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Glossary of Common Potato Storage Terms

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Introduction

MANY TERMS DESCRIBE THE PROCESSES, management, and equipment used for potatoes in storage. Some words, terminology, acronyms, or phrases may be specialized, technical, not commonly used, or have multiple meanings. This glossary has been collated to standardize and clarify their meaning. Ensuring common and consistent language to describe storage structure and management strengthens practical communication about potato storage. The list, however, is not inclusive and does not include technical refrigeration terms or diseases found in storage. Consult local refrigeration experts for additional clarification of refrigeration terms. Common potato storage diseases are discussed in *Diagnosis and Management of Potato Storage Diseases* (CIS 1131).

Glossary

°C. Degree Celsius. To transform a temperature in °C to degree Fahrenheit (°F), use the formula, T°F = T°C × 1.8 + 32.

°F. Degree Fahrenheit. To transform a temperature in °F to degree Celsius (°C), use the formula, T°C = (T°F) - 32)/1.8.

air flow rate. Rate of air provided to potatoes in storage. It is used to describe ventilation supplied per volume of potatoes. See **CFM**.

air intake door/fresh air doors/fresh air louvers. A storage opening to bring outside air into a building. The door or louver opens a certain amount, depending on the outside and inside air temperature. The outside air is humidified and distributed to the potatoes via the plenum or the air is blended with conditioned return air.

aerobic respiration. Potato tuber respiration that occurs in the presence of oxygen (O_2).

air velocity. Measurement of flow/speed of air in ft/min.

air volume. Total volume of air a storage can hold. This is determined when a building is constructed. Measured in cubic feet (CF).

ambient air. Outside air. Ambient temperature and humidity are equal to outdoor conditions.

anaerobic conditions. Lack of sufficient oxygen level for the crop.

anaerobic respiration. Potato tuber respiration that occurs in the absence of oxygen (also called fermentation) and can cause off-flavors and odors.

available cooling air. Outside air is available to cool the crop if the air is cooler than the stored crop. Use of evaporative cooling in conjunction with outside air may provide available cooling air even if the outside temperature is warmer than the set point of the storage.

black heart. A physiological disorder caused by a lack of oxygen or an excess of carbon dioxide (CO_2), which creates an asphyxiating environment. Characterized by black coloration in the center of the tuber.

blackspot bruise. Impact-related damage causing a dark discoloration under the skin of the tuber, where the point of impact occurred. The cell membranes are damaged, but the skin is unbroken.

BTU. An acronym for British Thermal Unit and a unit of energy. It is the amount of heat required to raise the temperature of 1 lb of water by 1°F, which describes the amount of heat in the storage given off by potatoes and equipment.

bulk density. The amount of potatoes (e.g., pounds) within a given space in storage (e.g., ft^3). Russet potatoes typically have a bulk density of 40–43 lb/ ft^3.

carbon dioxide (CO_2). Colorless gas from the respiration of stored potatoes and formed in the combustion of carbon-containing materials and in anaerobic fermentation (e.g., decayed potatoes). The atmosphere contains 0.04% (400 ppm CO_2).

cellar. The building or facility that stores potatoes (e.g., storage).

CFM. Acronym for cubic feet per minute. The volume of air that can be moved in one minute. Also referred to as "airflow." The CFM can be calculated by the volume of air the fan blade is capable of producing. It is often used to describe ventilation supplied per volume of potatoes. The common terms are CFM/ton of potatoes (e.g., 25 CFM/ton) and CFM/cwt of potatoes (e.g., 1.25 CFM/cwt).

chemical maturity. The tuber status with the lowest sucrose and reducing sugars and highest dry matter content.

chilling injury. Physiological disorder that results from the exposure of a tuber to temperatures below a critical temperature. Symptoms include off-white to purple discoloration with gray- or black-speckled blemishes or cavitations, primarily in the outer ring of tissue closest to the skin.

chronological age. Age of the stored potatoes measured in days after harvest.

