J Krishi Vigyan 2018, 7(1) : 216-219 DOI : 10.5958/2349-4433.2018.00136.8

Zero Energy Cool Chamber, Low Cost Storage Structure for Vegetables and Fruits in Churachandpur District of Manipur

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ABSTRACT

The keeping quality and longevity of fruits and vegetables requires high cost storage as well as high energy consuming technology. Our farmers cannot afford such technology due to the substantial financial involvement which makes the technique impracticable in rural areas. Massive quantity of fruits and vegetables are lost every year due to the lack of proper infrastructure for processing and post-harvest management. The zero energy cool chamber (ZECC) system of storage was introduced at Churachandpur district for storage of vegetable and fruits in order to reduce the problems of post-harvest losses at farmers' level. ZECC is a cost-effective, eco friendly and less energy requiring technology for storage and also improves the quality and productivity of vegetables and fruits by reducing field heat, increasing shelf life and checking post-harvest losses respectively. In the study it was found that shelf life of vegetable and fruit crops like cabbage, broccoli tomato, pineapple, passion fruit and banana could be enhanced through ZECC and that physiological loss in weight (PLW) in ZECC was also comparatively less as compared to the room condition. Hence, there is a great scope for popularization of ZECC for preventing losses during post harvest of fruits and vegetables in Churachandpur district of Manipur.

Key Words: Fruits, Physiological loss, Shelf life, Vegetables, Zero energy cool chamber.

INTRODUCTION

Storage and upkeep of fruits, vegetables and tuber crops is the single most crucial post-harvest activity. Due to lack of sufficient storage and processing facilities in the country, the considerable amount of fruits and vegetables are spoiled after harvesting. In developing countries, more than 40 per cent of the food losses occur at post-harvest and processing levels. In India, according to the recent report of ICAR the quantitative post harvests losses in fruits and vegetables ranged between 5.77 -18.05 per cent (Narayana, 2014) and therefore, prevention of such damages is the most appropriate method to make available more quality vegetables and fruits and is a complementary means of increasing income and production. The farmers of Churachandpur district have poor resource availability and in the absence of proper storage technique, the farmers usually sell their vegetables in the local markets just after the harvest. Transporting the crop in gunny bags on local transport to markets induce considerable stress on them. Due to lack of sufficient storage and processing facilities in Churachandpur district, the considerable amount of fruits and vegetables are spoiled after harvest. Losses occur in both ways *i.e.,* qualitative and quantitative terms. The spoilage of fruits and vegetables can be controlled by reducing the storage temperature and increasing the relative humidity. Refrigerated cold storage is considered to be the best method for storing fruits and vegetables, but this method is not only highly energy intensive but also requires enormous capital investment. Besides, it is not suitable for on-farm storage in rural areas, where the producer would like to store

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the commodities only for a couple of days to make it sufficient quantities before carrying them to the nearest market.

Considering acute energy shortage and inadequate cold storage facilities in rural areas, there is tremendous scope for adoption of low cost Zero Energy Cooling Chamber (ZECC) for short-term on-farm storage of perishable farm produce. ZECC is one such technology which can prolong the life of fresh produce through evaporation cooling without any utilization of external power. Lata and Singh (2013) had successfully experimented zero energy cool chamber for the farmers of Gujarat. Kumar *et al* (2014) studied utility of zero energy cool chamber successfully in Jaipur. The ZECC developed by Roy and Khurdia (1983) at IARI, Pusa, New Delhi for the storage of fruits significantly contributed towards the reduction of post-harvest losses and maintaining the quality of the produced (Singh *et al*, 2010). ZECC could lower temperature range of 10- 15°C cooler than the outside temperature and maintain about 95 per cent relative humidity.

