A Potato Glossary

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Introduction

This glossary has been prepared as a companion to *A Potato Chronology*. In that work, a self-imposed requirement to limit each entry to a single line forced the use of technical phrases, scientific words, jargon and terminology that may be unfamiliar to many, even to those in the potato business. It is hoped that this glossary will aid those using that chronology, and it is hoped that it may become a useful reference for anyone interested in learning more about potatoes, farming, and gardening.

There was a time, a century or more ago, when nearly everyone was familiar with farming life, the raising of potatoes and the lingo of farming. They were farmers themselves, they had relatives who farmed, they knew someone who was a farmer, or they worked on a nearby farm during their youth. Then, nearly everyone grew potatoes in their gardens and sold the extra. But that was a long-ago time. Now the general population is now separated from the farm by several generations. Less than 2 % of the US population lives on a farm and only a tiny few more even know anyone who lives on a farm. Words and phrases used by farmers and especially potato growers are now unfamiliar to most Americans.

Additionally, farming has become an increasingly complex and technical endeavor. New production techniques and handling practices, new potato varieties, new understanding of plant physiology, soil and pest ecology, and other advances too numerous to mention have resulted in difficult-to-understand jargon. Suffice it to say, it can be difficult to understand the newest findings and advances without at least a rudimentary understanding of the terms and phrases used in the business. Even many farmers do not know the technical jargon of their own industry. This writer admits that even though he grew up on a potato farm, still has close relatives working it and still dabbles in it from time to time, he has had to look up many, if not the majority, of these words and phrases in this work because the nuances of each were not clear or indeed were completely unfamiliar. Extrapolating this to the general public leads one to conclude that there must be a huge gap of understanding between farmers and consumers. This writer hopes that this work is useful for those interested in understanding the potato world.

This writer welcomes clarifications and corrections for he is sure mistakes and misrepresentations have crept in. This continues to be a work in progress; revisions will be issued periodically. Please forward any corrections, edits, new information and special requests to **rtuckerr@aol.com**

Readers will note some entries have no definition. This is not an error or problem with your computer; these are place holders for items yet to be researched.

A Potato Glossary

Abiotic In biology, the non-living parts of the environment that affect living organisms, including plants. This includes environmental variables such as water, light/shade, temperature, humidity, wind, soil, altitude, latitude, sun angle, etc., as well as physical factors such as chemicals (pollution), bruising, poor handling, etc.

Accession identifier An identifier recorded when an accession (new acquisiton) is entered in a genebank or germplasm collection.

Accession number A number intended to serve as a unique identifier for an accession. This number, once assigned, can never be re-assigned to another accession, even when an accession becomes extinct, its assigned accession number is still not available for re-use. Accession numbers

are alpha-numeric, composed of a three-letter abbreviation, left justified, followed by up to seven digits, right justified. See Accession number.

Acrylamide

A processing contaminant found in some cooked foods discovered in 2002 at which time it created a huge stir in the world-wide potato industry. While there is even now (2016) no concrete proof that acrylamide causes cancer in humans, the fact that it causes cancer in rodents is undisputed.

Accordingly, acrylamide is being closely watched by most regulating authorities, including European Food Safety Authority (EFSA), the Food and Agriculture Organization (FAO), and the World Health Organization (WHO) as well as some producer groups such as the Confederation of the Food and Drink Industries in the European Union (CIAA). Interestingly, the USDA ARS is not officially listed among these organizations. Nonetheless, unofficially, the USDA ARS is closely watching such research and indeed is conducting its own research. Due to the uncertainties regarding the health effects of acrylamide, its presence in the human diet is a concern. The potato industry is working hard to address this concern.

Acrylamide has the chemical formula C_3H_5NO. Its IUPAC name is prop-2-enamide. It is formed by way of the Maillard reaction where free amino acids react with asparagine and reducing sugars (glucose/fructose) at high temperatures to produce a plethora of flavor, aroma and color compounds.

This process begins slowly as cooking temperature rises, but when the temperature hits 338 °F, the formation of acrylamide accelerates remarkably as reducing sugars combine with the amino acid asparagine, especially in low moisture conditions. This commonly occurs in many foods when frying, baking, roasting, and broiling, especially when 'browning', which adds color, texture and taste to many foods people love to eat. Acrylamide is also commonly found in fried or baked goods such as French fries, potato chips, breakfast cereals, toasted bread, cookies, and surprisingly, coffee.

Temperatures below 248 °F have shown no increase in acrylamide. Consequently, boiling and microwaving are less likely to create acrylamide because temperatures rarely exceed 212 °F. The longer foods remain at high temperatures the greater the production of acrylamide.

Researchers at Rothamsted Research in the UK during three-year research program focused on genetics, agronomy and storage. They looked at varietal differences and the effects of storage on acrylamide formation in commercial varieties. The range is huge with acrylamide levels as low as 104 ppb to as high as 5,250 ppb.

In agronomic tests, researchers discovered that nitrogen and sulphur have a strong effect on acrylamide formation in potatoes. Water stress (drought) was also found to have a strong effect on acrylamide formation in potatoes with different cultivars reacting quite differently. Unfortunately, Russet Burbank, the American gold standard for taste, aroma, color and texture in French fries is particularly prone to developing high levels of reducing sugars as well as acrylamide.

Potato cultivars with low levels of reducing sugars and/or free asparagine in tubers would be a means of reducing acrylamide in processed potato products. For several decades, potato breeders have bred for reduced tuber sugar levels to facilitate the development of frying cultivars having lighter fry or chip color. Fortuitously, breeding for reduced sugar levels in potato has also contributed to reducing acrylamide. However, efforts in reducing the concentration of asparagine in potato were not a breeding objective until the recent elucidation of the role in acrylamide formation. In potato, asparagine concentrations are in excess compared to reducing sugar content, with the conclusion being that acrylamide formation will be determined largely by reducing sugar levels. However, while the majority of published data show stronger correlations between

reducing sugars and acrylamide formation than for asparagine, cold-induced sweetening in tubers following storage can change the balance, with reducing sugars no longer being limiting and asparagine content now becoming critical in acrylamide formation. A combined breeding approach for reducing acrylamide formation by lowering concentrations of both tuber reducing sugars and free asparagine appears warranted.

To that end, Simplot Plant Sciences of J.R. Simplot Company has developed a new GM potato variety, Innate®, with lower levels of asparagine which equates to 70% less acrylamide during processing. Some conventional cultivars and other GM cultivars offer solutions to the acrylamide issue as well.

Current data suggests that no single food contributes a majority of acrylamide to the average diet in Europe or the US. It is estimated that acrylamide is present in 40 percent of the calories consumed in the typical American diet. While that number can vary in some countries, there's nothing to suggest that eliminating any single food would significantly reduce the amount of acrylamide in the diet.

Aerial plant That portion of the potato plant appearing above ground. It consists of the stems, leaves, blossoms, and fruits. When grown from seed pieces, several shoots (sprouts) may arise from a single seed piece. This occurrence may cause physiological disorders in the developing tubers, such as tuber greening and growth disorders if the stem density is too high. The growth of the stem is erect in early stages, reaching 2-5 feet in height, but depending on variety, growth habit will range from erect to partially erect to fully decumbent. Density of stems also influences the stem height. As stem density increases, so does the height, and with this there is a decrease in axillary branching which decreases the photosynthesis potential. As the plant matures, the stem weakens and lays prostrate, eventually yellowing and dying back at the end of the growing season.

Aerial tuber Potato tubers that grow in air without soil and water.

Agribusiness, agri-business Producers and manufacturers of agricultural goods and services, such as fertilizer producers, farm equipment manufacturers, food and fiber processors, wholesalers, transporters, and retail food and fiber outlets.

Agricultural Assessment In New York State, a "use value" tax assessment for eligible farmland. This allows farmland to be taxed for its agricultural value, rather than its market (i.e., non-farm development) value. Any owner of land used for agricultural production may qualify for this tax relief if the land meets the requirements or is rented to an eligible farm operation. The premise is that large plots of land devoted to farming or other agricultural purposes require fewer public services than other more intensively used properties. As farmers often say, "Cows don't go to school and tractors don't dial 911."

The exemption you receive is the difference between the local assessed values and the state's agricultural values. New York state publishes agricultural values annually for 10 soil groups and for woodlands.

In NYS to qualify for agricultural assessment, landowners must meet the following:

- Have 7 acres or more of land in production for sale of crops, livestock or livestock products, or 50 acres of woodland used for the sale of woodland products (logs, lumber, posts, firewood); must be part of the farmed parcel(s) to qualify, it cannot be a separate tax parcel
- The same farmer must farm the land for at least 2 years,

- Farming enterprises must generate $10,000 in sales (average for 2 years). Note: a combination of enterprises generating $10,000 in sales will qualify. Up to $2,000 in wood product sales (timber, logs, posts, firewood) can qualify towards the $10,000 minimum,
- Start-up farms are eligible if they generate $10,000 in sales in the first year of operation,
- Farms less than 7 acres qualify if they generate $50,000 or more in sales,
- If at least 7 acres of land owned by a rural landowner are rented to a farmer, who meets the abovementioned income requirements, the landowner is eligible for agricultural assessment provided the landowner has a 5-year, written lease with the farmer

Agricultural District In New York State, an area encompassing various farms and farming activities with specially designated preferential real property tax treatment (agricultural assessment and special benefit assessment), protections against overly restrictive local laws, government funded acquisition or construction projects and private nuisance suits involving agricultural practices. The purpose of agricultural districting is to encourage the continued use of farmland for agricultural production against conversion to non-farming uses. The program is based on a combination of landowner incentives and protections, all of which are designed to forestall the conversion of farmland to non-agricultural uses. See also Agricultural Assessment.

Agricultural Marketing Service (USDA), a.k.a. AMS The section of the US Department of Agriculture whose mission is the promotion and marketing of agricultural commodities.

Air checking Shallow splits resembling fingernail cuts in the skin (periderm) of a potato tuber. Air checking typically occurs when highly hydrated tubers are harvested under cool temperatures and low relative humidity.

Air temperature A major factor promoting the growth of most plants, including potatoes. In Russet Burbank, the optimum air temperature for good growth leading to high specific gravity, starch content and tuber yield is 60.8 to 75.2 F. High air temperatures such as 80.6 to 86 F will cause heat stress which can induce misshapen tubers, high levels of reducing sugars and low levels of starch. See soil temperature.

