with bottom and side ventilation recorded at 60 DAS. Hence, it proves that developed improved storage structure becomes the prominent solution for long term bulk storage of onions.

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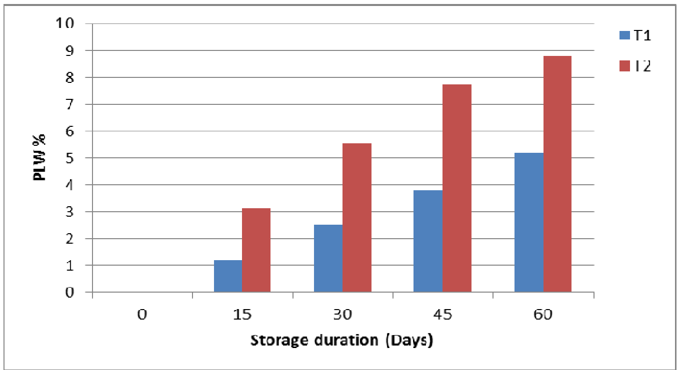
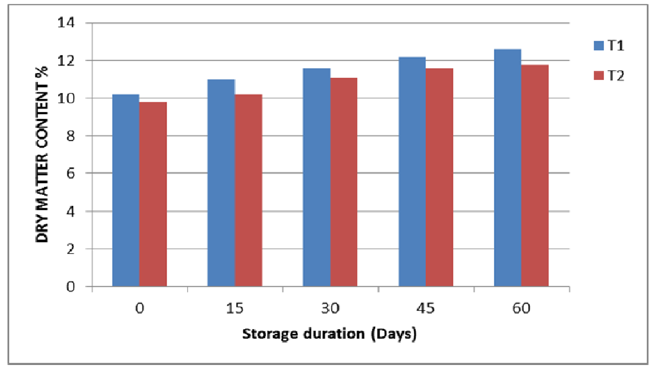


(a)



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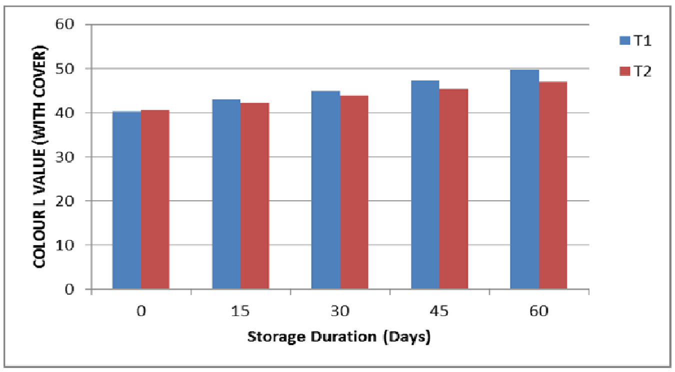

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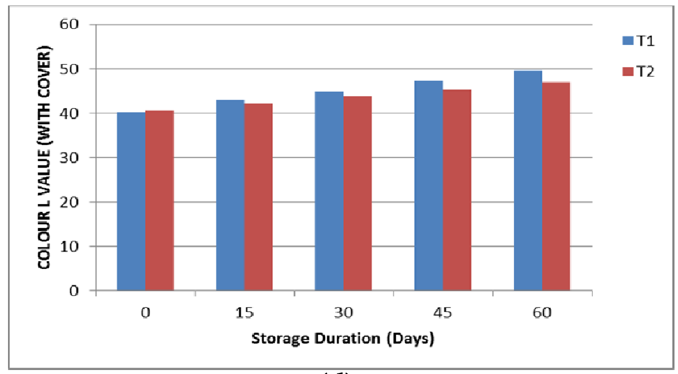

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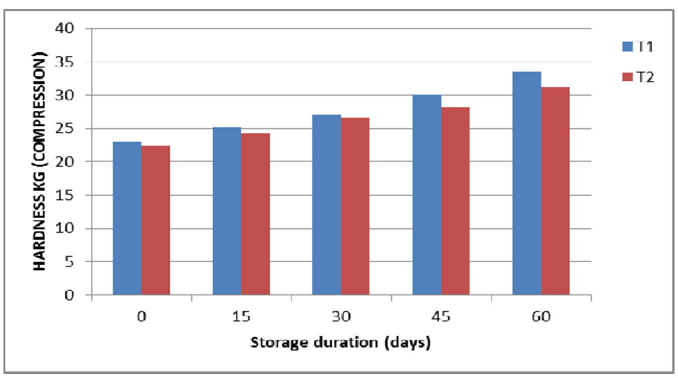

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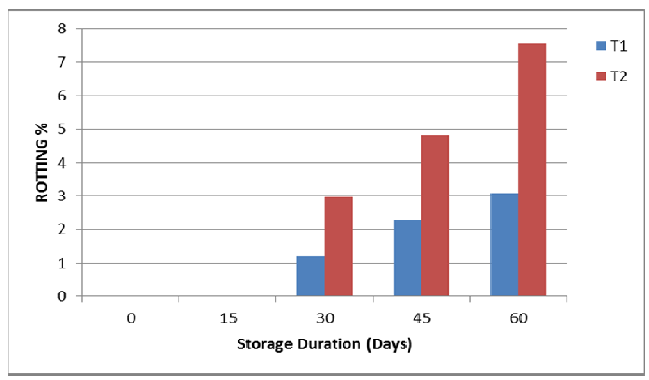

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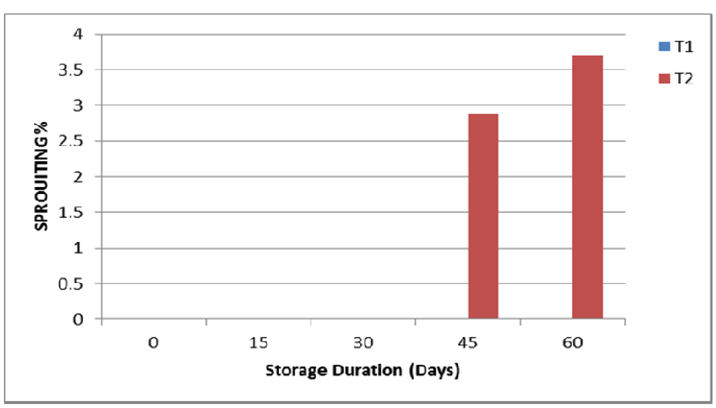

(g)

Fig. 2: Influence of storage conditions and storage duration on (a)PLW (b) Dry matter content (c) 'L' value (d) 'a' value (e) Hardness (f) Rotting percentage (g) sprouting percentage of onion.