MATERIALS AND METHODS

Study area

The study was carried out in Churachandpur districts of Manipur, northeast India. Churchandpur district is one of the hill districts of Manipur and is fifth largest district in the State by population. The density of the district population is 60/km^2. The total population of the state is 274143 and out of the total Churachandpur population, 6.7 per cent lives in urban areas and remaining 93.3 per cent lives in rural areas according to the 2011 census. The Churchandpur district receives south-west monsoon rain in summer and northeast monsoon rain in winter with an average annual rainfall of 1500 mm, with the peak rainfall received during the month from May to October. The district summer highest day temperature is in between 22 °C to 37 °C. The primary occupation of the people in the district is cultivation. People in the district mainly depend on shifting cultivation or *jhum* cultivation but horticulture plantation and other non-agricultural resources are also being practiced at minor scale. The primary fruit crops grown in the districts are pineapple, passion fruit, banana, etc. and the other vegetable crops like cabbage, tomato, chili, okra, broccoli, etc. are also grown in few pockets of the district. Till date agriculture continues to be the primary source of livelihood in the district.

Construction of zero energy cool chamber

The zero energy cool chamber (ZECC) has been designed by IARI Pusa, New Delhi (Roy and Khurdiya, 1983) and can be constructed easily with materials like brick, sand, bamboo, straw, gunny bag etc. It was constructed by following steps:

- Identifying an elevated level space having facilities of water supply
- The dimension of the floor of ZECC is 165 cm x 115 cm and layout with bricks.
- Double wall erection of brick at the height of 67.5 cm leaving gap of 7.5 cm in between two walls for filling of river sand.
- The uniform texture river bed sand could be used for filling up of the cavity between the double walls after soaking with water.
- It is necessary to cover the top with the bamboo straw and other locally available material to protect the chamber from direct sun or rain.

The principle of ZECC is based on evaporative cooling i.e. cooling effect created due to evaporation of water. The ZECC maintains the relative humidity inside the cooling chamber relatively higher than that outside the chamber which helps in lowering the temperature inside the cool chamber as compared to ambient temperature. The temperature variations inside the cool chamber happen to be very low as compared to outside fluctuation in mercury. The different stages for construction of zero energy cool chamber is given in Fig. 2.

RESULTS AND DISCUSSION

The trials were conducted in Churachandpur district, Manipur in cabbage, broccoli, and tomato for vegetable crops, while fruit crops taken for

Fig. 2. Different stages for construction of zero energy cool chamber

the experiments were the banana, pineapple, and passion fruit. These are the high-value horticultural crops planted by the farmers. Under the trial, the shelf life of cabbage, broccoli, and tomato were 5d, 2d and 7d, respectively under room condition and following vegetables could be enhanced their shelf life by keeping under ZECC condition at 11d, 7d and 15d, respectively as compared to the room condition (Fig.1). The physiological losses in weight (PLW) of these vegetable crops were also analyzed for both room and ZECC conditions. The PLW of fruit crops like pineapple at room condition was 6.8 per cent and 3.2 per cent under ZECC condition. The PLW of passion fruit and banana crops under room condition were at 7.5 per cent and 4.2 per cent respectively and 5.5 per cent and 2.4 per

