ANRD
Agriculture and Natural Resources Division

Guidance note

How to store potatoes

This guide is for everyone who wants to store table or seed potatoes for either short or long periods. It is mainly focused on small-scale stores but also provides guidance on the construction of larger stores.

Introduction

In order to get the highest market prices, the quality of potatoes offered for sale need to be protected, and post-harvest handling, storage and transport must be such as to maintain quality to the highest standard possible.

The post-harvest loss of island-grown potatoes is high on St. Helena. Indeed many potatoes are never actually harvested but are 'stored' in the ground awaiting a customer. Potato tuber moth (PTM), bacterial rots, rats and other pests inflict heavy losses.

The availability of suitable storage on the island would assist greatly in eliminating this type of loss, increase output, improve quality and contribute to better economic outcomes for growers and retailers alike.

The basic principles of potato storage

Potatoes belong to a group called semi-perishables which are products with high natural moisture content. These products cannot be dried like cereals as lack of moisture leads to shrinkage, weight loss and loss of marketability. Products such as potatoes also are vulnerable to physical damage leading to fungal infections, bacterial rots and insect attack.

Low storage temperatures, high relative humidity and adequate air flow and air composition are the main requirements for this group of products. Storage facilities must be designed according to certain specifications in order to deliver these requirements if tubers are to be stored for periods of three months or more.

Tubers go through three different storage phases. These are:

1. Curing
2. Cooling
3. Storage

<u>Disease growth and infection and insect pests</u>

Most disease organisms multiply very rapidly at high temperatures. Lower temperatures reduce the possibility of disease incidence during storage.

Since many of the common storage diseases occur naturally in the soil, they are transported into storage with the tubers. The first stage of storage immediately after harvesting is called "curing" and it is a natural process in the tuber of forming a thick skin. Wounds are healed

during this process and this helps to minimise invasion by disease causing organisms such as bacteria and fungi.

Careful harvesting, loading, transport and store filling are important to minimise bruising, skinning and cutting. Before storing, potatoes should be assessed for physical damage, soil adhering to tubers, surface moisture and any signs of disease, rot or pest damage. Only clean, healthy, dry tubers should be stored.

Damaged, infested or potatoes harvested from soils infected with bacterial wilts, blackleg, or other soft rots should be held separately and thereafter sold as quickly as possible. In addition, potatoes originating in soils infected with bacterial wilts or rots should never be used as a source of seed for further propagation.

Potatoes left in the ground for any length of time after maturity may become infested with PTM. If these potatoes are brought into a store, even a refrigerated one, it is inevitable that PTM infestation will spread to the already stored crop.

Sprouting

For long storage periods of more than 3 months a sprout inhibitor is recommended for table potatoes; this is not required for tubers stored for seed.

Small-scale short-term storage

If you have potatoes you want to store for a relatively short period, up to a few months, sort them well at harvest, putting aside any damaged, bruised or pest infested ones for immediate use. Handle the tubers carefully as bruising or damage can shorten storage life.

Before putting a new crop into storage, clean your store well with water and disinfectant to kill off any fungus or pests from the last crop. If PTM is a regular problem, apply a residual spray of a general insecticide such as Garden Ripcord (active ingredient cypermethrin) to the empty store just before harvest to kill any moths in the store.

Store them in paper sacks or boxes, in the dark, in a cool, clean place.

As potato tubers are living things they respire and create heat during storage, and the highest temperatures are at the top of the stack. This heat reduces the quality and storage life of potatoes and can also cause rot. It has been estimated that differences in temperature between the bottom and top of the stack is +2℃ for each metre of height. Sacks and boxes should be stacked off the floor and away from the walls so air can circulate around and keep the stack cool. Alternatively, you can pile loose tubers on racking made of chicken wire or wood or bamboo slats. This also makes any signs of pest infestation or rot easy to spot.

Check the store regularly so that any signs of pests or rot are picked up immediately. There are no pesticides available to kill pests on eating potato as it is human food. The PTM is the main pest you are looking for, check for slender grey-brown moths on the walls of the store. As soon as you spot them it is a sign the tubers are getting wormy and need to be sold or used as quickly as possible.

A high humidity of 90% to 95% is needed to prevent weight loss and shrinkage, and this may need to be provided with a humidifier. If condensation forms on the walls or tubers, air circulation must be improved.

Eating potatoes need to be protected from light to stop them from going green. The green itself is harmless but it is an indication of increased levels of substances called glycoalkaoids which are poisonous to people. Green potatoes should not be eaten or sold for consumption. Some potato diseases, such as late blight, can dramatically increase the levels of glycoalkaloids present in potatoes. Potatoes damaged in harvesting and/or transport also produce increased levels of glycoalkaloids; this is believed to be a natural reaction of the plant in response to disease and damage. This is another reason why tubers need to be sorted before storage, to remove all those damaged or from infected plants.

Seed potatoes, unlike eating potatoes, should be stored under diffuse light. It doesn't matter if they go green as they are not for eating, and the light slows sprouting and so prolongs their storage life. One or two small windows in the store are sufficient.

The plant known as wild current (Lantana) has natural insecticide in its leaves and can be used to help protect potatoes in store from PTM. Cut the branches green and layer them with the sacks or boxes, or mixed up with the loose tubers in the store. Make sure you put some over the top too. This natural insecticide won't affect the tubers or make them dangerous to eat.

