MANAGING POTATOES IN STORAGE WITH REFERENCE TO HEAT STRESS AND WATER STRESS

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INTRODUCTION

The primary goal of the storage manager is to maintain the quality of the potatoes over the length of the storage period. Whether the potatoes are stored for seed, processing or fresh shipment, the goal is the same. In order to maintain the stored tuber quality, the storage manager must recognize that each lot delivered to storage will require individual attention. Storage management is more than following general guidelines and recommendations. Special management techniques are implied when dealing with different lots or varieties or when the potatoes to be stored are grown under stressful conditions.

GENERAL GUIDELINES

In general, guidelines exist for temperature, relative humidity and air supply for storing potatoes. For processing, holding temperatures should be 45-47°F; for chipping, 50-55°F; and for fresh shipment, storage temperatures are typically 40-42°F. Seed storages are kept colder to prevent disease development and prolong dormancy, usually about 37-39°F. Relative humidity is kept high to prevent weight loss and to support wound healing. Fresh air is circulated through the pile to provide oxygen for respiration and to maintain the preferred temperatures (Fig. 1).

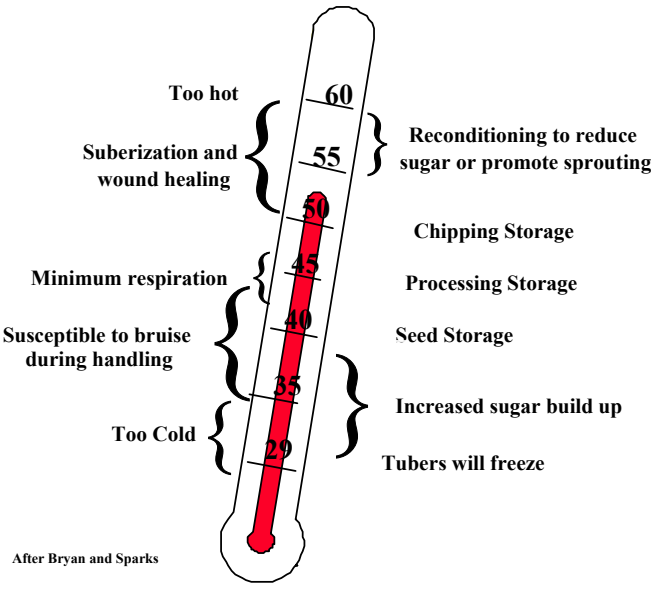

Figure 1. Temperature guidelines for Russett Burbank potatoes.

Stress during the growing season as well as stress in storage can cause problems for the storage manager. Seasonal stress usually manifests itself in storage by reducing the dormancy period. Both heat and water stresses are seen symptomatically in storage as earlier sprout development in the tuber.

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Chilling injury or frost may produce similar symptoms in storage by shortening the dormancy period. Disease is another stress factor that can change the natural rest period of the potato (Fig. 2). Because these field stresses can impact stored tuber quality, it is important for the storage manager to know and understand the different storage requirements and how to attenuate their impact.

Storage stresses – rapid temperature fluctuations, disease, heat, and carbon dioxide

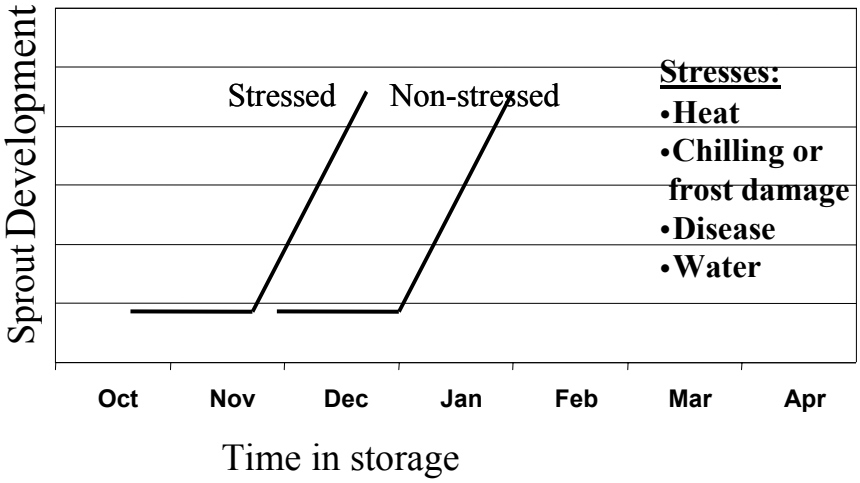

Figure 2. Field stress can cause potatoes to break dormancy sooner.

