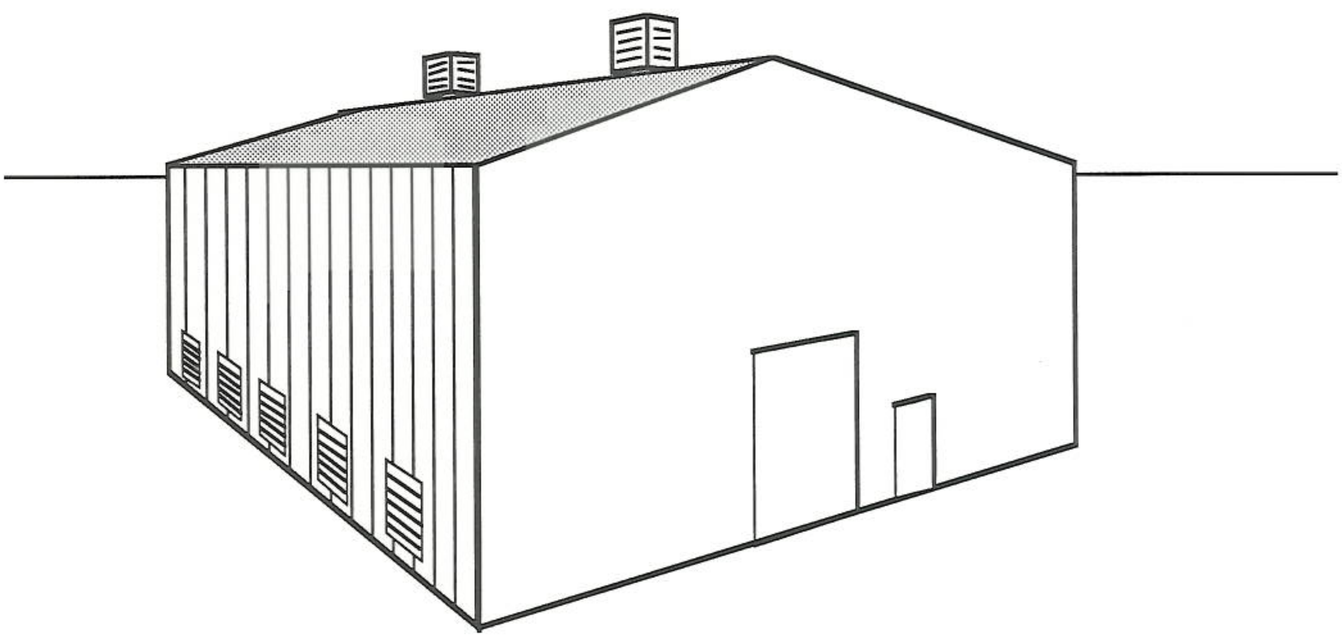
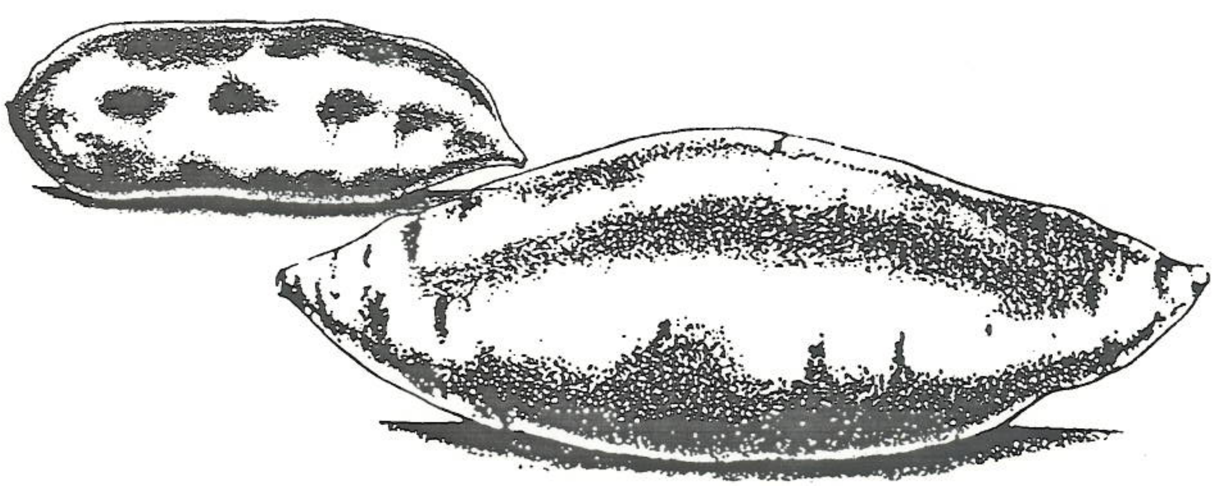
Curing and Storing California Sweetpotatoes





