

---

## POTATO STORAGE & VALUE PRESERVATION

---

### **MAIN POINTS:**

- Harvest crop only when soil and pulp temperatures fall between 10 °C and 20 °C.
- Remove field heat and bring down temperature to pre-conditioning phase.
- Maintain wound healing temperature for 15 to 30 days at RH 95%. Tuber will also mature during this period. In this period temperature should not rise above 21 °C.
- After wound healing period, reduce temperature about half degree a day to 7 to 10 °C for long term storage (10 °C to 12 °C for Chip potatoes). Lower temperatures will cause sugar build up and dark surface appearance.
- Maintain RH 95 to 98% to minimize shrinkage. Avoid free surface water on tuber to prevent soft rot development.
- Prevent excess accumulation of soil or debris that could block ventilation around surface of tubers. Soil clods cause poor air circulation which can promote rot.
- Dampness can cause decay, it is best not to wash potatoes before long term storage.

### **STORAGE PHASES:**

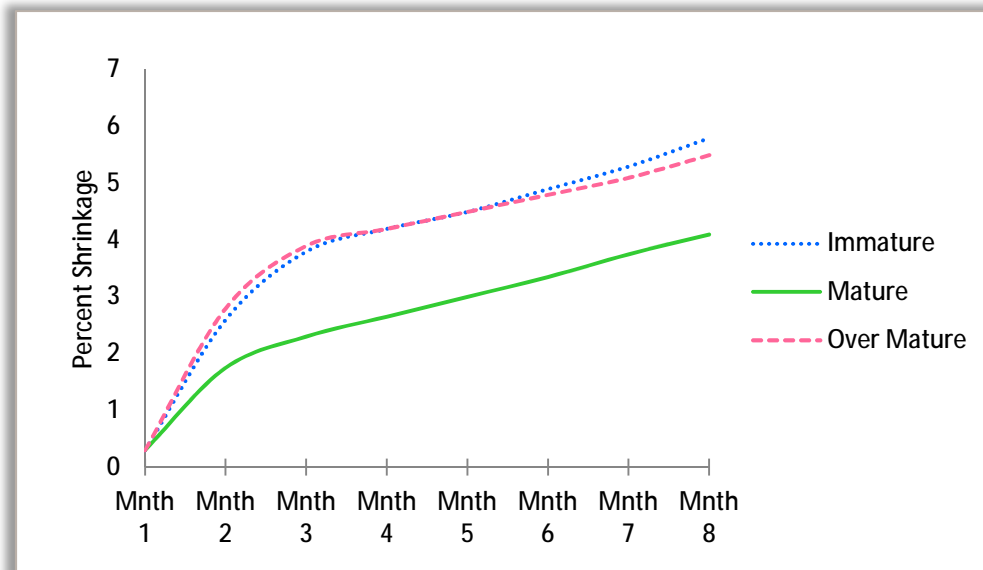
- **Equalisation** or drying phase: tuber surface moisture may need drying. Ventilation fan run continuously to equalize average pile temperature to within 2 °C of average pulp temperature.
- **Wound Healing**, pre-conditioning phase: 10 to 20 °C at 85 to 95% RH for 15 to 30 days. Care is taken to avoid water condensation. Temperatures upto 25 °C are also used but avoid above 25 °C.
- **Cooling** phase: temperature is brought down to 7 to 10 °C at about 0.5 to 1 °C per day. Cooling air should not be lower than 1.5 °C than the potatoes. Air flow maintained to provide even cooling. Ventilation with cool moist air.
- **Holding** phase: holding temperature and high RH maintained. Intermittent ventilation only to control CO<sub>2</sub> build up and maintain O<sub>2</sub> levels. Maintain potatoes at various locations within 1 °C pulp temperature of one another.
- **Reconditioning** phase: warming up of the potato from holding temperature to preferably within 5 °C of handling temperatures to avoid condensation, handling damage, recover color.

### **CONTROLLING WEIGHT LOSS:**

Weight loss (Shrinkage) occurs due to physical water loss (transpiration) and respiration. Respiration loss is relatively small and amounting to about 10% of total water loss.

- **Relative Humidity:** maintain a RH of 95% or more during storage. Particularly during early period when bruises are healing and maturing process is being completed. On

average the maximum shrinkage (approx two third) occurs during first 2 months of storage.



In each maturity case first two months are critical control periods.