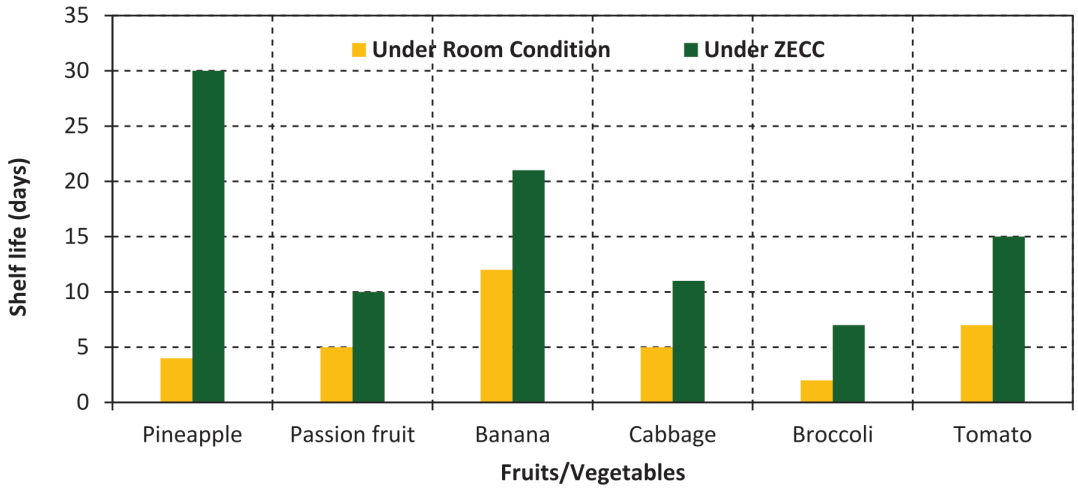

Fig.1. Comparison of shelf life of fruits and vegetables under ZECC condition and room condition in Churachandpur district, Manipur

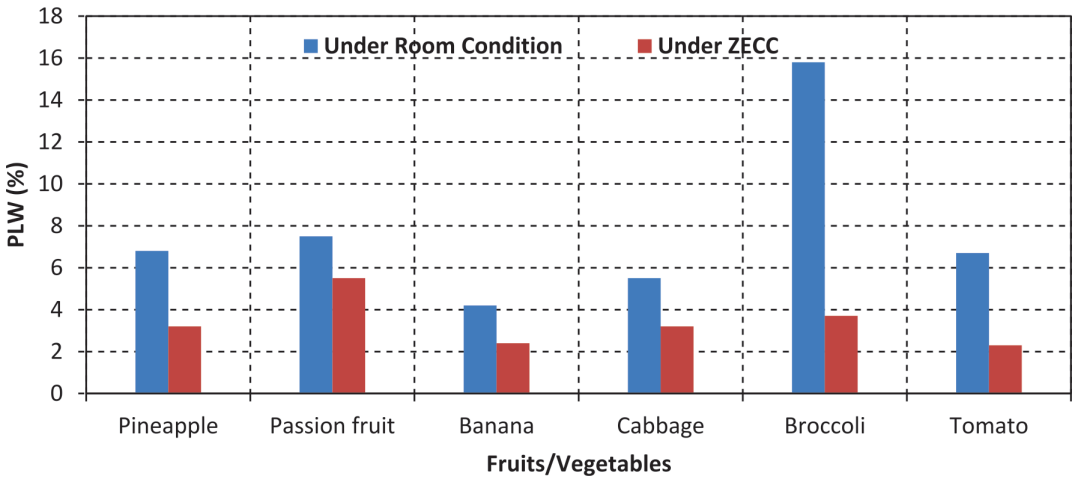

Fig. 2. Comparison on per cent of physiological loss in weight (PLW) of fruits and vegetables between room condition and ZECC condition

cent, respectively under ZECC condition. In case of vegetable crops, PLW for cabbage, broccoli, and tomato under room condition were 5.5, 15.8 and 6.7 per cent sequentially and PLW could be reduced at 3.2, 3.7 and 2.3 per cent, respectively under ZECC condition as compared to the room condition (Fig. 2).

CONCLUSION

Due to the lack of proper storage and processing facilities in Churachandpur district, a considerable amount of horticultural produce goes waste. Refrigerated cold storage is considered to be the best for storing fruits and vegetables, but this method is not only highly energy intensive but also requires enormous capital investment. Prevention of post-harvest losses using the most appropriate way to make available more quality vegetables and fruits and is a complementary means of increased production for the farmers. The zero energy cool chamber (ZECC) is a simple, low cost, effective and farmers' friendly technology which can be easily adapted by the farmers.

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Received on 20/3/2018 *Accepted on 20/6/2018*