Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 3, Issue 2; January-March, 2016 pp. 79-82

http://www.krishisanskriti.org/Publication.html

Low Cost Storage Technology for Farmers' Cooperative Groups and Retail Mandi

Deepak Huidrom[1], Neeru Dubey[2], Manju Rawat[3] and Thangjam Rishikanta[4]

[1]Amity Institute of Horticulture Research and Studies Amity University Uttar Pradesh, Noida
[2]Amity International Centre for Post-Harvest Technology and Cold chain Management, Amity University Uttar Pradesh, Noida
[3]Amity Institute of Environment Science
[4]Amity Institute of Horticulture Research and Studies Amity University Uttar Pradesh, Noida
E-mail: [1]dpkhuidrom@yahoo.com, [2]needub@gmail.com, [3]mranjan123@amity.edu, [4]rishi.snazzy@gmail.com

Abstract—*Horticultural crops are the most important source to nutritional security but suffer considerable nutrition, value and economic losses due to their high water content, perishable nature and high ambient temperatures particularly in the summer months. The best possible alternative for storage of these commodities is mechanical refrigeration, which is economically and practically not feasible for small scale. To overcome this problem a device "CoolBot" conceptualized by Mr. Ron Khosla was tested at organic farm of Amity University. It was installed in an insulated room along with room air-conditioner. The insulation material selected was 1 ft wide clay along with 6 inch thermocool for floor and roof. During the experiments with different commodities the room temperature was set as desired for the commodity and was maintained during the storage period, keeping the commodity fresh and marketable. The total cost of the storage facility comes to Rs 1.86 lacs for 8 MT capacities, which is way less than the conventional cold storage. The experiments conducted indicated that the temperature was maintained between 4-8^oC whereas the outside temperature showed a varied fluctuation between 42-45^0C. The core temperature of the commodities was maintained in the range of 8- 9^oC which off sets any losses which can occur because of high ambient temperatures. Commercially system was installed at a retail mandi at Sultanpur, Uttar Pradesh and the farmers and retailers are storing fruits like Mango, Guava, Citrus fruits, Watermelon, Muskmelon and vegetables like Chilli, Okra, Cabbage, Cauliflower, Bottle gourd, Bitter gourd, Potato, Tomato, Coriander, Spinach, Amaranthus etc. This system was found quite successful and the retailers are earning a fair amount of money with this facility. There total earning is Rs. 25,000/- per month with 25 days operational period and 50 % capacity utilization while the net earning is around 16,500/- per month. This system was commercial successful and helped in increasing the shelf life of the produce, provides storage facility to farmers and retailers at low cost and helps in planned marketing by preventing distress sale.*

1. INTRODUCTION

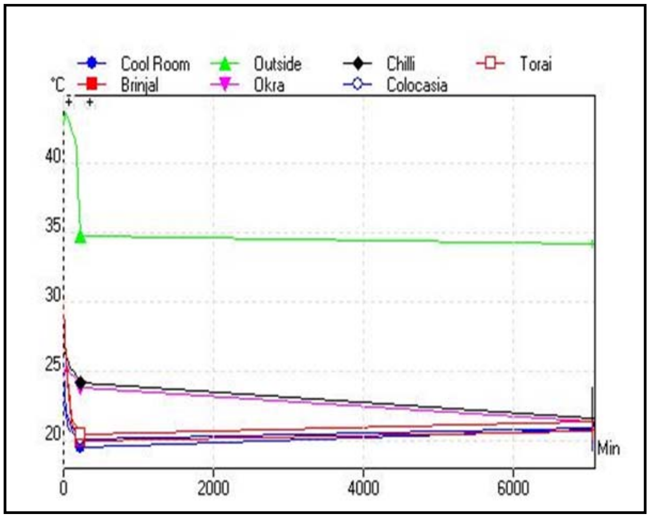
Mechanical refrigeration is the best technology for coolrooms and transportation systems, conventional reefers are economically and practically infeasible for limited resource farmers. A device named 'CoolBot' conceptualized by Ron Khosla was tested and verified in a low cost insulated room. This facility helps in maintaining the product storage temperature and relative humidity. It also helps to save not only on installation and repair costs but also reduces electricity bill and lower carbon foot print. This technology can easily serve in small scale cool rooms and small scale transportation facilities.