buildup – can limit the natural dormancy period of the potatoes (Fig. 3). Much of the in-storage stress that occurs falls within the responsibility of the storage manager to alleviate the stress impact on tuber quality. The decision to circulate fresh air daily and to control the pile temperature is an important first step to maintaining quality of the stored lot. Fresh air also purges excess carbon dioxide from the building and supports the wound healing action during the first few weeks in storage. High relative humidity is important

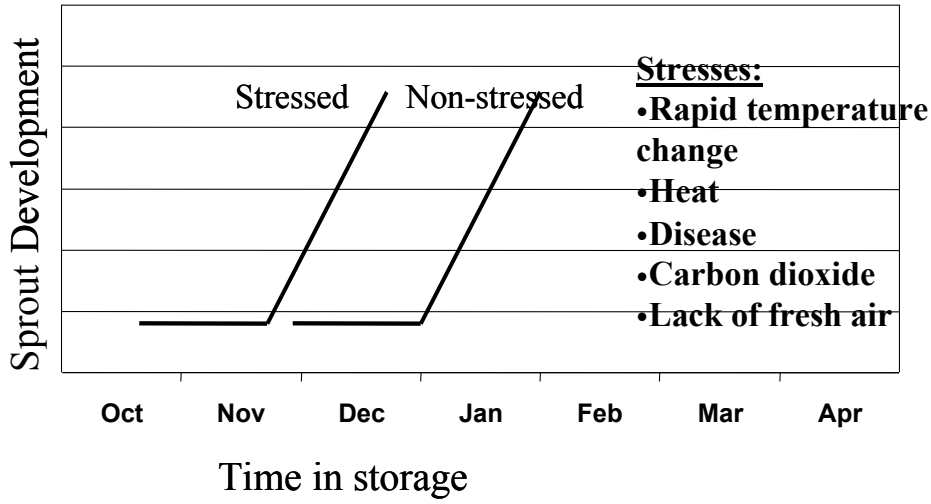

Figure 3. Stress in storage can also cause potatoes to break dormancy sooner.

at this stage of storage to minimize the shrinkage losses that occur prior to the completion of wound healing.

The single most important part of the storage season begins with the wound healing or curing period. This period, approximately two to three weeks long at 50-55º F and 95 percent relative humidity, requires plenty of fresh air daily. During this time, the potato becomes more resistant to storage diseases and loss of water from the interior of the tuber (shrinkage). Wound healing, repair of cuts and bruises, and curing, the formation of a protective layer between the tuber surface and the interior tissue, is required for all potato lots whether they are intended for short- or long-term storage.

The wound healing process begins with primary suberization, a thickening of the cell walls beneath the cut, scrape, or wound (Fig. 4). New cell layers (produced from phellogen through cell division) are then formed below this thickened cell wall formation. After these new cell layers are formed, their cell walls undergo thickening (secondary suberization) producing tissue resistant to dehydration and disease infection (wound periderm). This process may take several days to complete and is stimulated by plenty of fresh air and moderate temperatures. High relative humidity at this time maintains tissue integrity so the healing process can be completed.

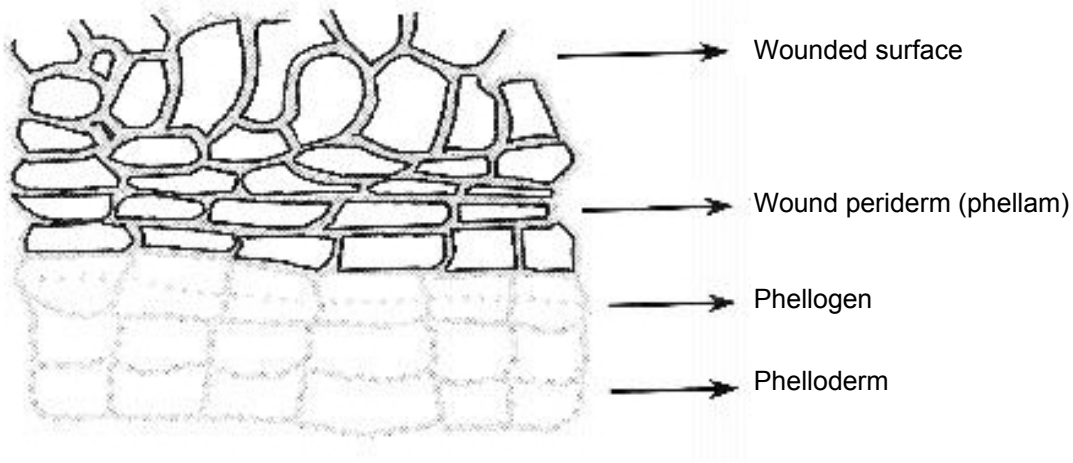

Figure 4. Components of a cured potato.