Allele Any of one or more alternative forms of a gene which relate to one trait or characteristic. In a diploid cell or organism, the two alleles of a given gene occupy corresponding loci on a pair of homologous chromosomes.

Amylopectin One of the two components comprising potato starch. Amylopectin is polymer of alpha-glucose but which has side-branches every 20 to 25 glucose units.

Potato starch has long been used as a binder or glue. Recent experiments using amylopectin alone as a coating color have shown better coverage and higher gloss on paper. It is used as a binder in spray-on concrete coatings, and it can be used to make yarn stronger.

At least one potato variety, Amflora, with 100% amylopectin has been developed using genetic engineering techniques for use in industrial potato starch production.

Amylose One of the two components comprising potato starch. Amylose is a long straight-chain polymer of anhydroglucose (alpha-glucose). However, potato amyloses are not entirely

linear, but have some branching. A branching point is usually shared by 2 to 5 molecules depending on condition of culture. Molecular weight varies from 68,900 to 82,600. Tuber maturity is associated with an increase in molecular weight and in the amylose unit chain.

Angle of Repose The naturally occurring stable slope angle from horizontal that an open face of granular material will assume as it is built from a conveyor or auger. For clean potatoes being stored in a bulk storage pile, the angle of repose of the face is 37 degrees from horizontal. When removing potatoes from the face of this pile, a new, steeper, unstable angle of repose will be created at about 45 degrees from horizontal.

Annual Any plant which completes its life cycle of seed germination, vegetative growth, reproduction, and death (scenescence) in a single year.

Anthocyanidin Plant pigments giving color to fruits and vegetables. They are one of the flavonoids composed of polyphenols or polyphenolic molecules. Red-fleshed potatoes contain pelargonidin and peonidin; purple-fleshed potatoes contain malvidin, delphinidin and petunidin.

Anthocyanin(s) A sugar or acid form of anthocyanidins. Anthocyanins are naturally occurring compounds that impart color to fruit, vegetables, and plants. Derived from two Greek words meaning *plant* and *blue*, anthocyanins are the plant pigments that make blueberries blue, raspberries red, and are thought to play a major role in the high antioxidant activity levels observed in red and blue fruits and vegetables. Anthocyanins are also largely responsible for the red coloring of buds and young shoots and the purple and purple-red colors of autumn leaves. Around 250 different anthocyanins have been discovered.

Anthocyanins are members of a class of nearly universal, water-soluble, terrestrial plant pigments that can be classified chemically as both flavonoid and phenolic. They are found in most land plants, with the exception of the cacti and the group containing the beet. They contribute colors to flowers and other plant parts ranging from shades of red through crimson and blue to purple, including yellow and colorless. (Every color but green has been recorded).

Researchers are attempting to identify and characterize the specific bioactivity of each anthocyanin in relation to human health. Anthocyanins may prove to be significant compounds for their ability to inhibit LDL (the "bad") cholesterol, prevent blood clotting, and to defend cells against dangerous carcinogens. Studies have already shown anthocyanins' positive influences on a variety of health conditions.

One reason is their anti-inflammatory properties, which affect collagen and the nervous system. Their ability to protect both large and small blood vessels from oxidative damage derives from a range of effects, including mitigating micro-vessel damage from high blood-sugar levels that cause complications in diabetics. By the same token, diabetic retinopathy, which damages eyesight, is caused by leaking, damaged capillaries.

Anthocyanins give red- and purple-fleshed potatoes their skin and flesh color. In potatoes, the skin alone may be pigmented, or the flesh may be partially or entirely pigmented, or both. An unpeeled, whole, fully pigmented potato tuber may contain up to 40 μg/100 g FW total anthocyanins. Red-fleshed tubers have acylated glucosides of pelargonidin, while purple-fleshed tubers have, in addition, acylated glucosides of malvidin, petunidin, peonidin and delphinidin.

The hydrophilic antioxidant activity of solidly pigmented red- or purple-fleshed tubers is comparable to Brussels sprouts or spinach. In red- and purple-fleshed tubers with total anthocyanin ranging from 9 to 38 mg/100 g FW, ORAC assays ranged from 7.6 to 14.2 μmole/g FW TE.

Potato tubers contain 20 mg/100 g FW of Vitamin C, accounting for as much as 13% of the total antioxidant capacity.

Anthocyanins are induced by light, temperature and water stress. Anthocyanins are proposed to be light attenuators induced in high-light conditions, such as in high latitudes of Canada and Alaska, and their biosynthesis is increased by colder temperatures and repressed by higher temperatures via MYB transcription factors. Cold temperatures are known to increase alternative splicing in tubers.

Antifreeze proteins a.k.a. AFPs. These are ice structuring proteins and other low molecular weight compounds that provide freeze tolerance in plants by non-colligative means.

Antioxidant(s) The term antioxidant covers a class of compounds that work in the body to prevent or inhibit oxidation of healthy cells. These compounds, also known as phytochemicals, reduce the harmful effect of oxidants by binding to them, thus decreasing their destructive power. This process is often referred to as the 'scavenging' of free-radicals. Antioxidants can also help repair damage already sustained by cells.

Antioxidants are highly diverse – in source, effect, and use. They are found in hundreds of naturally occurring substances and forms. Among the most recognized are vitamins A, C, and E, beta-carotene, alpha-lipoic acid and certain enzymes. In potato the main potent antioxidants are vitamin C, phenols and phenolic acids (especially chlorogenic acid and flavonoids).

All living cells produce their own antioxidants, but the ability decreases with age.

Some research indicates that at least some portion of antioxidant levels in plants is the result of stress such as drought, heat, cold, bruising, insect predation, etc. Little research has been conducted to quantify this.

In August 2010 scientists announced that they have induced higher levels (up to 60 percent higher) of polyphenols and chlorogenic acids in potato tubers by immersing them in water and subjecting them to ultrasound or to an electrical charge for up to 30 minutes.

Apical dominance In potato, the eyes (terminal buds) at the apical end inhibit the growth of lateral buds. As the tubers age the apical dominance gradually diminishes. This is why a wider distribution of sprouts will appear on tubers with an older physiological age.

Apical end The end of a potato tuber with the highest concentration of buds or eyes, called terminal or apical buds. This would normally be the end opposite the stem attachment. Some call it the 'bud' end.

Asparagine An α-amino acid used in the biosynthesis of proteins. A reaction between asparagine and reducing sugars or other source of carbonyls produces acrylamide in food when heated to sufficient temperature. Asparagine is found in asparagus, potatoes, legumes, nuts, seeds, soy and whole grains. See Acrylamide.

Atlantic Since 1985, the benchmark standard for main crop mid-season chipstock potato varieties in USDA / Snack Food Association (SFA) Chip Variety Trials.

Baby potato Any of various red, white, yellow, blue-purple potato varieties harvested in the early stages of growth, before maturity, in order to keep them small and tender. Baby potatoes will generally measure no less than 1 inch in diameter, but not as large as allowed for Size B. There is no official size standard for baby potatoes. This is an unofficial term utilized by marketers to the fresh market.

Since the official codification of 'creamer' potatoes in the U.S. Standards (April 2008), one can only hope that this term will eventually disappear from the marketplace.

Typical varieties are selected with high moisture and low starch content to make them suitable for serving boiled, fried, or roasted and excellent as side dishes or for use in potato salads, soups, stews, and casseroles. They are popular as creamed potatoes, which cooks the potatoes in a cream sauce with peas and onions.

Baby potatoes can be new potatoes or not. "Baby potato" is a much-abused phrase. **See New Potato**.

***Bacillus thuringiensis* subsp. *tenebrionis* (*Btt*)** A common gram-positive soil-borne bacterium belonging to the family *Bacillus cerus*. In its spore forming stage, it produces several insecticidal crystal Cry3A ð-endotoxins that are non-toxic to humans, other vertebrates, and beneficial insects, but which are toxic to some insects. These proteins are used as environmentally acceptable foliar insecticides against. *Btt* is used to control Colorado Potato Beetle.

Backcross, Backcrossing In plant breeding: To cross with one parent. Backcrossing is a process in which a breeder repeatedly crosses hybrid progeny back to one of the parents. For example, a first-generation hybrid F_1 with one of the parental genotypes of the F_1 hybrid.

Bacterial ring rot Disease of potato tubers caused by *Clavibacter michiganense* ssp. *sepedonicus*, formerly thought to be *Corynebacterium sepedonicum*. Historically, bacterial ring rot has been a huge problem in the potato industry. Determined and focused administrative controls (zero tolerance) during the latter half of the twentieth century has greatly diminished the severe effects of bacterial ring rot on growers, at least in North America. Bacterial ring rot has not been found in any New York State seed lots since 1987.

Bacterial ring rot derives its name from a characteristic breakdown of the vascular ring within the tuber. This ring often appears as a creamy-yellow to light-brown, cheesy rot. The outer surface of severely diseased tubers may show slightly sunken, dry and cracked areas. Symptoms can be less obvious than described above, appearing as only a broken, sporadically appearing dark line or as a continuous, yellowish discoloration.

History: In the 1930's and 1940's this disease became a very serious threat to potato production in Canada and the United States and consequently became largely responsible for uniform adoption of a zero tolerance regulation by all seed potato certification programs. Under these programs, seed potatoes are visually inspected for ring rot symptoms during the growing season and after harvest. All seed lots with any symptomatic plants or tubers were eliminated from the certification program. Reasonable levels of control over ring rot have been achieved in this way.

However, the persistence of infections that escaped the notice of inspectors as well as symptomless infections, resulted in occasional outbreaks of the disease. Because the pathogen is readily spread to potato tubers from contaminated equipment and potato storages, even slight levels of infection can cause widespread dispersion of the pathogen among seed lots and to new geographic areas. In temperate climates ring rot has become the most dreaded disease in seed potatoes because of the monetary cost associated with elimination of an entire potato crop from a certification program and the social stigma attached to its appearance.

Bacterial soft rot A potato disease caused by one or more of the following pectolytic bacteria: *Pectobacterium carotovorum* ssp. *carotovorum* (formerly *Erwinia carotovora* ssp. *carotovora*) or more recently by *Dickeya dianthicola* (formerly *Pectobacterium chrysanthemi* and before that *Erwinia chrysanthemi* pv. *dianthicola*, and before that *Erwinia chrysanthemi*).