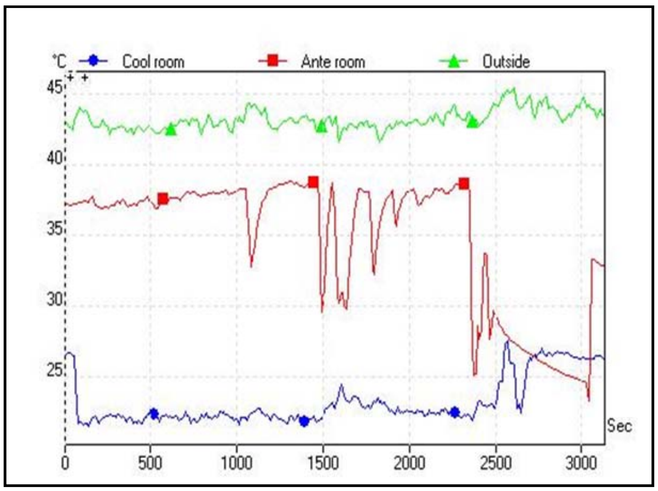
2. MATERIALS AND METHODS

The project focus was to develop a prototype low cost storage structure for the small and marginal farmers from locally available insulating material and to test the effectiveness of CoolBot/room air conditioner combination. This experiment was conducted at Amity University, and Farmer's field Sultanpur, Uttar Pradesh. An insulated room with capacity 8-10 MT was constructed along with an ante room. The insulating material used was 3 ft thick clay mud and rice husk along with untreated bricks for stability and support. The door of the cool room was a standard cold store door with 60 mm thick PUF. Roof and floor were insulated with polythene enclosed thermocool sheets which also acted as vapour barrier. A good energy efficient window Air conditioner unit was installed in the wall depending on the size of the room and the gap was sealed with the foam sealant. The CoolBot was mounted in the wall besides the Air conditioner and connected to the air conditioner. The data was recorded with the help of the pico logger.

3. RESULTS AND DISCUSSION

The initial experiments at Amity University Uttar Pradesh indicated a temperature level down to 4-8^{o}C when the temperatures in the outside showed a great fluctuation. The chart presented below clearly shows that the coolbot cool room maintains the lower temperature below 10^{o}C when the outside temperature ranges from 42-45^{o}C in the peak summer month of May-June.





The commodities that is chilli, torai, brinjal, okra and colocasia which were harvested at a higher temperature quickly cooled down to the 12-15°C and maintained the temperature throughout. The vegetables were firm, marketable and fresh after the storage period with no visible injury.

Vegetable inside the cool room

Data recording through pricologer

Specific vegetable crops tested

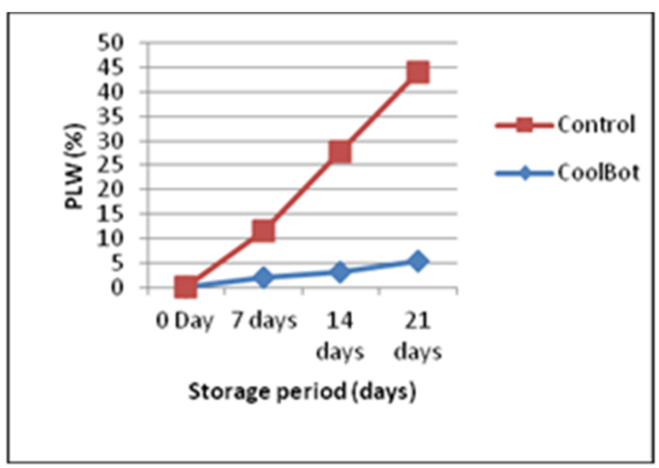
In the second experiment conducted at Amity University, different parameters regarding the shelf life and marketability of the four vegetable crops were tested and the results are presented below-

Physiological loss in weight

Physiological loss of weight is the most important parameter to judge the shelf-life of vegetables. Determining PLW of all vegetables, the weight of the vegetables was recorded and the total loss of physiological weight was then calculated by subtracting the final weight of the vegetables from the initial weight.