- Potatoes stored at low humidity level also suffer higher peel and trim losses.
- **Temperature:** a storage temperature of about 13 °C is optimal during wound healing and maturing phase. For longer storage periods a temperature of 7 to 10 °C is preferred. Avoid changing temperatures rapidly.
- Before removal from storage, allow temperature to rise to decrease bruise susceptibility.
- Lower temperatures cause potato starch to convert to sugar.
- **Ventilation:** high ventilation rates can increase transpiration losses. However coupled with high humidity environment, weight loss is minimized. When wet spots and rapid cooling is noticed, higher ventilation rates are justifiable. Once holding temperature is reached, ventilation can be reduced to about 0.25 cfm per 100 kgs of potato.
- Keep CO<sub>2</sub> levels at minimum with efficient ventilation. Always humidify ventilation air unless it is necessary to dry the potatoes. Incoming ventilation should be at 95% RH unless free water is present.
- It is not necessary to ventilate continuously unless ceiling condensation and tuber rot is a problem. Continuous ventilation increases shrinkage. Reduce the ventilation rate when top tubers are at same temperature as both bottom tubers and ventilation air. Intermittent (discontinuous) ventilation suffices during holding period.
- Typically ventilation air should be cooler than potato pulp temperature, else condensation and free water will result (but not lower than 1.6 °C from pulp temperature to minimize transpiration).

### **IMPACT of RH and SHRINKAGE:**

The single largest factor affecting **Shrinkage** rates is **Relative Humidity**.

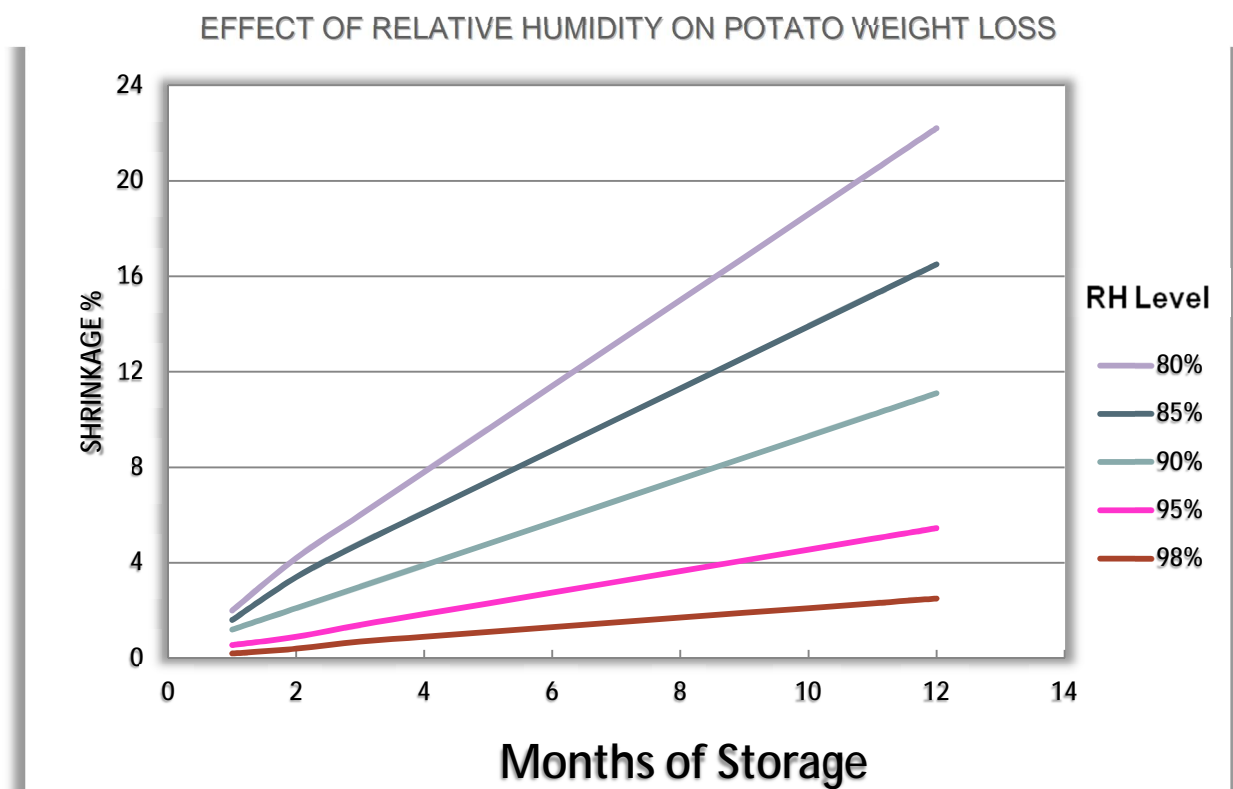
Stored potatoes lose weight by shedding water to the surrounding air (transpiration) and through the physiological respiration process.