The bacterial pathogens that cause soft rot of tubers, and wilting and necrosis of stems and foliage may be introduced as secondary-infecting

pathogens after the plant has been compromised. For example, bacterial soft rots of tubers can be introduced after fungal infection or through wounds caused by mechanical damage. The management options for control of *Pectobacterium* spp. and *Dickeya* spp. are limited, but are the same regardless of the species.

These bacteria grow at temperatures between 32 and 90 degrees F, with optimal growth between 70 and 80 degrees F. *Pectobacterium* spp. survives readily in soil and surface waters such as rivers, lakes, and even oceans, *D. dianthicola* less well. These bacteria are capable of multiplying and persisting in the root zones of many host and non-host crop and weed species. Bacterial soft rot occurs on a wide range of crops and is one of the most severe postharvest diseases of potatoes worldwide. Loss may occur during storage, transit or marketing. All potatoes varieties are susceptible.

Contamination of potato tubers occurs anytime they come into contact with the bacterium, most commonly during harvest, handling or washing. The bacterium invades the potato tuber chiefly through wounds. Most of the soft rot infections are in tissues that have been weakened, invaded or killed by pathogens or by mechanical means. Soft rot in tubers is favored by immaturity, wounding, invasion by other pathogens, warm tuber and storage temperatures, free water and low oxygen conditions. Tubers harvested at temperatures above 80 degrees F can be predisposed to soft rot. Decay can be retarded by temperatures less that 50 degrees F, the lower the temperature, the better. Immature tubers are susceptible to harvester-related injury and bacterial infection. Suberizing seed and treatment with fungicide is a tactic to reduce the risk of other seed infections that could lead to soft rot breakdown of the seed.

Soft rot on tubers first appears as small, tannish, water-soaked spots on the surface. These spots rapidly enlarge and the tissue decomposes in a soft, blister-like area on the surface of the tuber. Often, a slimy or watery substance oozes from breaks in the blister. The blister margin is darker than the tuber skin. Soft rot often follows bruising and is first white to cream-colored. After exposure to air, it becomes brown to black. The boundary between the disintegrated and the sound tissue is sharp. It is nearly odorless at the stage. As secondary rot occurs, the rot becomes very foul smelling. The rot typically progresses to the point of a chalky-white, foul-smelling mass.

Soft rot bacteria can invade potato lenticels when they are swollen, which is common with exposure to wet soils or soaking in water. The infected areas around the lenticels may be up to 1/4 inch in diameter, slightly raised above and darker in color than the potato skin. Flesh under the infected lenticel appears water-soaked and can be a yellow to cream color. The depth of the infection varies from 1/2 to 1/4 inch. When exposed to high temperatures, these infected lenticels may develop into soft rot. Under low temperatures, these lenticel infections can dry out, leaving a shallow spot with a chalky-white deposit under a normal skin color. Fresh, non-suberized wounds can also serve as entry points for the soft rot bacterium.

Soft rot symptoms on the foliage include weak, chlorotic (yellowed) plants with margins of leaflets curled upwards. Stem lesions are usually light brown, but can be colorless, but not black. Stems will rot and become very mushy. Tuber rot will occur as point infections often on an eye, but can be generalized on the tuber. The tuber rot is colorless and extremely wet and mushy.

Although *symptoms* of bacterial soft rot do not begin in the field, *control* of bacterial soft rot does begin in the field. Other diseases that produce tuber lesions need to be controlled. Consider these suggestions:

- Delaying harvest until the skin has set reduces tuber injuries. This will reduce the entry points for the pathogen.
- At harvest, watch tuber handling practices, and ensure good sanitary procedures to reduce spread of bacteria. Harvesting during wet, muddy conditions generally leads to an increase in bacterial soft rot in storage.
- Properly suberize potatoes to insure wound healing and reduce the infection sites for the pathogen.
- Leave potatoes a minimum of seven days after the vines are totally dead to encourage skin set and reduce bruising.
- Eliminate as much soil as possible before the tubers are stored, as soil can restrict air movement.
- If harvesting wet potatoes, ventilate continually until the potatoes are dry.
- Isolate problem potato lots in a separate bin.
- Check the pile temperature at regular intervals. Early detection aids in control, thereby reducing loss. If elevated pile temperatures are detected, consider hot-spot fans. These 1/3- to 1/2-horsepower fans are about 16 to 18 inches in diameter. When run continuously for up to several weeks, these hot-spot fans can stop storage breakdown.

Minimizing potato bruising, avoiding harvesting during wet conditions and placing the potatoes into a disinfected storage are three easy, cheap and effective control practices to reduce loss in storage from soft rot.

See also Fusarium dry rot.

Bacterial wilt

Bacterial wilt is one of the most destructive plant diseases. It has a very wide host range. On potato, the disease is also known as brown rot, southern wilt, sore eye or jammy eye. It is caused by a soil-borne bacterium named *Pseudomonas solanacearum*.

Typical symptoms are wilting, yellowing and some stunting of the plants, which finally die right back. Wilting is first seen as a drooping of the tip of some of the lower leaves similar to that caused by a temporary shortage of water. At first only one branch in a hill may show wilting. Affected leaves later become permanently wilted and roll upwards and inwards from the margins. The wilting then extends to leaves further up the stem and is followed by a yellowing of the leaves. This yellowing, wilting and in-rolling of the leaves makes diseased plants very obvious, especially when surrounded by healthy plants. The leaves finally turn brown and fall off, beginning at the base of the stem and continuing upwards.

Symptoms in the tuber are very specific: brownish-grey areas are seen on the outside, especially near the point of attachment of the stolon. Cut tubers may show pockets of white to brown pus or browning of the vascular tissue which, if left standing, may exude dirty white globules of bacteria. As the disease progresses bubbly globules of

bacteria may exude through the eyes; soil will often adhere to the exuded bacteria, hence the name 'sore eyes' or 'jammy eyes'.

Baking potato An unofficial, but widely used category of tablestock potatoes. It is used by growers, marketers, cooks and chefs, and consumers to describe potatoes with high specific gravity. In North America, such potatoes will normally have russeted-skin and white-flesh, but they may also be found with white or yellow skin or with yellow flesh. The important factor is not skin or flesh color, but the high specific gravity which makes them high in starch and gives them a dry, mealy texture. The flesh becomes light and fluffy when cooked. They are ideal for baking, mashing, and French fries.

Popular varieties for baking are Russet Burbank, Russet Norkotah, Russet Arcadia, Norgold Russet, Goldrush, White Rose (syn. Long White or California Long White) and Yukon Gold, though there are many other varieties with better flavor.

Bangers and mash A quintessential British comfort food, traditional pub grub, and a common everyday dish in the U.K. Bangers are British pork or beef sausages, and mash is slang for mashed potatoes. Bangers and mash are served by placing fried sausages on a pile of mashed potatoes and dousing them in onion gravy. While bangers and mash is a classic working class dish, it's also found gussied-up on gastro-pub menus where it may be prepared with any number of fancy sausages or gravies.

The term "banger" is said to refer to the sausages' tendency to explode—or bang around—in the pan when cooked over high heat.

Basal end That end of the potato tuber with the stem (stolon) attachment. Actually, the tuber itself is an enlarged portion of an underground stem, i.e. the stolon.

Beet armyworm (*Spodoptera exigua*) A major insect pest in the southwestern and southern US attacking alfalfa, beans, beets, cole crops, corn, cotton, lettuce, onion, peppers, potatoes, peas, and tomatoes**.**

It is a light-green to black larva with four pairs of abdominal prolegs and a dark head. There are many fine, white wavy lines along the back and a broader stripe along each side. There is usually a distinctive dark spot on each side just above the second pair of true legs**.**

Beet armyworm feeding on young tender growth can be very damaging to small transplants. Often a fine webbing is produced by smaller larvae near these feeding sites. Older plants can become rapidly defoliated.

Most *Bacillus thuringiensis* formulations are not effective against beet armyworm. Xentari, a *Bt* var *azaiwi* strain, is effective. Several agricultural insecticides are effective when applied on labeled crops early in accordance with recommendations. Beet armyworm is resistant to most chemical insecticides available to home gardeners. Hand picking early is recommended.

Binomial nomenclature In biology and taxonomy: A standard convention used for naming species. Traditionally, as the word 'binomial' suggests, the scientific name of a species is formed by the combination of two terms: the name and the species epithet or descriptor. The first term (generic name) is *always* capitalized, while the specific epithet (trivial "name") is not; both are to be typeset in italics, e.g. *Solanum tuberosum*. The genus name can be abbreviated to its initial letter, but never omitted (as *S. tuberosum*) when repeated or when several species from the same genus are being listed or discussed in the same paper or report. In rare cases this abbreviation form has spread to more general use—for example the bacterium, *Escherichia coli*, is commonly referred to by its abbreviated form *E. coli*.

Contrary to tradition, a full species name now consists of three elements: (1) a genus name, (2) a species epithet, and (3) a taxonomic author (e.g., *Solanum tuberosum* L.). Sometimes two authors follow a plant name, as in the wild potato name *Solanum brachistotrichium* (Bitter) Rydb. Friedrich Bitter described the plant as a variety, and Per Alex Rydberg transferred it to the species level. This originally published name is the *basionym*, or the original name later transferred in rank (here from variety to species). This use of two authors is not meant to serve as a credit device, but rather as a very useful way to trace the nomenclatural history of names.

Bioinformatics Bioinformatics uses methods from information technology and mathematics to solve problems in biology. The decoding of genetic information leads to a vast quantity of data that need to be organized, analyzed and interpreted. Bioinformatics helps in this process by developing software for the sequencing of genes.

Biological control The action of parasites, predators, or pathogens in maintaining another organism's population density at a lower average level than would occur in their absence. Biological control may occur naturally in the field or result from manipulation or introduction of biological control agents by people.

Biotic In biology, those living organisms in the ecosystem that affect plants. Examples are viruses, fungi, bacteria, insects, rodents, mammals, other plants (weeds and parasitic plants), etc.

Biovar In bacteriology, a group of microorganisms, usually bacteria, that have identical genetic but different biochemical or physiological characters.