The results were then expressed in percentage using

$$\text{Percentage PLW \%} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$



(a)

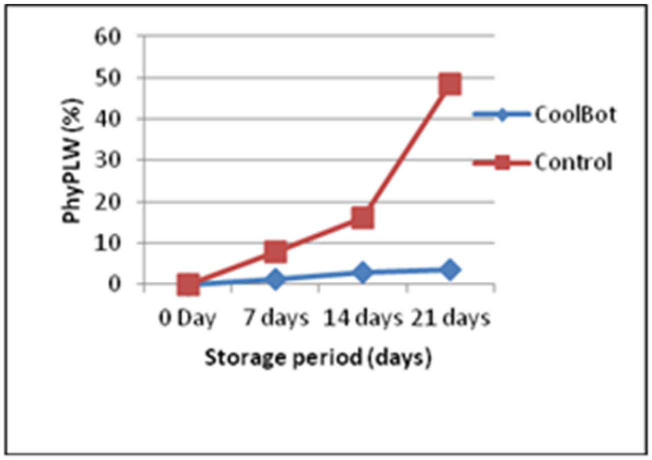


Fig. 2: Effect of storage on Physiological Weight Loss (PLW) of a) Tomato and b) Okra stored under Cool room and control conditions

The physiological loss in weight was observed during the storage period at 7th 14th and 21st day. The physiological loss in weight results in economic loss to the farmer/grower. Maximum losses in control was reported in Okra and Tomato where the PLW was around 50 % and 40 % respectively while in cool room it was less than 5 % in both the crops. Once the commodity losses 10 % of its original weight it starts to reduce its firmness and in all the commodity graphs mentioned above its clear that the commodity has reduces its 10 % during the first storage interval of 7 days while in cool room the PLW has not gone above 6 % in any of the product which shows that the produce are firm, uniform and marketable.

Core temperature

The table 2 presented below shows that the core temperature inside the CoolBot cool room was significantly lower than the control temperature. The pulp temperature has a direct bearing on the shelf life of the produce. Lower the pulp temperature means higher life of the produce and once the core of the commodity is cooled it takes about 8 hours to increase the internal temperature by 1°C. Significant variation in the cool room temperature and control temperature was found in Tomato where it ranged from 9.26- 9.51°C in the cool room and was above 34°C after 7 days in the control condition which will result in rapid deterioration of the produce.

Produce storage and shelf life is function of both temperature and time (Thompson et.al, 1998). The pulp temperature of produce influences its metabolism and consequently determines the deterioration rate. Generally, produce becomes more perishable as the temperature increases. In this experiment pulp temperature of different produce were measured and were found to be cooler than the control temperature which resulted in increased shelf life of the commodities. The relative humidity through out the experiment period was from 85- 90 %.

Table 2: Comparative core temperature of the commodities

	Pulp temperature			
	Tomato		Okra	
	CoolBot	Control	CoolBot	Control
0 Day	9.44	31.40	9.36	30.57
7 days	9.48	34.20	9.31	31.20
14 days	9.51	34.60	9.36	31.77
21 days	9.26	34.60	9.19	31.77
CD(0.05)	T= 15.92 S=22.51 T x S= 31.83		T= 1.40 S=1.98 T x S= 2.80	

Visual sensory rating

The visual sensory rating was recorded for the crops at weekly intervals and the details are presented in table below-

Table 3: Comparative Visual sensory rating of the commodities

	Rating			
	Tomato		Okra	
	CoolBot	Control	CoolBot	Control
0 Day	5	5	5	5
7 days	5	2	5	2
14 days	5	1	5	1
21 days	5	1	5	1

The effect were recorded on the visual sensory quality of the different vegetables and the table 2 presented above shows that in the cool room storage the Okra and Tomato

showed the maximum rating of 5 for storage period of 21 days and the product was marketable where as in control condition the product showed a lower market value from 7th day where as both the commodities were completely unmarketable from 14th day storage period.

