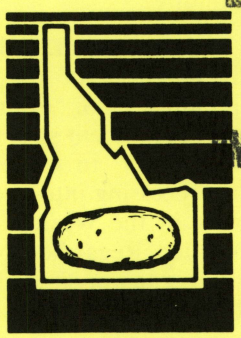
University of Idaho
College of Agriculture
Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 297
May 1975

Potato Storage - Construction and Management



by
Walter C. Sparks

Successful potato storage includes providing an adequate storage structure in which to place the tubers, providing and maintaining the proper storage environment, and following proper storage management practices throughout the storage period. Some of the fundamental requirements necessary to provide these conditions are:

CONSTRUCTION

A potato storage must have:

1) **Sound Structure.** Footings and structural members must withstand the weight and pressures of the dead load (rafters, insulation, roofing material, etc.) and all expected live loads (snow, wind, rain, side wall pressures of potatoes, etc.).

2) **Adequate Insulation.** *Providing adequate insulation is the first line of defense against condensation forming on the inside of the storage structure.*

The ceiling and walls should have enough insulation to control heat loss or heat gain. The heat transfer rate through the walls and ceiling should be no greater than 0.05 BTU's per square foot of surface area each hour for each degree Fahrenheit difference between inside and outside temperature (U value—heat transfer rate—no greater than 0.05 BTU's per square foot - hour - Fahrenheit degree. An R value—thermal resistance—not less than 20). This amount of insulation is equivalent to approximately 3 to 4 inches of polyurethane, 6 to 8 inches of fiberglass or 14 to 18 inches of straw.

Any movement of air within a wall or ceiling greatly reduces its insulating value (thermal resistance). To eliminate such air movement, blanket-type insulation should be flanged and thoroughly tacked to the rafter or studs so no air can flow around the edges of the insulating material, reducing its insulating value.

3) **Outside Waterproofing.** The roofing material of the storage should prevent rain or moisture from penetrating the insulating material. This is especially important with materials like straw. Insulation which has become wet is a poor insulator allowing heat to escape through the walls and ceiling. All precautions should be taken to keep the insulating material as dry as possible.

4) **Inside Vaporproofing.** Besides protecting the insulating material from outside moisture, it should be protected from moisture coming from the inside. Since the humidity in a potato storage is very high, the moisture which goes into the insulating material reaches a dew point and condenses into free water, which in turn reduces the effectiveness of the insulation barrier. To discourage inside condensation, the storage is usually lined inside with a vapor barrier of some type, such as polyethylene plastic, tar, sealed aluminum foil, or other suitable vapor barrier material. In the newer storages, spray-on polyurethane insulation acts as both an insulation and a vapor barrier.

5) **Proper Ventilation with Adequate Air Distribution.** A storage which is properly ventilated and has an adequate air distribution system will maintain a uniform temperature throughout the potato pile. However, many storages have air distribution systems which do not give same amounts of air at ends of the duct, creating different temperatures within a pile of potatoes.

Many structures with forced air ventilation systems having too much air with too low humidity dehydrate or pressure-flatten potatoes on the bottom of the pile. This can be largely overcome by providing only enough air to dissipate the heat from the respiration of potatoes and uniformly distribute temperatures within the pile. Ducts should not be over 10 feet apart (closer spacing would be acceptable) and airflow should be from the bottom up through the mass to remove the heat from the respiration of potatoes.

Experiments in Idaho have shown the amount of air needed to cool the potatoes is 0.5 cfm/cwt (10 cfm/ton). After the potatoes have been cooled to the holding temperature, as little as 0.25 cfm/cwt (5 cfm/ton) is enough if supplied through ducts placed not over 10 feet apart with a static pressure-drop across the orifices in the lateral ducts or ½ inch of water. Also the velocity of airflow in the duct should generally be not more than 1,000 feet per minute.

6) **Adequate Humidification System.** An adequate humidification system during the cooling period in the fall will maintain the humidity of the ventilating air at a minimum of 95% to 98% relative humidity. The humidifier should be placed downstream from the motors or fans in case of heat increase in the air passing over the motors. The air used to ventilate the pile of potatoes should have a minimum 95% relative humidity.

7) **Adequate Controls and Equipment.** Adequate controls will maintain the temperature of the air used to properly ventilate the potatoes. For example, if the potatoes are seed variety, the equipment should be able to maintain the temperature at a 38° to 40° range. If the potatoes are to be used for processing into French fries — such as the Russet Burbank in the Western States — a minimum of 45° is recommended. Regardless of the intended use for the potatoes, after a temperature has been set and the equipment calibrated, the proper temperature should be provided and maintained.

A humidification system large enough to provide the proper humidity when the outside air is at its lowest humidity should be provided.

The fan should provide the volume of air necessary to cool the potatoes in the desired length of time and maintain this temperature throughout the storage period.

MANAGEMENT

Proper management of a potato storage includes providing and maintaining the correct temperature, humidity, and air circulation, so that stored tubers retain maximum appearance, internal texture, quality, and food value with a minimum loss from rot, shrinkage, and sprouting.

Storage management can usually be divided into: 1) wound healing and curing period, 2) regular longtime storage or holding period, and 3) removal or handling period. Each period has a particular function and should be carefully managed according to the function it is meant to provide.

In the wound healing and curing period which follows the harvest period, bruises and injuries caused during harvest heal over—a suberized layer and a wound periderm form preventing entrance of rot organisms and reducing the danger of rot. Conditions usually considered necessary for rapid healing of wounds are:

1) A temperature of 45°F or higher.
2) A high relative humidity (above 95% R.H.) in the air surrounding the tuber.

The Russet Burbank variety heals fairly readily at 45° to 55°F provided the relative humidity of the air surrounding the tuber is a minimum 95%. If the relative humidity of the storage is low during this wound-healing period, a starch layer may form and prevent proper healing. *Maintaining sufficient high humidity in the air during the wound-healing period is one of the most important steps in the proper management of a potato storage cellar.*

The second phase of storage management is the holding or longtime storage period. The use for which the tubers are intended will dictate the storage temperature. For instance, tubers for seed must be kept below 40°F. Tubers to be processed into French fries or potato chips must be kept at temperatures 45° to 50°F. Since potatoes kept at these temperatures will begin to sprout in a few weeks, they must be treated with a sprout inhibitor if they are to be kept any length of time at these warmer temperatures. Results obtained by the University of Idaho show that Russet Burbank potatoes kept at 45° with high humidity and treated with a sprout inhibitor lose less weight and have a lower respiration rate than tubers stored at any other temperature. Consequently, for long-term storage with the least amount of weight loss, store Russet Burbank potatoes at temperatures no lower than 45° and use a chemical sprout inhibitor to prevent sprouting.

The third phase in storage management is the removal and handling operation. When potato tubers have been stored at 40°F, the tubers should be warmed to at least 45° before removing them from the storage. In all cases, careful handling must be practiced to reduce injury. Cold-brittle potatoes are easily injured.

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8M-5-75