Blackheart In potato, a physiological disorder caused by insufficient oxygen in a tuber. Blackening of tuber flesh follows acute oxygen deficiency associated with either low temperature in confined storage or high field soil temperatures or very wet soil conditions. The tissue dies from the inside out and turns jet black. Tubers are initially solid. Smell is absent. Affected tubers rot later. Tubers stored at too high or too low temperatures may develop blackheart. Development is more rapid at high temperatures. Tubers harvested from low, wet areas may also show blackheart. Proper storage temperature and good ventilation help to control this disorder

Blackleg A bacterial soft rot disease of potato now known to be caused by two different pathogens: *Pectobacterium* spp. (formerly *Erwinia* spp.) and *Dickeya* spp. (formerly *Pectobacterium chrysanthemi*). *Dickeya* spp., primarily *Dickeya dianthicola*, is relatively new problem in potatoes having been first reported in the Netherlands in 1972. Since 2004, a new pathogen, *D. solani*, has been spreading across Europe.

Until recently, reports of *Dickeya dianthicola* in the U.S. have been rare. It showed up in Washington State in 2008, but in summer of 2015, numerous reports of an outbreak arose from Maine to Michigan, apparently spread by seed potatoes. By September 2015, it was being reported in Idaho as causing aerial stem rot symptoms. As of 2015, *D. solani*, a more virulent species, which has been reported in potato in Europe, has not been identified in North America. Yet, Dr. Jianjun Hao, Univ. of Maine, seems to have identified *D. dadantii* in Maine.

Blackleg symptoms from *D. dianthicola* are visually “indistinguishable from those of the more established blackleg pathogen *Pectobacterium* spp.” However, epidemiologically, *Dickeya* spp. are different from *Pectobacterium* spp. in that they can start disease in potatoes from lower inoculum levels, are more aggressive, spread more readily through the plant's vascular tissue, and have higher optimal temperatures for

disease development. *Dickeya* spp. also appear to be less able to survive than *Pectobacterium* spp. in soil and other environments.

Blackleg causes a black soft decay of the stem with resultant wilting and eventual death of the tops. Soft rot, as the name implies, results in a wet rot of tubers with a delineated boundary between rotted and healthy tissue. Infected tubers form a source of inoculum for future generations. Blackleg is favored by cool, wet soils followed by high temperatures after plant emergence. Tubers are more susceptible to soft rot if exposed to free water and warm conditions. It is thus most prevalent in washed potatoes stored in plastic bags during the summer.

See also *Dickeya*.

Black scurf See Rhizoctonia.

Black spot A bruise caused upon impact of a potato against a solid object. The tissue is damaged just beneath the skin without breaking the skin. A pigment called melanin is produced following the injury of cells and results in a brown, gray or black appearance of tuber tissue. The damage does not require broken cells, but only mixing of the substrate and an appropriate enzyme. Within 24 to 48 hours later the damaged tissue turns dark gray to black in color, but it can only be seen after peeling the potato.

Blight A generic term referring to disease characterized by rapid and extensive death of plant foliage. A general term applied to any of a wide range of unrelated plant diseases. (e.g., chestnut blight, fire blight, late blight, halo blight). See also Late blight, Early blight.

Blue Tag Grade In New York state, foundation and certified seed potatoes that also meet or exceed the requirements for U.S. No. 1 Seed Potato Grade Standards.

Boiling potato These are so-called waxy potatoes (U.K.) and moist potatoes (U.S.). They are high in moisture and sugar, but low in starch, i.e. low specific gravity. They are ideal for soups, casseroles, salads, roasting, and barbecuing because they are firmer and hold their shape better than baking (floury) potatoes. When mashed, they sometimes come out thick and lumpy, instead of smooth and creamy.

Some popular varieties are Red LaSoda, LaRouge, Red Pontiac, Red Norland, Dark Red Norland, Red Bliss, Yellow Finnish, Ruby Crescent, Australian Crescent, Adirondack Red, Adirondack Blue, Daisy Gold, Red Maria.

Bombiderres A term used for potatoes in North and West Africa, from the French pomme de terre.

Bordeaux mixture A fungicide made of a mixture of hydrated lime and copper sulfate. It was first used to control *Plasmopara viticola*, the cause of Downy Mildew of Grapes, but also found to be effective against *Phytophthora infestans*, the cause of Late Blight of Potato. This mixture is named for the university in which it was developed in the nineteenth century.

Box truck See Bulk truck.

Bratkartoffeln German for pan-fried potatoes. Typically made from left-over potatoes, sometimes in combination with onion and chips of bacon. Moist potato varieties are preferred for this, otherwise they may turn to mush. See also Home fries.

Breeding In classical breeding, one attempts to provide plants with desired characteristics by selection of appropriate mates where the result is dependent on chance; modern biotechnology can provide organisms directly with specific traits

Buckskinning A blemish of red-skinned potatoes in which skin color is lighter than desired and is combined with soft, but roughened skin appearance similar to suede leather or buckskin. It may be caused by excessive heat or soil calcium deficiency during tuber growth.

Bulk density The density of a unit volume of particulate materials including voids and water, generally expressed in lb/ft^3. It is the mass of the material divided by the volume it occupies. The volume includes both solids and voids, i.e. the space between the solid particles—pores and voids, and including any water that might be present in the voids.

Bulk density of whole, fresh potatoes in bulk storage piles or pallet boxes is 42 to 45 lb/ft^3 depending on variety and tuber shape. This is for unsized potatoes piled directly from bulk trucks delivered from the field. Bulk density for potatoes graded for size will vary from these rules of thumb. Size B potatoes will have a higher bulk density than Size A due to the smaller void ratio of Size B.

Bulk density of potato flakes is 13 lb/ft^3. Bulk density of powdered potatoes is 48 lb/ft^3.

While bulk density might seem an esoteric characteristic, consider this: the bulk density of Pringles versus that of regular potato chips. It ought not take a rocket scientist to determine that Pringles™, with a regular and most importantly, a stackable shape that lends itself to close packing in a tubular package as opposed to a loosely packed bag of regular potato chips, is a more densely packed and more efficient package. Yet, when one considers the cost of shipping, a low bulk density product such as potato chips versus the cost of a relatively high bulk density product such as Pringles, one will wonder at the relative cost of each.

It ought to make no sense until one considers the profitability of shipping a product with a high bulk density versus one with a low bulk density and when the consumer is clueless about what is going on.

Bulk truck A vee-bottomed truck box equipped with a conveyor for motorized unloading mounted on a truck body with specialized transmissions for traveling very slowly alongside a potato harvester during harvest season. It is used to collect potatoes from the field (directly from the harvester) and to transport them to the storage building or to the processor. A bulk truck may also be used at other times for transporting bulk potatoes from place to place. Bulk trucks come in various lengths from 16 feet long to 22 feet and longer.

Bushel A unit of dry measure (volume) containing eight dry gallons (or four pecks) which had become standardized by the end of the eighteenth century; abbrev., bu. Later, as weighing scales became commonplace, dry measure was gradually converted to the equivalent weight of each commodity being measured. For potatoes, a bushel volume of potatoes was standardized at 60 pounds weight, and a peck was standardized at 15 pounds weight. Bushel and peck were the standard unit of commerce in the potato trade for a century or more, but by the mid-twentieth century they were replaced by the hundredweight (cwt). Now, in potato industry, bushels and pecks are obsolete.

Butyrate A short-chain fatty acid (SCFA), similar to acetate and propionate, that supports gut and human microbiome well-being. Butyrate is one of the most important SCFAs synthesized from resistant starch by the microbiota. It provides the main energy source for the cells

that line the human gut and, by doing so, butyrate helps maintain the integrity of the gut lining, an important barrier between gut environment and the rest of one's body.

Eubacterium rectale is a member of the gut microbiota that produces butyrate when it breaks down resistant starch. Resistant starches can also nourish bacteria (like *Ruminococcus bromii*) that, in turn, produce fuel for butyrate-producing bacteria (like *Faecalibacterium prausnitzii*).

When you eat resistant starch, it passes undigested through the stomach and the small intestine and ends up in the large intestine, where bacteria digest it and turn it into short-chain fatty acids. The most important of these SCFAs is butyrate.

Butyrate is the preferred fuel of the cells that line the colon.

Therefore, resistant starch both feeds the friendly bacteria and indirectly feeds the cells in your colon by increasing the amount of butyrate.

Buy local See Locally grown.

California long white Not a variety or cultivar, but a type of white potato characterized by oblong to long shape, shallow eyes, smooth-skinned white tubers with a high specific gravity. The most common variety is White Rose (syn. American Giant, Wisconsin Pride). Another is Castile (syn. Beltsville). See also Long White Potato.

Calyx The sepals of a flower; they enclose the unopened flower bud.

Canopy The leafy parts of vines or trees. In potatoes, this refers to the density and coverage of the leaf canopy developed by potato plants. In row crop potatoes, the spacing of seed pieces and width of rows is such to optimize productivity in a given field. As it happens, row spacing is coincidentally optimized for the potato leaf canopy of most potato cultivars. That is, at full maturity, the leaf canopy will close in over the space between rows, shading out weeds, lowering soil temperature, and slowing soil evaporation rates.

Relative humidity in the potato canopy can be 5 to 10% higher than that of the ambient air creating a microclimate within (beneath) the canopy that is different than the ambient air. Effective control of blight and other moisture sensitive pathogens will take this into account.

At full plant maturity, the leaf canopy is at maximum photosynthetic capacity and the tubers are bulking at their maximum rate. The longer a canopy is at maximum capacity, the higher the yield. Tuber bulking rate and duration can be detrimentally influenced by cold temperatures, insect damage, soil moisture, and timing of plant maturity. Timing of each of the above individually and in concert will have varying affects on yield.

Capper-Volstead Act Enacted February 18, 1922, an act that exempts agricultural cooperatives from federal antitrust laws. It authorizes farmer associations to form voluntary cooperatives for producing, handling, and marketing of agricultural products. It is also known as the Cooperative Marketing Act.

Carapulcra An ancient dish, maybe the oldest Peruvian stew. It is made from dehydrated (or dried) potatoes (papa seca), pork or chicken (or both), but sometimes beef, hot yellow ají (peppers), peanuts finely ground, cumin and other spices. Originally, the carapulcra was made in clay pots, but this is not necessary.