Table 4 Comparative costs of installing a commercial refrigeration system and a modified room air conditioner for a produce cold room

	Conventional 2 ton refrigeration system*		**CoolBot-controlled room air conditioner	
	(USD)	INR (Rs. Lakh)	(USD)	INR (Rs. Lakh)
Refrigeration equipment	$4,000	2.20	$678	0.373
Construction cost+labor	$4,000	2.20	$1520	0.836
Total	$8,000	4.40	$1028	1.209

*based on estimates by Thompson et al, 1998
**based on actual expenses at Amity University coolroom

The table 4 presented above clearly shows that the cost of CoolBot air conditioner combination is much lower than the cost of mechanical refrigeration. The control system is designed so that any moisture condensed on the refrigeration coils is returned to the cold room air and the system will like cause less product moisture loss than the commercial refrigeration system.

Commercial success of the coolroom

The system was installed at a retail mandi at Sultanpur, Uttar Pradesh in coordination with Agribusiness System International, Sunhara India Project, Lucknow in June 2012 and the data shows that in the month of June-July when the outside temperature ranged from 30-40^{o}C the temperature inside the cool room was maintained at 6-10 ^{o}C even though there were frequent interruptions of light.

The farmers and retailers are storing fruits like Mango, Guava, Citrus fruits, Watermelon, Muskmelon and vegetables like Chilli, Okra, Cabbage, Cauliflower, Bottle gourd, Bitter gourd, Potato, Tomato, Coriander, Spinach, Amaranthus etc. The per crate storage fees is Rs. 5/- and the retailers only sell the vegetable as per the demand while whatever commodity is left is stored inside the cool room which has resulted in loss reduction to not more than 1-2 %.

The retailers at the Sultanpur are earning a fair amount of money with the CoolBot cold storage facility created at their mandi and there total earning is Rs. 25,000/- per month with 25 days operational period and 50 % capacity utilization while the net earning is around 16,500/- per month. The capacity utilization is increasing on per day basis and if the 100 % capacity utilization is done then net earnings will be around Rs. 30000-40,000/-

Benefits of the technology

The major outcomes of the technology are increased profits through:

- Enables access to a key postharvest management tool – cold storage
- Low cost technology puts cold storage within the financial reach of small and marginal farmers
- Extends shelf life of produce – quickly lowering produce temperature after harvest extends shelf life by reducing metabolic activity and microbial growth.
- Allows farmers to leverage market factors such as price fluctuations, thereby minimizing potential for distress sales by small farmers
- This system can be easily installed and built at the farm with locally available materials like rice husk and mud.
- This technology is also environmentally friendly because of lower electricity consumption and low carbon emissions.

REFERENCES

[1] Boyette MD and Rohrbach RP. A low-cost, portable, forced-air pallet cooling system. Applied Engineering in Agriculture 1993: 9(1):97–104.

[2] Catherine K. P. Hui and Clement Vigneault, 2003. Transportation and Handling of fresh fruits and vegetables. Chapter 20 From Handbook of Post Harvest Technology. Edited by Amalendu Charaverty, Arun S. Majumdar, and G. S. Vijaya Raghwan, and Hosahalli S. Ramaswamy. Marcel Deker Inclusive, New York 2003.

[3] Kader, A.A., ed. 2002. Post-harvest technology of horticultural crops. Oakland: University of California, Division of Agriculture and Natural Resources Publication 3311, 535 pp.

[4] Sunil Saran, Neeru Dubey, Vigya Mishra, Shailendra K. Dwivedi and Naga Laxmi M. Raman. 2013 Evaluation of coolbot cool room as a low cost storage system for marginal farmers. *Progressive Horticulture, Vol. 45, No. 1, March 2013. Pp 115-121*

[5] Thompson, J.F., F.G.Mitchell, T.R. Rumsey, R.F. Kasmire, and C.H. Crisoto. 1998. Commercial Cooling of Fruits, Vegetables and Flowers. Publication 21567. California: Divison of Agriculture and Natural Resources, University of California.

[6] Coolbot™ - http://storeitcold.com