CIPC. Acronym for chlorpropham, the most common sprout inhibitor used to control sprouting in potatoes. It is applied thermally in storage or as a spray treatment at packing.

cold sweetening. The accumulation of soluble sugars in potatoes when exposed to low temperatures. This condition allows the reducing sugars to increase in the potato and can darken its processing color.

cold sweetening resistance. Variety resistance or tolerance to cold sweetening. This allows a variety to be stored at colder temperatures than nonresistant varieties and not accumulate as a high of sugars that cause darkening of the process color.

condensation. A process in which water vapor in the air becomes liquid; occurs when the air is cooled below the dew point temperature while saturated with water vapor and the water condenses out. Condensation may happen when warm air hits cold potatoes or surfaces, the air reaches the dew point, and water droplets form.

control panel. Computer that controls the storage system based upon sensing environmental parameters integrated with desired set points.

controlled atmosphere (CA). Refers to the ability to control conditions in storage by decreasing oxygen and increasing carbon dioxide concentrations. It is commonly used in apple storages and not used in potato storage.

cooling. Removing field heat and heat from tuber respiration and equipment from a storage.

curing/wound healing conditions. Environmental conditions soon after harvest that favor healing of damaged and shatter-bruised potatoes to minimize weight loss and disease entry. Warmer temperatures and high humidity promote wound healing.

cutting black. An industry term that refers to a potato tuber internal browning/blackening defect seen under a flattened or pressure-bruised area.

dehumidification. Ways to reduce excess water vapor in the air (humidity) in the storage. Methods include the use of heaters to increase temperature above the pile and the use of refrigeration.

dehydration. Potato tuber water loss, which can result in flaccid potatoes more prone to pressure flattening.

Delta-T (ΔT). The difference in temperature between the top and the bottom of a pile of potatoes.

dew point. The temperature when air becomes saturated with water vapor and no longer holds all the water and the water condenses out, forming free moisture.

dormancy. The period of time after harvest when a potato either doesn't sprout evenly under favorable conditions (endodormancy) or its initiation of sprouting delays due to a cooler storage temperature (ecodormancy). Describes the number of days in storage until the initiation of sprouting begins.

duct. Air distribution system underneath a potato pile. Ducts can be both belowground (concrete/metal with air floors) or aboveground with corrugated metal pipe. The duct discharge area is an opening in the duct for proper air distribution and pressure. Ducts are also referred to as laterals or tubes.

ethylene (C_2H_4). A gaseous plant hormone involved in ripening and senescence processes. Used as a sprout suppressor in potatoes.

evaporation. Loss of water from the skin of a tuber.

evaporative cooling. The process of cooling air by forcing air through water-soaked media, which cools the air via evaporation.

fan speed. The rate of rotating blades (fan) that generates a flow of air for ventilation purposes. Measured in revolutions per minute (RPM) or Hertz (60HZ) or percentage of full speed (80%).

field heat. Temperature of a crop at the time of harvest.

flattening (pressure). The physical damage that develops on tubers within a pile that is characterized by a flattened or depressed area on the tuber surface. Can result in pressure bruise (blackening).

freezing injury. Damage that results from the freezing of tissue and formation of ice crystals at temperatures below the freezing point.

fructose. A reducing sugar in a potato tuber that reacts with amino acids in the presence of heat to form a darker fry color. It is often found at similar or lower levels than the percent glucose.

glucose. A reducing sugar in a potato tuber that reacts with amino acids in the presence of heat to form a darker fry color. Glucose levels are often evaluated in tubers to assess their processing quality and reported as percent glucose on a fresh weight basis or in mg/kg.

glycoalkaloids. Naturally occurring compounds found in conventional potato varieties that contribute modestly to a potato's characteristic flavor. However, elevated levels can impart a bitter taste. The primary glycoalkaloids present in a common potato are α-chaconine and α-solanine.