Carbamates A class of pesticides.

Carbohydrates In potato, carbohydrates are found in the dry matter and consist of starch, sugars, cellulose (cell walls) and pectins (cell binding materials). All of these compounds are polymers derived from the simple sugar, glucose.

Carfentrazone-ethyl An agricultural chemical used for a variety of weed management as well as a desiccant for vine kill. It is available as a water-dispersible granule that can be used alone or in tank mix combinations. It has an REI of 12 hours and a PHI of 7 days.

Carotenoids A large class of well-known phytopigments giving plants their yellow or orange color. Carotenoids are found in fruits and vegetables and are known to have biological activities that promote health. At least 600 different carotenoids exist. Commonly consumed fruits and vegetables contain groups of 40 to 50 carotenoids, which are grouped into three categories based on their color.

Yellow and orange fruits and vegetables - such as apricots, mangos, peaches, carrots, yellow and orange-fleshed potatoes, sweet potatoes and winter squash - contain the greatest variety of carotenoids. Some of these are alpha-, beta-, and gamma-carotenes; lutein; lycopene; neurosporene; phytofluene; phytoene; and xanthophylls. This group of fruits and vegetables provides vitamin A through bodily conversion of the alpha-, beta- and gamma-carotenes. They also protect DNA from damage, an occurrence that can result in unrestrained cellular growth. Yellow-orange carotenoids appear to protect against several cancers including breast, colorectal, lung, prostate and uterine.

Yellow and green fruits and vegetables - such as tangerines, chard, collards, sweet corn, kale, okra and spinach - contain lutein, zeaxanthin, alpha- and beta-carotene and beta-cryptoxanthin. Carotenoids from these fruits and vegetables appear to prevent age-related macular degeneration and cataracts as well as to lower uterine cancer risk.
Red carotenoids - common to berries, watermelon, rhubarb and tomatoes - contain an abundance of lycopene, zetacarotene, phytofluene and phytoene. All of these carotenoids are free radical quenchers that may help prevent prostate cancer.

All potatoes contain carotenoids, primarily lutein, zeaxanthin, and violaxanthin, all of which are xanthophylls, but yellow-fleshed tubers will contain higher concentrations. Potatoes contain only a trace of alpha- and beta-carotene, therefore potatoes are not a source of pro-vitamin A carotenes. Skin and flesh color are a direct indication of carotenoids present in a potato tuber.

Carotenoid concentrations in potato are not diminished by cooking and processing.

Studies show total carotenoids of 50 to 100 μg/100 g FW in white-fleshed varieties and up to 2000 μg/100 g FW in deep yellow and orange fleshed varieties. Research as of 2004, shows that in potatoes with total carotenoids ranging from 35 to 795 μg/100 g FW (fresh weight), the lipophillic extract of potato flesh presented ORAC values of 4.6 to 15.3 nmoles a-tocopherol equivalents/100 g FW.

Cartagena Protocol on Biosafety A supplementary accord to the Convention on Biological Diversity, adopted by the Conference of the Parties on 29 January 2000. It seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology. It establishes a procedure for insuring that countries are provided with the necessary information to make informed decisions before agreeing to the import of such organisms into their territory.

Certification agency In the US, seed potato certification is the responsibility of a land-grant university, a state department of agriculture, or a grower (crop improvement) association. As a result, a

great deal of diversity exists among states in the rules and regulations that govern the certification process.

The certification agency is generally responsible for conducting all required inspections, be they field, storage, or at shipping point. Since participation in seed certification is voluntary, the responsibility to carry out all recommendations and to follow seed certification regulations rests solely with the grower. Interaction and communication between the seed certification agency, the seed potato grower and the commercial potato industry they serve is critical.

Certified seed See Seed Certification.

α-chaconine A bitter-tasting alkyloid compound, similar to α-solanine, created when potato tubers are exposed to sunlight.

In high concentrations, α-chaconine can cause headaches and stomach aches.

Green-colored portions of potato tubers probably contain some amount of α-chaconine and/or α-solanine, and gernerally speaking, should be avoided. This is easily accomplished by peeling away the green portions of the tuber.

See also 'Green' potatoes. See also α-solanine.

Chef potato For many decades, 'chef' was an unofficial term used in both the potato industry and the food industry to refer to larger-sized potato tubers preferred by chefs and cooks for baking. In 2008, the revised U.S. Standards for Grades of Potatoes, effective 21 April 2008, now sets Chef size potatoes as those from 2 ¾" (8 oz.) min. to 4 ½" (28 oz.) ma

Chef size potatoes can be any variety or potato type. It is simply an indication of tuber size.

Some sources suggest that chef potatoes are russet potatoes, but this is incorrect.

The revised U.S. Standards for Grades of Potatoes, effective 21 April 2008, now sets Chef size potatoes as those from 2 ¾" (8 oz.) min. to 4 ½" (28 oz.) max.

See Restaurant potato.

Chips In the UK: french fries

Chipos™ An engineered, prefabricated 'potato chip' manufactured by General Mills starting around 1967. This was the first engineered, prefabricated 'potato chip to find traction in the U.S. marketplace.

Chipos were made from reconstituted dehydrated potato flakes, flash-fried and enhanced for shelf-life with BHA and BHT.

Ironically, while Chipos were the subject of a lawsuit brought by Weaver Potato Chip Co. and PCII in late 1969 or early 1970 and while they actually won the suit with the proviso from the judge that Chipos could be called potato chips as long as General Mills stated with a prominent accompanying declaration that CHIPOS are made from dried or dehydrated potatoes.

Despite this victory, Chipos never did achieve a permanent place in the marketplace and were subsequently discontinued by General Mills.

Chipper In the U.S.: A potato variety well-suited for making potato chips. See Chipping potato.

Chipper In the U.S.: A manufacturer of potato chips. In the UK: a device for cutting potatoes into 'chips'.

Chipper In the UK: a device for cutting potatoes into 'chips', i.e. french fries.

Chipping potato In the U.S., a potato variety (cultivar) with high chipping quality, i.e. high solids content, high peeling efficiency, good shipping qualities and good finished chip color, i.e. a variety suitable for making high-quality potato chips.

Chipping quality This is the suitability of a potato variety (cultivar) for making high-quality potato chips. Industry standards have been developed establishing fry color, internal discoloration, peeling efficiency (both after harvest (fresh) and from storage) for most commercial potato varieties. Those varieties meeting these standards are grown and sold as 'chipping potatoes'.

Chipstock In the U.S., chipstock refers to those potato varieties preferred for making potato chips. See Chipping potato. See also Chipper.

Chlorosis The loss of chlorophyll from the tissues of a plant, resulting from microbial infection, viral infection, the action of certain phytotoxins, the lack of light, to magnesium or iron deficiency, etc. Chlorotic tissues commonly appear yellowish. See Mosaic.

Chromosome The structure made up of DNA and proteins which carries the majority of the genetic information of the cell.

Chromobacterium subtsugae* sp. *nov A newly discovered Chromobacterium bacterium with a unique strain that exhibits insecticidal activity. It is toxic to Colorado Potato Beetle, and it is effective to varying degrees on gypsy moth, small hive beetle and tobacco hornworm.

Chromobacterium subtsugae was isolated from soil rich in decomposed hemlock needles collected in the Catoctin Mountain region of central Maryland, USA. It is a member of Bacteria; Proteobacteria; Beta-proteobacteria; Neisseriales; Neisseriaceae; Chromobacterium.

Toxicity is found in supernates, filtrates and extracts of the bacterium strain containing active metabolites.

United States Patent No. 7244607 was given to USDA ARS in July 2007 for use as a biocontrol agent. Under this protection the technology has been licensed for commercial use (December 2007).

Chuño A potato product created through a process of crushing and freezing. It was developed high in the Andes Mountains thousands of years ago as food preservation technique by the Quechua and Aymará Indians. It may be the first freeze-dried food. Chuño can be stored for a year or more.

CIP The International Potato Center (Centro Internacional de la Papa) located at La Molina, Peru. CIP's mission is to find ways to reduce poverty and achieve sustained food security in developing countries. It conducts scientific research and related activities on potato, sweet potato, and other root and tuber crops and ways to improve management of natural resources in the Andes and other mountain areas. It also maintains the largest collection of potato genetic resources: nearly 5,200 distinct cultivated types and more than 2,100 wild relatives corresponding to 151 species.

Clean A term used in the U.S. Standards for Grades of Potato. In this context "clean" means that at least 90 percent of the potatoes in any lot are practically free from dirt or staining and practically no loose dirt or other foreign matter is present in the container.

Clone noun, 1) A population of recombinant DNA molecules all carrying the same inserted sequence; 2) a colony of micro-organisms containing a specific DNA fragment inserted into a vector; 3) a population of cells or organisms of identical genotype.
verb: 1) The use of in vitro recombination techniques to insert a particular DNA sequence into a vector; 2) the selection of a unique virus isolate from individual plaques, pocks or lesions or by limiting dilution; 3) the vegetative propagation of an organism to produce a population of identical individuals.

An individual organism with an identical genetic makeup to another individual. Clones descend from an individual parent. Several common foods are clones: potatoes bananas, plantains, strawberries, apply, olives, citrus and pineapples.

When a clone contains a variant from the original, which can result from a change in a single gene, it is called a mutant.

In cultivated potatos all cultivars are clones except those that are grown from true potato seed.

Cohort In statistics and demographics: a group. More specifically, a cohort is a group of subjects that share a particular event together during a particular time span. Statisticians and demographers will compare different cohort populations to separate various factors in their analysis (cohort study).

Cold-induced sweetening (CIS) In potato, cold storage (5 to 10 °C) triggers the conversion of starch to glucose and fructose, a phenomenon known as cold-induced sweetening (CIS). Potato chips and french fries produced from cold-stored potatoes with elevated amounts of sugars are unacceptably brown- or black-colored and bitter tasting. This is a huge concern amongst chip and fry processors.

Cold potato routing In electronics: As opposed to hot potato routing, this phrase refers to data packets that are kept on a server's backbone until the last possible minute. Often used for streaming media, this kind of routing enables hosts to keep the data on their backbone with zero packet-loss and zero latency until they get as close as possible to the end-user, thus supporting hundreds of thousands of concurrent users.