Transpirational water loss can be greatly prohibitive if not efficiently controlled. This cannot be totally stopped but can be reduced by maintaining as high a RH as possible. Shrinkage due to respiration far less and effectively controlled by temperature maintenance.

Maintaining High RH is possible when crop is healthy, free of bruises and low presence of diseases. Ventilation with high RH air is especially critical during initial phase, soon after harvest and during curing.

Comparing weight loss over six month period of storage at 10 °C at various RH levels – at 90% RH, shrinkage is double that at 95% RH.

Typical cold stores loose 7 to 10 % weight – they maintain 85 to 90% humidity.



### **Preparing the Cold Store**

The cold store preparation must begin well before harvest. All components of the cold storage should be examined, cleaned and repaired as needed and operated so as to establish a satisfactory storage environment before the first potato is introduced.

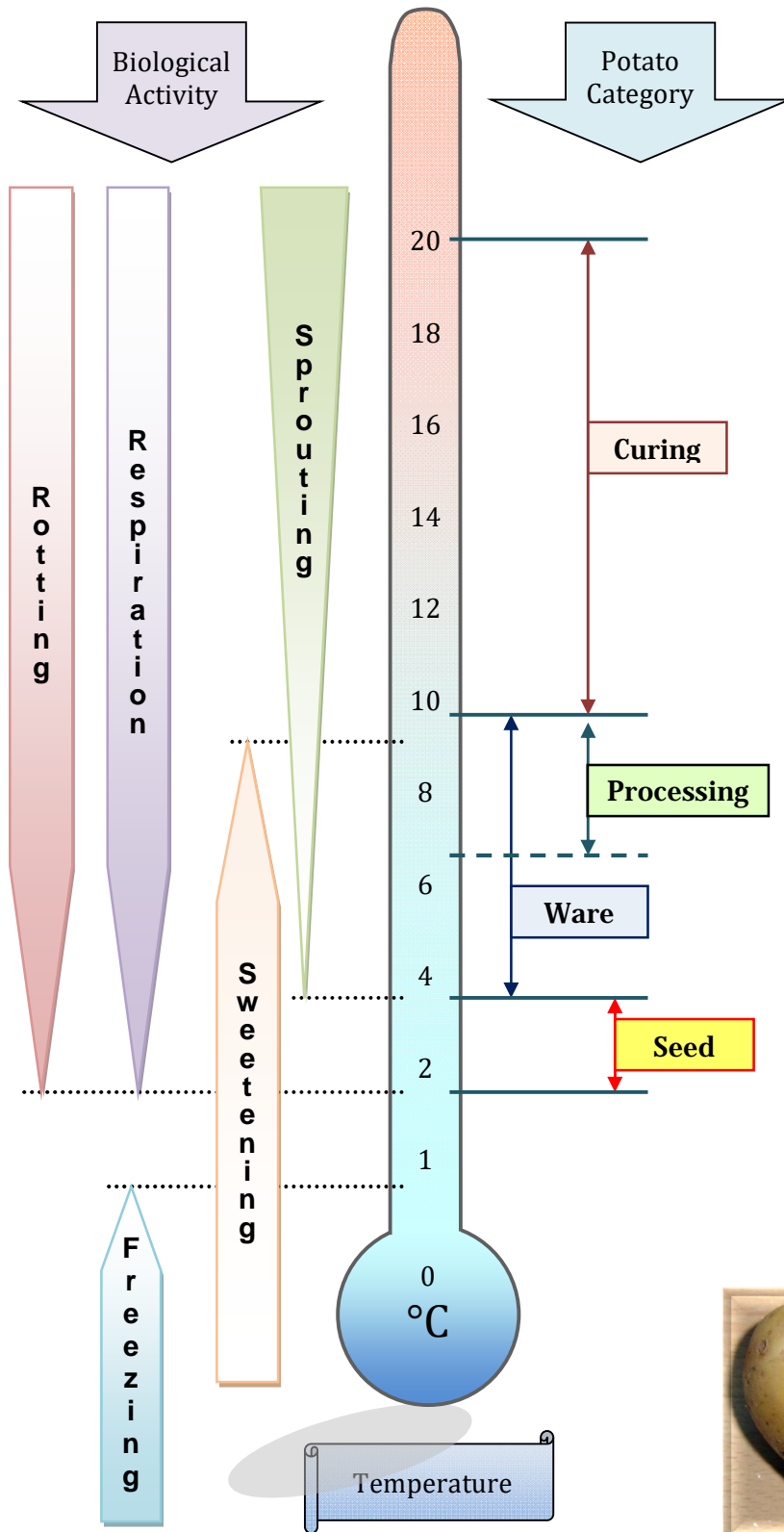
Important steps in preparing the storage include these:

- Thoroughly clean the storage spaces and machinery of previous debris and dirt using a pressurized water and steam as necessary.
- Disinfect equipment and storage structure with recommended materials. Maintain store cleaning records.
- Perform maintenance and repairs on ducts and structure as needed.
- Clean dust and dirt from the fan blades.
- Check dampers and louvers for free movement.
- Calibrate thermostats, sensors, controls, humidifiers and check the functioning of limit switches.
- Lubricate motors, confirm working good condition.
- Check condensate drains are functional.
- If using raised storage floors, the storage floor can be wet to help maintain high humidity initially.
- Pre-cooling: Operate the entire system so as to humidify and to cool the space to 12 °C at least 24 hours before potatoes are introduced.

### POTATO TRIVIA

- ◆ A potato is about 80% water and 20% solid.
- ◆ Indians in Peru were the first to cultivate the potato over 4000 years ago.
- ◆ The Symara Indians in South America developed over two hundred varieties at elevations of over 10,000 feet over sea level.
- ◆ The potato name is derived from the American Indian word "Batata", & was introduced to Europe by Spanish conquerors during late 16<sup>th</sup> Century.
- ◆ At first, potatoes were not accepted by Europeans. Some because potatoes were not part of the Bible, while others attributed common diseases to potatoes.
- ◆ Today, the average American eats 140 pounds of potatoes per year. Germans eat more than 210 pounds per year.
- ◆ Potato relatives are tomatoes, chillies and tobacco.
- ◆ Potatoes are the staple diet for 2/3<sup>d</sup> of the World.
- ◆ China is the highest consumer of Potatoes.
- ◆ 100g of potatoes gives you 390kj, 100g rice: 445kj and 100g bread: 1050kj.
- ◆ In 1995, potato plants were taken into space with the space shuttle Columbia. This marked the first time any food was ever grown in space.

## RELATIONSHIP: POTATO BIOLOGICAL ACTIVITY & TEMPERATURE



## APPENDIX - I

### Average constituents of potato per 100 gms.

Sl.No.	Constituents	Weight (grams)
1.	Water	74.70
2.	Carbohydrates (Starch and Sugar)	22.60
3.	Proteins	1.60
4.	Fibre	0.40
5.	Fat	0.10
6.	Minerals	0.60



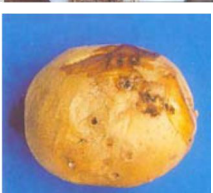
Source: Potato in India, Central Potato Research Institute (CPRI), Shimla

### Characteristics of Potato Fit for Processing

Characteristics	Type of Potato Products			
	Dehydrated	French Fries	Chips	Canned
Tuber size	30	50	40-60	35
Specific gravity	1.080	1.080	1.085	1.080
Dry matter (%)	22-25	20-23	22-25	18-20
Starch (%)	15-19	14-16	15-18	12-24
Reducing Sugar (%)	0.5	0.5	0.25	0.5
Shapes / Sizes preferred	Medium to large sized	Long oval shaped	Round to oval	Small sized

Source : Post Harvest Manual for Export of Potatoes, APEDA, New Delhi.

### PATHOLOGICAL STORAGE DISEASES

<b>Charcoal rot</b>	Formed darkened patches on tubers which later become water soaked and black.		Require early harvesting, seed treatment with fungicides like Aretan or Agallol.
<b>Late Blight</b>	Brown colouration of infected tubers, wet rot in storage.		Seed treatment with fungicides and proper pre harvest cares should be taken.
<b>Wart</b>	Tubers become undersized		Apply heat treatment for tubers.
<b>Soft rot</b>	Tubers are infected through wounds.		Wash tubers with chlorinated water before storage. Dry surface water or use high vent rate on storing.