CURING AND STORING CALIFORNIA SWEETPOTATOES

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February, 1993
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Properly cured sweetpotatoes loose less weight, have a higher sugar content, and are less susceptible to disease organisms (with the exception of black rot) than are uncured sweetpotatoes. This has been shown by many people over the years but how much weight savings can a grower expect and does the savings pay for the cost and nuisance of curing?

Uncured sweetpotatoes have weight loss rates of 1.5% to 4% per month. The variation in rate is caused by differences in the level of harvest injury and differences between cultivars. Weight loss is caused primarily by water escaping through the surface of the root. If scuffing at harvest removes some skin, the sweetpotatoe's natural moisture barrier, the sweetpotato will be more susceptible to moisture loss during storage. The Jewel variety has only moderate potential for weight loss compared with varieties like Travis and Centennial.

The curing process allows the sweetpotato to heal harvest wounds and retard the rate of moisture loss during storage. Well cured sweetpotatoes loose only 1% to 2% of their weight per month.

California climatic conditions and harvest practices tend to favor low levels of weight loss in storage. We conducted two storage tests of cured versus uncured of Garnet variety sweetpotatoes. The cured roots lost an average of 1.7% of their initial weight per month for six months of storage. Uncured sweetpotatoes lost 2.6% of their weight per month. In the 1990 test we also recorded the packout of the cured and noncured sweetpotatoes. The cured had a packout of 42% while only 18% of the noncured sweet potatoes were suited for market.

Table 1. Weight Loss in Sweetpotato Curing and Storage.

(Garnet variety)

	noncured		cured	
	first 5 da. (%)	storage (%/mo.)	5 da. cure (%)	storage (%/mo.)
1983	1.23	2.61	1.39	1.67
1990	4.80	2.60	4.61	1.75
avg.	3.01	2.61	3.00	1.71

Curing is also a cause of weight loss. Improper curing conditions, particularly low humidity in the curing room, can result in up to 10% weight loss. This of course would make curing infeasible. Proper curing temperatures and humidities can result in less than 1% weight loss. In our tests, the roots lost 3% of their weight during curing. However, uncured sweetpotatoes loose weight rapidly when they are first put into storage. We found that during the first 5 days of storage uncured sweetpotatoes lost as much weight as those that under went a five day cure.

Cost of Curing

Table 2 lists the costs for curing sweetpotatoes in California. The total cost per bin is $1.45. The cost per 40 lb. carton, assuming an 80% pack out, is only $0.07/carton. If we assume that uncured sweetpotatoes will loose 0.9 % more weight per month than cured roots and a carton is worth $10, then the weight savings for curing is worth $0.09/ month. This means that the cost of curing is paid back in less than one month of reduced weight loss. Sweetpotatoes that are going to be stored for more than one month should be cured.

The value of curing adds up for each month of storage after the cost of curing is paid back in the first month. For example, after six months of storage a 40 lb. carton of cured roots has a 25 cent greater value than an uncured carton based on weight savings. In addition to this, the cured sweetpotatoes have less likelihood of disease problems and will have better quality.

Table 2. Cost of Curing Sweetpotatoes in California.*

Cost for curing a batch of 300-1000 lb bins of sweetpotatoes

	Cost
labor - 8 hr at $7/hr	56
lift truck - 8 hr at $12/hr	96
natural gas - 143 therms at $0.50/th	72
heaters - annualized cost of $1000/yr, 6 cures/yr	170
humidifier - annualized cost of $240/yr, 6 cures/yr	40
curing cost for 300 bins	$434

The curing cost per 40 lb. carton is is $0.07, assuming an 80% packout.