Colligative properties Those properties of solutions that depend on the number of solute particles in a given volume of solvent and not on the mass of solute particles. These properties include vapor pressure, boiling point, freezing point, etc.

Colorado Potato Beetle Also called potato bug and potato beetle. Colorado potato beetle was first documented by Thomas Nuttal in 1811 and scientifically described in 1824 by Thomas Say from specimens collected in the Rocky Mountains on buffalo bur. In modern references, Colorado potato beetle is commonly referred to as *Leptinotarsa declimineata* (Say).

The insect's association with the potato plant, *Solanum tuberosum* (L.), was not known until about 1859 when it began destroying potato crops about 100 miles west of Omaha, Nebraska. The insect continued its rapid spread eastward at the rate of 85 miles per year, reaching the Atlantic coast by 1874. The evolution of the name ‘Colorado’ potato beetle is somewhat curious since the beetle did not originate in Colorado, but is believed to have originated in central Mexico. It had a series of names from 1863 to 1867, including the ‘ten-striped spearman,’ ‘ten-lined potato beetle,’ ‘potato-bug’ and ‘new potato bug’. Colorado was not connected to the insect until Walsh (1865) stated that two of his colleagues had seen large numbers of the insect in the territory of Colorado

feeding on buffalo bur, *Solanum rostratum*, a.k.a. buffalobur, Kansas thistle, sand bur, Mula mujer, a member of the potato/nightshade family, Solanaceae, a wild spiny ground cherry belonging to the potato family. This convinced him that it was native to Colorado. It was C.V. Riley (1867) who first used the combination: Colorado potato beetle.

True potato beetles are members of the beetle genus *Leptinotarsa*, with 32 species in North America, including Mexico; 10 species in the continental United States. The most notable is the Colorado potato beetle, *Leptinotarsa decemlineata* (Say), which is present in most of the United States and has been introduced into Europe and parts of Asia. It is one of the most serious insect pests of potatoes and other solanaceous plants. C.V. Riley, the noted entomologist, once stated, "It never quits a locality when it obtains a foothold."

The adult beetle passes the winter in the ground and in the spring flies about on broad, rose-colored wings until it finds young potato tops. It even burrows into the potato hills to meet the rising sprouts half way. As soon as the young tops appear the female attaches a cluster of twenty to forty oval orange-colored eggs to the under side of a leaf. In the course of a week tiny hump-backed larvae of a Venetian-red color appear and betake themselves to feeding vigorously and voraciously on the leaves of the plant. They have a faculty of climbing to the very tip of the growing stalk where the young leaf is tenderest.

As the CPB larva grows older it becomes paler in color and its sides are marked by two rows of black spots. In about three weeks it enters the ground and makes a burrow in which it remains for a few days, emerging a perfect beetle with striped wing covers. From egg to beetle is a period of four to six weeks. The female beetle lays 300 to 800 eggs in a season, and, under favorable circumstances, the fourth generation, great grandchildren, mature into adults before winter. The adults burrow in loose soil to spend the winter.

Colorado potato beetle is a multivoltine species with a facultative overwintering diapause that takes place at the adult stage and is induced by a short-day photoperiod. After diapause initiation, the beetles either burro into the soil or move toward field edges by flight and walking, presumably orienting themselves toward tall vegetation common in hedgerows. Upon arrival to overwintering sites, pre-diapause migrants immediately burrow into the soil to diapause.

Colorado potato beetles are capable of flying several kilometers. Given favorable wind speed and direction, Colorado potato beetles can fly more than 100 km. Flight is very important to Colorado potato beetle to colonize new habitats and to escape hostile environments. Walking is relatively less important because beetles are able to walk only several hundred metres at a maximum speed of about 1 cm/sec.

Beetle flight is strongly related to air temperature, starting at 15 C and reaching 100% for unfed overwintered adults at 20 C. The CPB has three distinct types of flight. The first is short-range, local, or trivial flight. This is a low-altitude flight with frequent turning which occurs strictly within the local habitat. It serves to distribute eggs within a field or for mate-finding. For both sexes, this flight serves a short-range, bet-hedging function which allows both males and females to distribute its offspring in both space and time.

The second type of flight is long-range or migratory flight. This is a straight-line, often downwind flight over distances of several hundred metres or more, used for colonization of new areas. It is not necessarily connected with the immediate search for a new host habitat.

The third type of flight is diapause flight. This is a low-altitude, directed flight, which often starts with a spiraling ascent from the crop to an approximate 5 m. altitude

and a subsequent orientation towards tall vegetation. The beetles fly to wooded sites or uncultivated field areas where they immediately burrow into the soil to disperse.

Both sexes perform all three types of flight patterns.

Colorado potato beetle is a polygamous species with both males and females copulating multiple times with different partners. Males often guard females following copulation and will display aggressive behavior toward other males. Between five and twenty percent of all copulations do not result in sperm transfer. Sexually mature females produce an airborne sex pheromone which acts as a long-distance attractant for males.

Some authorities suggest at least three matings are required to completely fill the female's spermatheca. However, others point out that neither sperm number, nor fecundity is positively correlated with the number of matings. Furthermore, there is decrease in hatch-rate with increase in matings, demonstrating a cost of polyandry.

Colorado potato beetle has a legendary ability to develop resistance to a wide range of pesticides used for its control. In 1865 potato growers first applied Paris green (lead arsenate) against them. Plants in the family *Solanaceae*, which are natural food sources for this insect, have high concentrations of rather toxic glycoalkaloids in their foliate. These toxins protect them from a wide range of herbivores. However the Colorado potato beetles have evolved an ability to overcome the toxic defenses of its hosts. Apparently, this ability also allows them to adapt to a wide range of human-made poisons. Also, high beetle fecundity (on average, about 600 eggs per female) increases the probability one of the numerous offspring mutates, just as buying 600 lottery tickets increases probability of getting a winning one compared to buying just 6 lottery tickets.

Resistance mechanisms in the Colorado potato beetle are highly diverse even within a relatively narrow geographical area. Furthermore, the beetles show cross-resistance to organophosphates and carbamate, and multiple-resistance to organophosphates, carbamate, and pyrethroids. Laboratory selection experiments showed that in addition to the resistance to synthetic insecticides, the beetle has a capability to develop resistance to the *Bacillus thuringiensis* subsp. *tenebrionis* delta entodtoin.

The first instance of CPB resistance to synthetic organic pesticides was noted for DDT in 1952. Resistance to dieldrin was reported in 1958, followed by resistance to other chlorinated hydrocarbons. In subsequent years the beetle has developed resistance to numerous organophosphates and carbamates. In some cases, a new insecticide failed after one year (e.g., endrin) or even during the first year of use (e.g., oxamyl). Presently it is resistant to a wide range of insecticides, including the arsenicals, organochlorines, carbamates, organophosphates, and pyrethroids.

In 1995, Bayer introduced Imidacloprid as the savior to the scourge of the Colorado Potato Beetle. In many areas, after only two years on Long Island, NY, sometimes three in other areas, the CPB had already acquired resistance to this new neonicotinoid compound. By year 2000 the CPB had acquired resistance to Imidacloprid throughout the eastern US.

Commodity That which affords convenience, advantage, or profit, especially in commerce, including everything movable that is bought and sold (except animals), i.e. goods, wares, merchandise, produce of land and manufactures, etc. Commodities are valuable as money, the common measure. Potatoes are a commodity.

Common scab A disease of potato tubers that results in lowered tuber quality from scab-like surface lesions. There are no aboveground symptoms. Common scab occurs in all production areas and is most severe in soils with a pH above 5.5, especially above 5.8. It is caused by *Streptomyces scabies*, but is a direct response to soil pH.

Common scab is controlled or at least greatly suppressed at soil pH levels of 5.2 and lower. Common scab lesions are quite variable. Distinctions have been made between russet (a superficial corky tissue covering large areas), erumpent (a raised corky area), and pitted (a shallow-to-deep hole) scab. All are caused by *Streptomyces scabies*; however the type of lesion is likely determined by host resistance, aggressiveness of the pathogen strain, time of infection and environmental conditions. Scab is most severe when tubers develop under warm, dry soil conditions. Coarse-textured soils that dry out quickly are more conducive to scab than fine-textured soils.

S. scabies are resident in most soils and will increase with successive potato crops. Consequently, crop rotation with grains or other non-host crops will reduce, but not eliminate *S. Scabies*.

S. scabies infects young tubers through the lenticels and occasionally through wounds. Initial infections result in superficial reddish-brown spots on the surface of tubers. As tubers grow, lesions expand, becoming corky and necrotic. The pathogen sporulates in the lesion, and some of these spores are shed into the soil or reinfect the soil when cull potatoes are left in the field. The pathogen survives in lesions on tubers in storage, but the disease does not spread or increase in severity. Inoculum from infected seed tubers can produce disease on progeny tubers the next season.

Common scab does not affect total yields, but it does diminish marketable yields for tablestock uses, since tubers afflicted with scab do not meet US No. 1. Even process tubers can be rejected if lesions are deep-pitted enough to cause peeling losses and appearance issues.

Control of common scab has been attempted with soil amendments, biopesticides, chemical pesticides (fumigants), seed treatments and optimal soil moisture levels. Control was usually inconsistent, and none reduced scab to acceptable economic levels. The only practical solution would seem to be the breeding of resistant potato varieties

Competitive exclusion agent An organism capable of outcompeting other organisms, thus excluding them from the environment.

Conjugated linoleic acid (C.L.A.) A naturally occurring trans-fat.

Consumer preferences Those characteristics of potato tubers that are important enough to users that they sway purchase choices. These characteristics include tuber size and shape, depth of eyes, skin color, flesh color, texture, flavor and cooking attributes.

Contact herbicide A herbicide that does not move from the initial point of uptake in a plant.

COOL Country of Origin Labeling. A requirement signed into U.S. law under Title X of the Farm Security and Rural Investment Act of 2002 and again in 2008 (known as the 2002 and 2008 Farm Bills amending the Agricultural Marketing Act of 1946.). This law requires retailers—those defined as full-line grocery stores, supermarkets and club warehouse stores selling perishable agricultural commodities at retail—to notify their customers of the country-of-origin of muscle cuts of beef (including veal), lamb (including mutton), pork, goat, and chicken; ground beef, ground lamb, ground pork, ground goat, ground chicken; wild and farm-raised fish and shellfish; perishable agricultural commodities; peanuts; pecans; ginseng; and macadamia nuts. This information must be on the product itself, on the master shipping container, or in a document that accompanies the product through retail sale.

