Construction and Testing of Evaporative Cooling barn for storing Potatoes

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Abstract— During the experiment the various parameters like D.B.T, R.H (inside & outside), air flow rate, inside room and outside atmospheric temperature & weight loss were observed. With the help of these parameters cooling load is calculated. The mean D.B.T and the relative humidity of inside and outside were 28º and 92% and 35º and 65% respectively. The system cooling efficiency was 130%. A test on the barn using 10 Kg of tuberous root for 8 weeks, it was observed that the moisture loss are approximately the same (12%).The moisture content of the root decrees from 70% to 57% and 62% to 51% (wb) And percentage weight loss increased from 0 to 13 and 0 to12.5 on first and second testing. The percentage wholesomeness decreased linearly with storage time from 100 to 75% and 100 to 65 % on various roots respectively. Percentage weevil damage increased non-linearly with storage time and started 5 and 6 weeks in storage both the roots respectively. Percentage sprouting increased non-linearly with storage time and started 4 and 6 weeks for the roots respectively. Percentage shrinkage increased linearly with increasing storage time from 0 to 4% and 0 to 5% for the roots respectively. Percentage decay increased linearly with increasing storage time from 0 to 31% and 0 to 78% for the roots, respectively.

Finally the experimental study of natural cooling barn is proved very effective.

Key words- Natural cooling barn, sweet potato, cooling load.

1. INTRODUCTION

The basic principle relies on cooling by evaporation. When water evaporates it draws energy from its surroundings which produce a considerable cooling effect. Evaporative cooling occurs when air, that is not too humid, passes over a wet surface, the faster the rate of evaporation the greater the cooling. The efficiency of an evaporative cooler depends on the humidity of the surrounding air. Very dry air can absorb a lot of moisture so greater cooling occurs. In the extreme case of air that is totally saturated with water, no evaporation can take place and no cooling occurs. Though potatoes have numerous benefits, storage is still a challenge due to high temperature recorded throughout the year. Under the natural ambient environment the root last only 1-2 weeks with no temperature control and not more than 5 weeks under ordinary storage condition. On the other hand the edible tuberous root sustains chilling injury when stored at temperature below 8^{o}C. other researchers reported that potatoes farmers do not store their harvested potatoes at all because of high deterioration in storage and inappropriate storage technology. This situation drastically limits the potential income of the farmers and discourages large scale production. This study present the development, design and testing of an evaporative cooling barn for storing potatoes, specifically the study presents an affordable evaporative cooling barn capable of storing small to medium scale production of the roots for at least three months.

2. MATERIAL AND METHOD:

A site was selected for the construction of the evaporative cooling barn. A shady area was selected cleared and leveled. Precautions were taken to avoid the trees from interfering with the air flow and also to prevent trees from falling on the structure during storms. The land had a good drainage and the door and window was oriented in south-north direction to provide good ventilation during day & night, and to prevent direct sun rays from entering the structure. Material used for construction of storage structure includes are wood, bamboo, grass, jute sack, wire, sack, rod, pipes, etc.

3. CONSTRUCTION:

The frame is constructed by welding the iron rods. And the base is made by metal sheet, on this frame jute sack filled with thatch is mounted on the roof, and the walls are covered by grass. After that grass is tied with the help of GI wires. At the top and sides of the structure above the grass filled jute sack, pipes are fitted for water supply. In the pipes holes are made so that water can spread all over the structure. Pipes are interconnected with the help of T and L joints. Somewhere at middle of the pipe, small pump is fitted and dipped in the container containing water on which the whole structure is placed. Inside the structure one rack is placed containing brine and ash treated potatoes. And above that 20 grams dry silica gel is placed for reducing humidity. Readings are taken twice a week

Recommended font sizes are shown in Table 1.

4. BRINE PRE TREATMENT:

All the test roots were initially cured at 29-32^{0} C and relative humidity of 90% for 7 days to heal harvesting wounds. Pre storage treatment comprised brine solution. The roots were dipped in to the brine solution and dried in the sun before storage. Brine possesses an alkaline property. This alkaline component is loathsome to most microbes and insects. Therefore, it can play important role in preserving potato roots from decay and weevil damage.

After the construction of evaporative cooling barn two verities of potatoes were cured and stored in the barn. 2 rack, each containing 5 cured samples were placed in the shelves of the evaporative cooling barn.

The sample is tested every two weeks for three months. During each sampling one potato is randomly selected for destructive analysis. The daily temperature and relative humidity of inside and outside air stream of the evaporative cooling barn determined with a digital thermo hydro graph. The cooling efficiency of the storage structure was calculated by the formula.

$$\eta = \frac{Td - Tc}{Td - Tw} \times 100$$

Where T_d and T_w are the dry and wet bulb temperature of ambient air stream and T_c dry bulb temperature of air stream inside the barn, after the cooling efficiency of the structure was determined it was tested on the potato tuberous root parameters such as moisture content, weight loss, energy content, shrinkage.2 potatoes were selected at random from each rack and chopped into slices. 10 gm was taken and dried in an oven at 150°c until constant weight. the ratio of the difference between the initial weight and final weight to the initial weight was determined as the moisture content . Energy content was calculated by using the equation

E=-17.38M+1699

M= moisture content

E= energy in KJ per unit weight (100 gm).

Shrinkage of root was determined by measuring the diameter of the root with a caliper at the start of the research and also at every 2 week interval. The differences in the final and initial diameter were used to calculate weight shrinkage

5. CONCLUSION:

The study has affirmed that low temperature and higher relative humilities, in combination with appropriate pretreatment are important to protect the integrity of fresh potato against various forms of deterioration. The use of traditional storage structures to achieve optimum climatic conditions in tropical climates however, requires careful engineering. The evaporative cooling barn promised some solutions for storage although the temperature attained was still high compared with the 13-15 ^{0} C storage requirement. Generally, it may be concluded, comparing the mix of performance indicators, that the brine and ash treated roots had better storage performance. The use of the evaporative cooling barn in combination with brine and ash pretreatment may therefore be explored to improve the shelf life of potatoes.

1). There was no significant effect of storage time on weight loss, shrinkage, and energy content. However, there was significant effect on sprouting, incidence of root rot.

2). The moisture content of the root tubers decreased with storage time from 70 to 59% (wb) at a rate of 0.65% per week.

3). Percentage total weight loss increased linearly from 0 to 11.9% at rate of 0.92% per week.

4). The percentage wholesomeness decreased linearly with storage time from 100 to 76% at a rate 2.048% every week.

5). Percentage weevil damage increased non linearly with storage time and started between 6 and 10 weeks after storage.

6).percentage sprouting increased non linearly with storage time and started between 4 and 6 week after storage.

7). Percentage shrinkage increased linearly with increasing storage time from 0 to 4.6 % at a rate of 0.4% per week.

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