Large-scale long-term storage

A large-scale modern facility for long-term storage (around 8 months or more) must be designed to:

a) Introduce air at 16-18℃ for 5 days to stimulate wound healing
b) Maintain a high relative humidity to maintain wound healing and prevent drying out
c) Reduce temperature gradually to the appropriate holding temperature by removing the heat of respiration, and circulating cool, fresh air through the crop
d) Maintain holding temperature appropriate to crop being stored eg table or seed requirement
e) Provide air circulation for tuber respiration
f) Remove carbon dioxide and other deleterious gasses

Temperature

Table potatoes may be stored at 5-7℃.
Seed potatoes need 2-4℃.

A low temperature minimises weigh losses due to respiration and shrinkage; this is usually minimal at about 7℃. Tuber weight loss due to respiration can amount to 1.5% of the total weight of the crop over 8-10 months storage. So moisture loss due to dehydration and dry matter loss due to respiration are serious quality issues and must be managed to maintain crops of marketable quality.

Temperature changes in store should be introduced gradually. In general temperature should be reduced by no more than 1.5℃ /day. This gradual reduction helps slow changes in sugar content than can affect cooking quality.

Relative Humidity (RH)

Most tuber shrinkage that occurs during the first month of storage results from water lost before completion of the wound healing process. Moisture loss and shrinkage is a hundred times greater from wounds than from undamaged area.

Wounds allow the entry of fungi and bacteria present on the tuber surface. The process of wound healing is temperature dependent as follows:

- Below 5℃ between 21 and 42 days
- At 10℃ between 7 and 14 days
- At 15℃ between 5 and 10 days
- At 20℃ between 3 and 6 days

Maintaining a high relative humidity (RH) helps prevent early dehydration and reduce shrinkage. The current recommendation is to maintain 95% RH or above.

Free moisture due to respiration or condensation is the cause of much loss due to the spread of rot organisms. Condensation can occur on the surface of the tuber or on any inside surface of the storage facility. Maintaining circulating air at a slightly cooler temperature than that found at the bottom of the potato pile will reduce condensation onto the surface of the potatoes while good insulation and adequate air movement will prevent condensation on internal surfaces.

Air circulation and carbon dioxide (CO2)

The quality of many fruit and vegetables is actually enhanced under conditions of high CO2 and low O2. However the opposite is the case for potatoes. A level of 1% is the upper allowable threshold for potatoes. A constant flow of fresh air is required to maintain CO2 levels at or below this threshold.

Storage Structures

There are four factors when choosing a potato storage design

1. Style of structure
2. Insulation
3. Ventilation and dehumidification
4. Refrigeration and air requirements

Style of Structure

Any type of building can be adapted to store potatoes. Steel frame buildings are unsuitable due to condensation and difficulty insulating exposed steel frames and columns.

Insulation

Insulation reduces heat loss and prevents condensation. Enough insulation should be installed to achieve a minimum thermal resistance (RSI) of 6.1 which is equivalent to 250mm glass fibre or 150mm polyurethane. Ceiling fans are useful for reducing free moisture on the ceiling surface and the top of the potato pile. Insulation also decreases heat loss through walls and ceilings which results in more heat of respiration exhausting from building via the ventilation system.

Ventilation and dehumidification

A modern fully automatic ventilation system controls temperature and circulates air through the potato pile. Air is forced down the main air funnel; then via lateral ducts outwards and

upwards through the potatoes and out of the building through ventilation slots. Target air flow is 8L/s/tonne.

Main points for ventilation:

- Move air through the crop within a few hours to reduce humidity and allow moisture to evaporate
- New crops introduce moisture on surfaces or adhering soil. This free moisture humidifies the air resulting in condensation on other parts of the crop or on steel structures within the building.
- Once potatoes are dry it is essential to keep them dry
- Avoid sudden steep temperature gradient which will cause condensation
- Reduce temperature by no more than 1.5℃ a day to prevent condensation
- Keep store temperature within 4℃ of ambient temperatures, otherwise keep ventilation going
- Ware crops can take 2-3 weeks to reach holding temperature of 4-5℃, depending on ambient air temperature.

Refrigeration and air requirements

Auxiliary refrigeration requires the installation of an in-store air cooling system or the introduction of already cooled air. This is the preferred method for large-scale, long-term storage as the required temperatures can be reached, maintained and increased by shutting the system off. This system also allows temperatures to be reached rapidly or according to a pre-set timeline.

Maximum air flow at 16-18℃ should be provided for the first 5 days to promote and establish wound healing and the stabilisation of the crop. The target 8L/s/Tonnes air flow may not be needed throughout the storage period however it should be controllable for use if rots begin to develop.

Centrifugal or axial flow fans are best. Basket fans are useless as they deliver large amounts of air at minimal pressures but virtually no air at or above the pressure caused by the potatoes themselves.

Bulk Density

The Bulk Density and therefore the storage capacity of potatoes is:

- loose: 670-680 kg/m2 floor surface
- in boxes: 650 kg/m2 floor space
- in bags (dense packing): 550 kg/m2 floor surface
- in bags (rows of bags and space between rows): 420 kg/m2 floor surface

Further information

For further information on potato storage there is abundant information for all scales of storage on the internet. Alternatively, please contact Farmer Support or Pest Control at ANRD on 24724.