Retail stores such as fish markets, butcher shops and other stores that do not invoice the threshold amount of fresh produce (fruits and vegetables) are exempt.

Restaurants, cafeterias, food stands, taverns, bars, lounges and other food service establishments are exempt.

The interim final rule for mandatory COOL for fish and shellfish became effective 4 Apr 2005; the interim final rule for mandatory COOL for the remaining covered commodities became effective 30 Sep 2008. The final rule for mandatory COOL for all covered commodities became effective 15 Mar 2009.

Processed foods are those derived from a covered commodity that has undergone specific processing resulting in a change of character of the covered commodity, or that has been combined with at least one other covered commodity or othe rsubstantive food component (e.g., cohocolate, breading, or tomato sauce. Specific processing that results in a change in the character of the covered commodity includes cooking (e.g. frying, broiling, grilling, boiling, steaming, baking, roasting), curing (e.g., salt curing, sugar curing, dring), smoking (hot or cold), and restructuring (e.g., emulsifying and extruding). Processed foods are exempt from COOL, except when modified by the Tariff Act of 1930 or the Customs and Border Protection (CBP) and Food Safety and Inspection Service.

Frozen potato products present certain complications of interpretation under COOL law. Frozen hash browns are considered processed and therefore exempt, while frozen French fries are not considered processed and therefore subject to COOL law.

Furthermore, potatoes undergoing the following are not considered processed and therefore subject to COOL: peeled, sliced, diced, blanched, par frying, or par boiling. Also, lightly battered with a starch (rice flour), salt, leavening agent, xanthan gum, oil, dextrose, or SAPP for the purposes of maintaining color, texture or flavor would not change the character of the product, and it would still be considered a covered commodity.

Corolla The petals of a flower considered as a group or unit and usually of a color other than green.

Cortex In potato tubers the narrow band of storage tissue between the ski and the outer medulla or storage parenchyma.

Couch potato A person who spends most or much of his time sitting or lying on a couch, or perhaps an armchair or recliner, watching television in his underwear and often drinking beer. Typically, couch potatoes are supposed to be overweight or out of shape.

Some studies have said that the "couch potato lifestyle" is a serious health hazard to its practitioners. Ten studies presented at the 2003 meeting of the American College of Sports Medicine suggested that there could be a genetic basis for the "couch potato lifestyle".

In the United Kingdom, a plan of the Prime Minister's Strategy Unit tied attempts "to combat the couch potato culture" to improve the U.K.'s “international sporting performance.”

Various activities have been designed for or around the couch potato, including a type of investment portfolio ("Couch Potato Portfolio") and fantasy football leagues.

Greyhound dogs, well known for their sprinting ability, are sometimes called "forty-five mile per hour couch potatoes."

See also Mouse potato.

Count cartons (a.k.a. count boxes or count packs) These are shipping containers, most usually 50-lb boxes or cartons, specially prepared to provide consistent size and uniformity of potato tubers. They are sold by tuber-count: The higher the count (for 50-lb total weight), the smaller the tuber size. Count boxes typically range from 50-count (large tubers) through 110 count (small tubers) in increments of ten.

- 40-count box: Each tuber is xx – xx by weight; 38-42 tubers per carton; these are really large tubers

- 50-count box: Each tuber is 13-18 oz by weight; 48-53 tubers per carton; large tubers preferred for baking and French frying
- 60-count box: Each tuber is 12-14 oz by weight; 57-63 tubers per carton; large tubers preferred for baking and boiling
- 70-count box: Each tuber is 10-12 oz by weight; 67-74 tubers per carton; mid-size tubers used across a wide-range of purposes from baking to boiling to frying to roasting
- 80-count box: Each tuber is 9-10 oz by weight;76-84 tubers per carton
- 90-count box: Each tuber is 8-10 oz by weight; 86-95 tubers per carton
- 100-count box: Each tuber is 7-9 oz by weight; 95-105 tubers per carton
- 110-count box: Each tuber is 6-8 oz by weight; 105-116 tubers per carton
- 120-count box: Each tuber is xxx oz by weight; 114 to 126 tubers per carton

Knowledgeable chefs prefer to buy potatoes in count cartons for consistency of size in order to optimize cooking times in the kitchen. Knowledgeable retailers prefer to buy count cartons, especially for their loose potato (bulk) displays because of the uniformity of size and quality.

Creamer See Creamer potato.

Creamer potato Formerly a potato industry 'consensus' standard for any of various red, white, purple potato varieties harvested in the early stages of its growth, before they mature, in order to keep them small and tender. Revised U.S. Standards for Grades of Potatoes, effective 21 April 2008, includes a new category for Creamer potatoes codifying the old 'consensus' standard. Creamers are those tubers sized from ¾" min. to 1 5/8" max. diameter; there is no weight requirement. See also Baby Potato and Size C.

Crisps In the UK: 'potato chips', as they are known in the U.S.

Crisps In the US: crisps are potato chips manufactured from dehydrated, flaked and rehydrated potatoes, which are then pressed into thin uniform shapes and baked. Pringles™ and Lays Stax™ are 'crisps' in the US.

Critical Day Length For potatoes this is the length of day that triggers tuber initiation. Tuber initiation begins when the day length becomes shorter than a cultivar's critical day length (CDL). CDL varies between cultivars.

Crop In taxonomy, the total of all cultivars/cultivar groups that constitute a agricultural, horticultural, or silvacultural product, such as potatoes, cabbages, hardwood trees. For seed potatoes: A variety and class of seed potatoes, growing in an aseptic environment, a protected environment or in one or more fields of a farm unit.

Crop rotation The growing of different types of crops, in recurring succession, on the same land. This is a common farming practice used to maintain the fertility of the soil, to minimize insect infestations, and to reduce soil-borne pathogens.

For potatoes, traditional rotations commonly include oats, rye, and buckwheat. Potatoes should be grown in a crop rotation that will enhance the soil fertility, maintain a loose friable soil condition, reduce weeds, increase organic matter, conserve soil moisture, and reduce crop loss from insect damage and plant diseases. No specific crop rotation crops or schedules can be given, as combinations vary from place to place. Potato growers must develop the rotation best suited to local environmental conditions, crop alternatives, and market prospects.

In general, long rotations (potato crops planted three or more years apart on the same land) are particularly good for reducing potato losses caused by soil-borne organisms causing such diseases as scab, verticillium wilt and fusarium wilt. Wheat wireworms (*Agriotes mancus*) increase in abundance in fields planted for several years to hay and grass crops and may be a serious threat to a potato crop immediately following the plowing under of a heavy grass sod, alfalfa, or clover. On the other hand, the Pacific Coast wireworm (*Limonius canes*) increases in fields under intense cultivation, but the population decreases when fields are planted to hay crops.

Cross In plant breeding, the mating of a female and male of an animal or plant species. If the parents are unrelated, the offspring is called a hybrid.

CSA Community Supported Agriculture Program. CSA consists of a community of individuals who pledge support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm, with the growers and consumers providing mutual support and sharing the risks and benefits of food production. Typically, the members or "share-holders" of the farm or garden pledge in advance to cover the anticipated costs of the farm operation and farmer's salary. In return, they receive shares in the farm's bounty throughout the growing season, as well as satisfaction gained from reconnecting to the land and participating directly in food production. Members also share in the risks of farming, including poor harvests due to unfavorable weather or pests. By direct sales to community members, who have provided the farmer with working capital in advance, growers receive better prices for their crops, gain some financial security, and are relieved of much of the burden of marketing.

CSA is sometimes known as "subscription farming," and the two terms are sometimes used interchangeably. However, in some cases, the latter term is intended to convey philosophic and practical differences in a given farm operation. Subscription farming (or marketing) arrangements tend to emphasize the economic benefits, for the farmer as well as consumer, of a guaranteed, direct market for farm products, rather than the concept of community-building that is the basis of a true CSA. Growers typically contract directly with customers, who may be called "members," and who have agreed in advance to buy a minimum amount of produce at a fixed price, but who have little or no investment in the farm itself.

Cull (culls) Tubers that are discarded at any stage of crop production or handling (harvest, storage, grading, shipping, spring cleanup, or planting) are known as "culls." Culls are not sold on the open market because they are not up to grading standards. But they may be sold as animal feed, or as ‘seconds’ to consumers (who enjoy their low price and don’t mind the extra paring before cooking), or spread on fields as compost or fertilizer for non-potato crops.

Culls spread in fields may survive to the next year, if they are not destroyed (frozen, crushed, composted, or buried at least 2 feet beneath the soil surface). Infected tubers that are planted or cull tubers that survive the winter are called volunteers and may be sources of the pathogen that initiate epidemics the following season. Seed growers will not spread culls on potato fields.

Culm In botanical context, originally referred to a stem of any type of plant. It is derived from the Latin word for 'stalk' (*culmus*) and now specifically refers to the above-ground or aerial stems of grasses and sedges. It is still occasionally found referring to the stems or vines of potato plants.

Cultivar In simplest terms: A variety developed specifically for large-scale agriculture.

In less-simple terms: A plant derived from a cultivated variety that has originated and persisted under cultivation, but is not necessarily referable to a botanical species and of botanical or horticultural importance and requiring a name.

Alternatively, cultivar is a systematic group of cultivated plants that is clearly distinct, uniform and stable in its characteristics, and which, when propagated by appropriate means retains these characteristics. For example, Russet Burbank and Yukon Gold are cultivars of potatoes.

In taxonomic nomenclature, cultivar is the lowest rank of cultivated plants. In technical writing, the cultivar name follows the genus and species and is always capitalized and written inside single quotes but not italicized. For example, Yukon Gold is *Solanum tuberosum* 'Yukon Gold'. Alternately, it may be written *Solanum tuberosum* (cv) 'Yukon Gold' or 'Yukon Gold' potato.

It is possible to have a cultivar of a variety. For example, *Cornus florida* var. *rubra* 'Cherokee Chief'.