## APPENDIX - II

### **HARVESTING CARE :**

The following harvesting care should be taken :

- a) Follow the practice of Dehauling [cutting of haulms / aerial parts by sickle or killing by chemicals (e.g. Gramoxone) or destroying by machines] when the crop attains 80-90 days and when the aerial part of the plant turns yellow.
- b) Always harvest in dry weather.
- c) Stop irrigation about two weeks before dehauling.
- d) Avoid bruising and skinning to make tubers less susceptible to rot diseases.
- e) Harvest the crop after 10-15 days of haulm cutting.

### **DRYING AND CURING :**

- A) The following care should be taken during drying:
  - (a) Always dry the harvested tuber quickly to remove excess moisture from the surface of tubers for improving their keeping quality.
  - (b) Always dry the harvested tuber in storage shed, expose to sun causes the greening of potatoes.
  - (c) Do not store the tubers immediately if they are exposed to rain after harvest.
- B) The following care should be taken during curing:
  - (a) Follow the curing process at 10 to 20 °C with a 95 % relative humidity.
  - (b) For optimum suberization, curing is essential for healing the wounds of tubers resulted from cutting and bruising during harvesting.
- C) The following care should be taken during sorting:
  - (a) All the damaged and diseased tubers should be removed during sorting.

### **DO'S & DON'TS**

- |  |  |
|--|--|
| ✓ Harvest the crop, in dry weather.  | ✗ Harvest the crop, when the weather is moist.   |
| ✓ Stop irrigation two weeks before dehauling.  | ✗ Continue irrigation two weeks before dehauling.  |
| ✓ Avoid bruising and skinning of tubers during harvesting.                                       | ✗ Neglect bruising and skinning of tubers during harvesting.                               |
| ✓ Dry the harvested tubers in storage.   | ✗ Dry the harvested tubers in open sun. Expose potato to light.                            |
| ✓ Separate the damaged and diseased tubers before storing.                                       | ✗ Mix the damaged and diseased tubers before storing.                                      |
| ✓ Grade the potatoes manually or mechanically.   | ✗ Store the matured with immature tubers.  |
| ✓ Store at 2-4 degree centigrade in cold store for the purpose of preventing sprouting.          | ✗ Store above 2-4 degree centigrade in cold store if sprouting not desired.                |
| ✓ Use sprout inhibitors (e.g., CIPC) to store potatoes at 10-12 degree centigrade in cold store. | ✗ Store potatoes at 10-12 degree centigrade in cold store without using sprout inhibitors. |

## TYPICAL QUALITY CRITERIA FOR TABLE POTATO



**POTATO BABY**



**POTATO**

<b>Product</b>	<b>Potato (Domestic use)</b>
<b>Other Names</b>	Aloo (Hindi), Alu gadde (Kannada), Urullai(Tamil), Urulagaddah (Telugu)
<b>Variety</b>	various
<b>Variants</b>	Potato, Potato Fresh, Potato Mettupoliam, Potato Shimla, Potato Haldwani and Potato baby.

### Appearance

<b>Color</b>	<b>As per variety</b>
<b>Visual Appearance</b>	Clean and firm
<b>Shape</b>	Round/oblong as per the variety
<b>Sensory</b>	Hard, firm, without sprouts and free from visual defects.
<b>Size</b>	Large / Premium - Dia > 61 mm Medium / Economy - Dia 45 – 60mm Small - Dia 30 - 44 mm Potato Baby < 30mm

### Serious defects

<b>Diseased</b>	<b>Any infection caused by virus, bacteria and fungi. Blight and Black heart</b>
<b>Rotting</b>	Rot due to fungal and bacterial infection
<b>Insect infested</b>	Any tuber with insect / borer infection

### Other Defects

<b>Cuts/Cracks</b>	<b>Any deep cut/crack.</b>
<b>Nodes</b>	More than 2 nodes.
<b>Bruising</b>	Bruised marks covering > 5 % surface area.
<b>Pressure Damaged</b>	Pressure damage > 5 sq mm area.
<b>Mis-shaped</b>	Badly Mis-shaped or doubles.
<b>Watery Spots</b>	Watery spots on surface.
<b>Scab</b>	Major Scab holes.
<b>Black Scurf</b>	Black scurf on surface covering > 10%area.
<b>Green Spots</b>	Green spot – covering > 20 Sq mm area.
<b>Shriveled/loose</b>	Shriveled/loose texture (Dehydrated).
<b>Chipped</b>	Any tuber with chipped surface

### Storage Conditions

Intended Use	Temperature	RH (%)
<b>Seed</b>	2.4° C	95
<b>Table</b>	7° C	98
<b>Processing</b>	8-12°C	95