MAINTAINING QUALITY IN STORAGE

Quality concerns in storage may result from potential changes in fry color, disease development, sprouting, shrinkage, internal defects, or simply how to handle field stressed tuber lots. Each of these concerns may require specific action from the storage manager. For fry color problems, the troubled lot should be sampled frequently to monitor changes in reducing sugar content that causes unacceptable finished product. A biweekly sampling can alert the manager to the storage life of individual lots while there

is still time to decide whether to market the potatoes or attempt to recondition them into acceptable cooking quality.

Early sprout development can be one of the quickest ways to reduce tuber quality in storage. Sprouting greatly increases the rate of respiration and water loss from the tubers with concomitant increases in reducing sugars in the tubers. Sprout control is usually effective with either an in field application of maleic hydrazide or a post harvest application of chlorpropham. Both of these chemical sprout suppressants are effective for several months after normal dormancy break in storage. However, use of chlorpropham may be required earlier in the storage period due to conditions supporting earlier sprout growth or dormancy break such as field or storage stress on the stored lot. Chlorpropham should not be applied until wound healing is complete.

The rate of shrinkage of a given potato lot is greater during the first few days in storage and then decreases with time (Fig 5). Total shrinkage losses can equal 10 percent or more during long-term storage, consequently are important considerations for storage management. Quality loss with increased shrinkage involves the potential for pressure bruise. Pressure bruise can also occur due to sprouting in storage, excessive ventilation, or high storage temperatures. Regardless of the cause, pressure bruise can seriously reduce the quality of the stored crop.

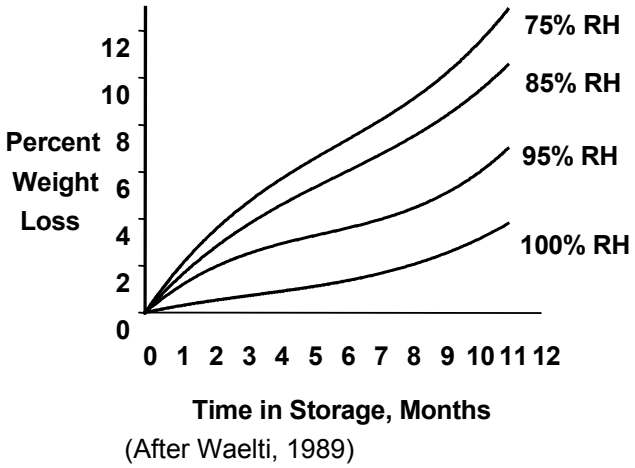

Figure 5. Weight loss of potatoes stored at various supply air humidity levels.

Storage disease development is one of the most serious problems for a storage manager. Usually, disease suppression in storage involves a number of good management practices. Proper wound healing is the most common way to limit the onset or development of disease, but the storage manager can also use temperature control beneficially. Cool storage temperatures limit nearly all potato diseases. However, the presence of a diseased lot can cause temperatures surrounding the disease organism to increase. These pockets of heat can

- **Soil born / tuber born**
- **Infections through**
  - **Wounds**
  - **Lenticels**
  - **Other diseases**
- **High humidity in storage**
- **bers**
- **Spreads in storage ("hot spots")**

Figure 6. Bacterial soft rot.

encourage bacterial soft rot development that can limit the storage life of the lot (Fig. 6). Management of potato disease usually includes the use of significant volumes of air to help dry out wet spots caused by decaying potatoes.

Any field stress that causes development of jelly-end tubers can cause significant problems for the storage manager. These tubers have a wet stem end that must be dried out and cured during the wound healing period. Improper wound healing may accentuate disease development into the jelly end of the tuber. However, a wound periderm will form under the jelly end tissue preventing further water loss and limit the potential threat of soft rot infection. Management of jelly end tubers in storage is similar to any wet or muddy product brought into storage during early harvest. Increased air supply or length of circulation time may be necessary to maintain the quality of the crop and to prevent disease development before the pile has achieved holding temperature. Only occasionally will relative humidity need to be reduced for early storage conditions, i.e., wet harvest conditions or severe silver scurf infection.

SUMMARY

There are several stages of good potato storage management.

- ✓ Evaluating the crop
- ✓ Removal of field heat and/or moisture
- ✓ Curing and preconditioning
- ✓ Cooling
- ✓ Holding
- ✓ Possibly re-conditioning

By following good storage practices, it is possible to maintain harvested tuber quality in storage for several months. A good manager is aware of the potential problems that may develop with each stored lot. Proper wound healing is a key to long-term storage. Without a proper wound healing period, the risk of disease development is increased and the remaining part of the expected storage season may be unnecessarily shortened.