* The analysis assumes no cost for the curing room and fans. All curing is done in rooms that are designed for storage and the room cost is best assigned to the cost of storage. Often the heaters are also used for pre sprouting prior to planting but in the analysis the full cost of the heaters is assigned to curing.

How to Cure Properly

Proper curing requires a sweetpotato flesh temperature of 85°F and a relative humidity of 85-90% surrounding the sweetpotato. Temperatures below 85°F increase the curing time as table 3 shows. Temperatures above 95°F virtually stop the curing process. A relative humidity below 90% dramatically slows curing and allows high levels of weight loss. Laboratory tests have demonstrated weight loss of more than 8% during a cure at 80% relative humidity, but at 90% relative humidity the curing weight loss is reduced to less than 2%.

Table 3. Effect of Temperature on Curing Time for Sweetpotatoes.

Temperature (°F)	Curing Time (days)
75	15 - 20
80	8 - 10
85	4 - 7
95	no curing

A curing room must have a heater sized to rapidly raise the crop to proper curing temperature. A heater capacity of 2000 Btuh is required to heat a 1000 lb bin of sweetpotatoes from 55°F to 85°F in 24 hours. Multiply this number times the number of bins in your curing room to find the heater capacity you will need.

The heaters are often placed in the top of the curing room as shown in figure 1. This keeps them off the floor and out of the way of lift truck activity. But we found that the ceiling temperature in the room is sometimes 10°F warmer than the floor. As table 3 shows, curing times are very different over a 10°F temperature range. If the air temperature at the top of a curing room is 85°F, then the bottom roots will be exposed to a 75°F temperature and will not be cured in a typical 4 to 5-day curing cycle. The temperature variation also results in large differences in relative humidity. For example, if the floor air temperature is 75° with an 85% relative humidity, and the ceiling is 10°F warmer, then the relative humidity at the ceiling will be about 60%. This is low enough to retard curing. In this example, temperature near the floor is enough below the optimum to slow curing and relative humidity near the ceiling is low enough to slow it there.

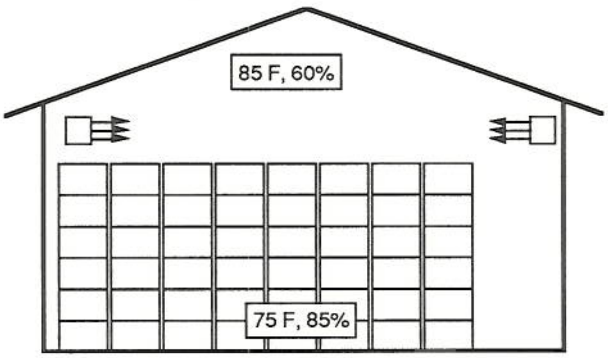

Figure 1. Curing room with top mounted heaters. Numbers in boxes are typical air temperature and relative humidity in the top and bottom portions of the room.

The problem can be solved by introducing the heat near the floor. The rising heat causes a natural flow of air in the room, producing temperatures at the floor and ceiling that are within 3°F of each other. Some operators put the heater directly on the floor. Others have installed the heater on the outside of the curing room and ducted the air into the room. The outside installation keeps the heater out of the way of forklifts and does not use any valuable floor space.

Another option is to leave the heaters near the ceiling and install propeller-type ceiling fans near the ceiling to mix air in the room as shown in figure 2. One fan rated at 27,000 cfm in free air is needed for 300 bins (1000 lbs. of sweetpotatoes per bin). A large ceiling fan like this uses less than one-eighth horsepower.

Both systems require that the bins be stacked to leave space for air flow between neighboring bins. A four to six inch gap between bins is needed on at least two sides of each bin.

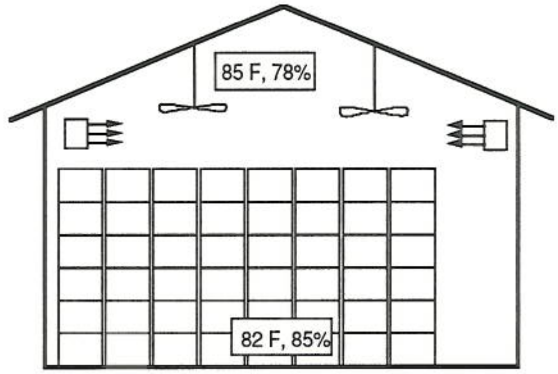

Figure 2. Curing room with top mounted heaters and ceiling fans. Numbers in boxes are typical air temperature and relative humidity in the top and bottom portions of the room.