greening. Green discoloration in a tuber (increase in chlorophyll) due to exposure to light. Occurs in the field or in storage.

heat load. The amount of heat in storage to remove to cool down the crop to a desirable temperature. The heat can come from warm potatoes (**field heat**) and high rates of respiration (**vital heat**). In storage, other sources of heat besides potatoes add to the heat load, such as heat transfer from the outside to the inside of the building and heat from operating electrical equipment (e.g., fans). The various sources of heat add to the total heat load that needs to be removed from a building.

heat units. An objective measure of temperature exposure over time. Similar to growing degree days in the field, accumulated heat units can be calculated in storage by adding the maximum and minimum temperatures together daily, dividing by 2, and subtracting the base temperature. Base temperature varies, but 38°F can be used to calculate the storage heat unit.

heating system/heaters. Propane or electrical heaters can be used if additional heat is needed for a stored crop or to help with condensation.

hertz. Unit of measurement for electricity frequency and often used to describe **variable frequency drive** motors. The standard unit is 60 hertz (hz), which means the fan motors are at full capacity.

holding temperature. Temperature of a storage that remains constant for the bulk of a storage season. Its value depends upon variety and market use. It is the lowest temperature at which potatoes are stored.

insulation. Used on a storage structure to limit the heat exchange between inside and outside the storage and to prevent condensation on the walls and ceiling or roof.

light tree. A set of lights outside a storage building that indicates if a system is on/off or in standby mode. It does not indicate if a system is running properly.

louvers/doors/fresh air doors/exhaust louvers. Storage openings designed to bring outside air into a building or to exhaust air from inside a building.

maleic hydrazide. A plant growth regulator applied in a field as a foliar application for sprout suppression in storage. It inhibits plant cell division, but not enlargement of existing cells.

modified atmosphere packaging (MAP). Packaging that changes the air composition within by allowing certain gases to move across a film.

oxygen (O_2). A colorless, odorless, tasteless gas essential to living organisms, which is converted to **carbon dioxide (CO_2)** via **respiration**.

peeping. The initial stage of sprout development where bud development is visible in an eye.

physical maturity. Reached by a tuber when the skin sets.

physiological age. The physiological status of stored potatoes, based upon chronological age and field and storage conditions. Warmer storage temperatures physiologically age tubers.

physiological disorder. A disorder not caused by a pathogen or insect. Also referred to as an abiotic disorder.

plenum. The area leading from a fan house to distribute air to a lateral duct system.

preconditioning. The action of keeping potatoes at warmer temperatures soon after harvest to help lower **reducing sugar** content.

pressure bruise. The physical damage associated with pressure flattening and characterized by an internal gray/black discoloration. Also referred to as **cutting black**.

pressure flattening. See **flattening.**

psychometric chart. Conceptual visualization of the physical and thermal properties of air dependent upon atmospheric pressure, water content, and temperature.

ramping rate. Daily modification (or every twenty-four hours of available cooling) that decreases a storage temperature to reach a holding temperature. It often ranges from 0.1°F/day to 1°F/day.

recirculate. The process of continuous ventilation with internal air without bringing in fresh outside air.

reconditioning. The action of warming up potatoes to decrease their sugar content and lighten the fry color out of storage and preprocessing. Often done at temperatures of 55°F–68°F for short periods.

reducing sugars. Glucose and fructose are common reducing sugars in potato tubers. Higher levels equate to darker fry color.

refrigeration. Cooling the storage air by removing heat and transferring it to a heat exchanger to absorb and externally release the heat.

relative humidity (RH). The amount of water vapor in air at a given temperature compared to the maximum amount of water that temperature can hold. The relationship is expressed as a percentage.

respiration. Tuber's metabolism of using oxygen to break down carbohydrates (**starch** and sugars) into simpler molecules of **carbon dioxide** and water with the concurrent production of energy, mostly in the form of heat. Respiration is normally expressed as mL or mg CO_2 kg^{-1} h^{-1}.

run time. The amount of time storage fans run. Cooling-available run time ventilates with fresh, outside air.

saturated vapor pressure (SVP). The **vapor pressure (VP)** of saturated (100% **RH**) air at a given temperature. The air within the intercellular spaces of a potato is at SVP.

senescent sweetening. The accumulation of **reducing sugars** in potato tubers due to the physiological aging of a tuber.

sensor. A tool that identifies and reports inputs from a surrounding environment. Inputs may be temperature, **carbon dioxide**, and humidity.

set point. The temperature at which a **control panel** is set.

shatter bruise. Physical injury to a potato due to a mechanical impact. The external impact force is great enough to cause the cells to rupture by physically breaking the skin, forming cracks or cuts.

shrink(age). The amount of weight loss that occurs in storage due to water loss, respiration loss, and/or decay or defects.

spinners/humidifier. A centrifugal-type humidifier in which the spinning disk rotates at high speeds to disperse water into small droplets to increase humidity in the **plenum**.

sprout inhibitor or suppressant. A chemical application either in the field (**maleic hydrazide**) or in storage as a thermal aerosol application. Current common products: **CIPC**, clove oil, 3-decen-2-one, diisopropylnaphthalene, dimethylnaphthalene, ethylene, mint oil, and 1-octanol.

sprouting. Visible bud growth in the eyes and/or the initiation of sprout elongation.

starch. Major carbohydrate that forms in a potato tuber from sugars.

static pressure. The resistance that air encounters as it moves through a ventilation system. The flow of air meets with resistance, which reduces the pressure in the air stream, giving rise to a certain head loss.

structural load. The amount of force and stress from potatoes, wind, and snow that storage building walls and ceiling withstand before weakening.

suberization. The process of developing a protective suberin barrier on a cut or the wounded tissue of a tuber. It is often used to describe the period of time when

potatoes are held in storage to encourage wound healing. See **wound healing**.

sucrose. A disaccharide sugar composed of **glucose** and **fructose**. Sucrose is produced in the leaves via photosynthesis and transported to actively growing tuber.

sugar ends. The darkened end of a fry strip. A physiological disorder associated with elevated **reducing sugar** concentrations and reduced starch in a tuber. It is most common on the stem end of tubers.

temperature differential (TD). The temperature difference between any two points of measurement. For example, the return air and downstream from the evaporator coils of a refrigeration unit.

vapor barrier. Material used to protect storage structure insulation materials from moisture and to minimize air and heat movement across a building surface.

vapor pressure (VP). The partial pressure of water vapor in the air (kPa, mm Hg, etc.). Water moves from areas of high-water VP to areas with low-water VP.

vapor pressure deficit (VPD). The difference between the **saturated vapor pressure (SVP)** and the **VP** in the surrounding air. The greater the VPD, the greater the driving force for water loss from a commodity. Calculate using the formula, VPD = $SVP_{tissue} - VP_{air}$.

variable frequency drive (VFD). An electrical device that controls the speed of an electric fan motor. It changes the **air flow rate**.

ventilation. Forced air flow used to maintain the desired temperatures and to supply humidification to a crop.

vital heat. Heat generated due to **respiration**. For every gram of **CO_2** produced, 2.55 kcal is generated. Higher respiration rates mean that more vital heat (energy) is generated.

water loss. See **dehydration**.

weight loss. Associated with **dehydration (water loss)** and carbon losses (due to **respiration**) of tubers during storage. Often given in percent loss (beginning weight minus ending weight divided by beginning weight x 100). This can include loss due to disease decay and defects.

wound healing. The process of a tuber forming a barrier over damaged areas to reduce weight loss and pathogen entry. The barrier includes **suberization** and wound periderm formation.

Further Reading

Hunter, J. 1986. "Heat of Respiration and Weight Loss from Potatoes in Storage. In *Engineering for Potatoes*. East Lansing, MI: Michigan State University/B. F. Cargill.

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