Both of these systems will limit temperature differences to about 3°F. This will limit relative humidity differences to about 8 percentage points, which is acceptable. Even though an 85-90% relative humidity is needed for curing, it is possible to get good curing with 70% relative humidity in the driest part of the room because humidity in the bin is usually higher than the room air. Sweetpotatoes release moisture keeping humidity in the bin higher than the room.

Water must be added to the room to maintain a high enough relative humidity. Commercially available humidifiers are used by some growers. Portable units are the most convenient. They are much easier to maintain than the ceiling mounted units. Some people have used evaporative coolers as humidifiers. The units are placed inside the curing room with no provision to bring in outside air and operated normally. Most curing room operators depend on evaporation from a wet floor to keep the humidity high.

All of these systems will probably work, but measure the relative humidity periodically to make sure. Also, it is important to regularly check the air temperature near the ceiling and near the floor. If the temperature difference is kept below 3°F and the relative humidity near the floor is 85%, curing will be uniform.

Storage

Maximum storage life is obtained by keeping sweet potatoes at a temperature of 55° to 60°F and a relative humidity of 85% to 90%. Short exposures to temperatures as low as 50°F may not cause damage. However, storage below 53°F for several days will cause chilling injury, resulting in flesh discoloration, internal breakdown, off flavors and hard core when cooked and increased susceptibility to decay. Storage temperatures above 61°F will cause sprout development, pithiness and internal cork.

In California sweetpotatoes are cooled after curing with evaporatively cooled air. Uniform air flow through the storage room is obtained by placing the cooling unit on the ridge of the insulated building. Vents are located near the ground, around the room perimeter. This causes the cooled air to be distributed throughout the room (figure 3). Cooler capacity should be about 30 cfm per 1000 lb bin and 1 ft^{2} of vent area is needed per 500 cfm of cooler capacity. Vents are screened and often fitted with gravity operated louvers.

Later in the storage season as air temperature drops, the water pumps in the coolers can be turned off and the coolers operated as ventilation fans. Coolers should be on whenever the room temperature is above the proper storage temperature and the outside air is 3 to 5 °F cooler than the room temperature. Most storages are fitted with turbine vents to passively remove heat that may build up near the roof on sunny days.

Newer storage rooms are steel framed, metal covered buildings. They are insulated with two to three inches of foam board insulation. Smaller rooms in a storage complex have an aisle on one side of the room to allow loading and unloading. Larger rooms have a center aisle.

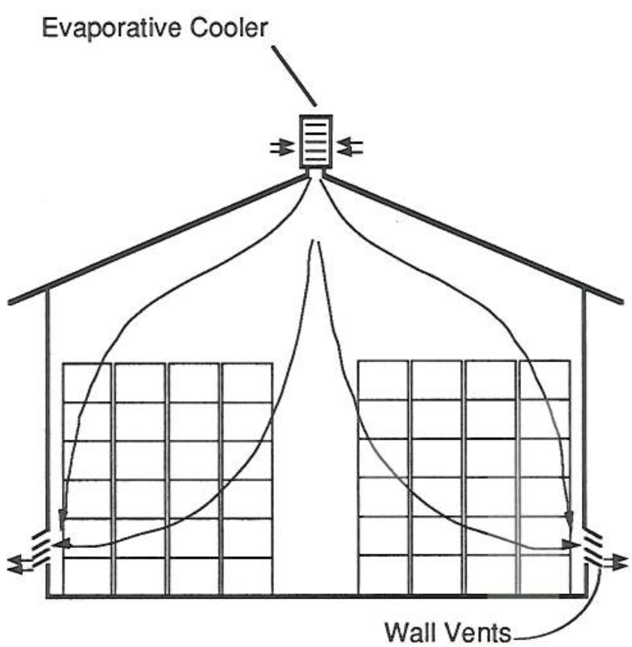

Figure 3. Air flow in an evaporatively cooled sweetpotato storage room