The term cultivar was coined by Liberty Hyde Bailey in the first part of the twentieth century from 'cultivated variety'.

See Variety.

Cultivar epithet

A cultivar epithet must exist only once in every genus because the very nature of cultivars often defies assignment to botanical species, whereas at the level of genus (or hybrid genus) cultivars can be assigned. That is to say, attributing a cultivar to a genus is a relatively simple task, whereas assigning it to a species is difficult or impossible because there are so many interspecific hybrids (sometimes of multiple hybrid origins) and sometimes companies keep pedigrees a secret. Therefore, a species epithet is not a mandatory part of a full cultivar name, but a (notho)genus is. Thus it would not be allowed to have two ornamental fig cultivars named 'Beauty' because within the genus *Ficus* only one such name would be allowed. The situation *Ficus elastica* 'Beauty' and *Ficus altissima* 'Beauty' would thus not be allowed because both could be *Ficus* 'Beauty,' and *Ficus* is a denomination class (the species is not mandatory for nomenclature of the ICNCP).

Trademarks used in the trade of cultivated plants are an increasing source of nomenclatural confusion. Some breeders try to get ownership of the name of a cultivar as well as ownership of the cultivar itself. The UPOV convention and the U.S. Patent Act expressly prohibit this. A cultivar epithet may not also be a protected trademark. This is a very logical consequence of the main purpose of a cultivar epithet: a label to be used worldwide to designate a particular cultivar in communication. A trademark may *not* be used worldwide and basically only at the discretion of the trademark owner. Obviously those two purposes are entirely different. A trademark serves to identify the products of a certain grower or company and may be used to enhance the focus of the public to the quality of the products of that particular grower or company. It is a typical commercial trading tool. However, all the individual products sold under the use of a trademark must still have generically usable individual names for purposes of communication and reference, and this is where the cultivar epithet comes in.

Cultivar-group

Taxonomic categories used by the International Code of Nomenclature of Cultivated Plants (ICNCP) to associate cultivated plants with traits that are of use to agriculturists and farmers, but which imply no phylogenetic differences between the groups.

Cultivar-groups are often used for crop plants where natural species boundaries are difficult or impossible to determine.

Cultivated plant A plant whose origin or selection is primarily due to the intentional activities of mankind. Such a plant may arise either by deliberate or, while in cultivation, accidental hybridization; or by selection from existing cultivated stock; or it may be a selection from minor variants within a wild population and maintained as a recognizable entity solely by deliberate and continuous human propagation (Spooner).

Culton A systematic group of cultivated plants. There are two types of culta: the cultivar and the cultivar group.

Cutting Table In the days before seed-cutting machinery, this was a wooden table on which workers would manually cut seed pieces or sets with a potato knife, with the intention that each seed piece would have a viable eye for sprouting, and slide the cut pieces into burlap bags or boxes affixed at one or both ends of the table.

Cyst nematode See Potato cyst nematode.

DARD Chip Initiative In the UK, esp. Northern Ireland, DARD = Department of Agriculture and Rural Development. This was a program intended to improve the quality of potato chips by focusing on improving the potato varieties grown for the chipping industry in Northern Ireland. Its focus was on chip color, peeling efficiency and variety performance. DARD was formed during the UN International Year of the Potato in 2008.

Daughter plants Vegetative progeny of plants that develop along the runners produced by another called the mother plant.

Dauphine A French dish made with mashed potatoes, flour, nutmeg, butter and milk and then fried.

Day neutral The term applied to cultivars that produce flower buds more or less independently of day length.

Decumbent In botany: the posture or growth habit of a plant with full-grown stems at about the time of maximum growth which are entirely devoid of the capacity to stand upright. Decumbent plant stems lie prostrate, or closely hug the ground, with tips rising upward.

Degeneration Throughout the nineteenth and early twentieth centuries potato growers noticed that after eight or ten years of using seed from the previous year's crop, even the most skilled and experienced were afflicted by a loss of vigor and decrease of production in their potato crops. This was long attributed to "loss of vigor" in the seed and the phrase "running out" was assigned to this diminution in yield despite use of the highest quality of seed extant and the proper use of all standard practices in potato growing .

It was only in the early years of the twentieth century that the cause of this degeneration was found to be caused by various viruses accumulating in the potato seed. Viral carriers were subsequently identified as insects, such as aphids, and other vectors. Once this was discovered and understood, a major change in the potato industry ensued. That is, the seed potato industry was born.

Initially, potato growers were trained to recognize the abnormal physical characteristics of infected plants by agents of state-sponsored potato programs and growers began pulling infected plants from their fields. This process of removing infected plants from fields is called roguing. After instituting these practices, seed quality immediately improved. During the 1920s, the resulting increase in production was

immediately recognized by commercial growers, seed growing associations were formed and seed growing became a recognized specialty.

In the latter part of the twentieth century, all state-funded and most other seed suppliers, due to technological advancements in the commercial production of virus-free *in vitro* seed stocks, began supplying virus-free seed stock to seed growers, and together with short flush-out durations, roguing has become obsolete. In short, degeneration is no longer a concern in commercial potato production.

However, that is not to day that viral infections are no longer a concern. Inexplicably, viral infections are found to be an increasing issue in some growing areas. Research is on-going to explain this detriment to production and to develop remedies to keep it in check.

See also roguing, seed potatoes, potato virus A, S, M, X, Y, M, leaf roll (PVRL) and mop top (PVMT).

Dehiscence (adj. deshiscent) A botanical term describing the ability to naturally split apart at maturity along a line (lateral suture) in order to release seeds, pollen, spores as a capsule or anther. This line is often called the line of dehiscence.

In potato blossoms, the anthers are typically five in number and together form a cone held together along five lines of deshiscence. At maturity pollen escapes through small pores on the inner aspect of the apex of each half of the anther. In some blossoms these lines are different color than the anther itself resulting in a wide color combinations which are often used to help differentiate varieties.

Delaney Clause In 1958, the Delaney Clause was included in the Food Additives Amendment to the Federal Food, Drug and Cosmetic Act. It stated that no food additive (including pesticides) could be considered safe if it were found to induce cancer when ingested by man or animal, i.e., a zero cancer risk standard.

The Delaney Clause required EPA to consider only a pesticide's risk and not to consider any offsetting benefits. It mandated a 'zero risk' standard, implying that no food additive is likely to offer benefits sufficient to outweigh any risk of cancer.

The 'zero-risk' standards of the Delaney Clause made carcinogenic additives illegal without regard to other characteristics of product use, such as other health risks or benefits.

In practice however, EPA decided to regulate all pesticide residues using criteria known as 'negligible risk' and to ignore the criteria for setting tolerances that require 'zero risk.' And, since EPA was not following the law, this policy was challenged in the courts. In July 1992, the EPA policy was overturned.

In 1996 when Congress passed the Food Quality Protection Act, the Delaney provision was thrown out and new ways of assessing risks and benefits were introduced.

Denomination class A nomenclatural device found only in the ICNCP. It is defined as a taxon, or a designated subdivision of a taxon, or a particular cultivar-group, within which cultivar epithets must be unique.

Desiccate To dry out, to dehydrate.

Determinate growth In botany, a type of growth habit. Plants having a bush like growth habit whose floral buds all appear in unison and whose foliage stops growing at tuberization. In potato, determinate growth is typical of early season varieties which stop producing new plant growth after tuber initiation. These varieties tend to have shorter plants with fewer flower clusters. Tubers set just above the seed piece. See also Indeterminate growth.

Diameter The diameter of a potato tuber is defined in the U.S. Standards for Grades of Potatoes as the greatest dimension at right angles to the longitudinal axis, without regard to the position of the stem end.

Diapause In biology: A period of inactivity or rest during which normal biological development is suspended in response to regular and recurring periods of adverse environmental conditions such as temperature extremes, drought or reduced food availability. It is a physiological state of dormancy with very specific initiating and inhibiting conditions.

Diapause is usually exhibited by insects. It is a 'sleep time' that is different from hibernation and stratification because the animals do not grow during this time. Diapause is a suspension of development that can occur at the embryonic, larval, pupal, or adult stage, depending on the species. Insect diapause is triggered by environmental cues, such as daylight or temperature or other stresses. Generally, speaking, diapause is a natural adaptation that allows organisms to survive predictable, unfavorable environmental conditions, such as temperature extremes, drought or reduced food availability.

The latter is often seen in temperate-zone insects, where diapause is induced by changes in the photoperiod (the relative lengths of day and night). The day length when 50% of the population has entered diapause is called the critical day length, and it is usually quite sudden. Insects entering diapuse when the day length falls below this threshold are called long-day insects. Those insects that develop normally when there are only a few hours of sunlight and that enter diapuse when exposed to longer days are called short-day insects. The critical day length is a genetically determined property.

Diapause is most often observed in arthropods, especially insects. Diapause is especially important in temperate zone insects that overwinter such as Colorado potato beetle.

Re. Colorado Potato Beetle: Although overwintered adults usually die during the second summer of their lives, up to 25% of the overwintering population may enter the second diapause.

***Dickeya* spp.** A genus of bacterium containing at least six species. These pathovars were recently raised by taxonomists to species level, one of which, *D. dianthicola* is an important pathogen of potato, i.e. blackleg.

In regard to blackleg, *Dickeya* spp. are epidemiologically different from *Pectobacterium* spp. in that they can start disease in potatoes from lower inoculum levels, are more aggressive, spread more readily through the plant's vascular tissue, and have higher optimal temperatures for disease development. *Dickeya* spp. also seem less able to survive in soil and other environments than *Pectobacterium* spp.

Dickeya dianthicola (formerly *Pectobacterium chrysanthemi* and before that *Erwinia chrysanthemi*) A pectolytic soft rot pathogen (bacterium) of potato. It causes blackleg, aerial stem rot and soft rot in potato. It is more aggressive and detrimental than *Pectobacterium* spp.

It was first identified in potato in The Netherlands in 1972 though it had been reported in ornamentals since the 1950s. It has been spreading across Europe since.

It was first reported in potatoes in the U.S. in Washington State in 1984, but until recently, reports of *Dickeya dianthicola* in the U.S. have been rare. But during the summer of 2015, numerous reports of an outbreak arose in Delaware, Florida, Pennsylvania, Minnesota, North Carolina, Ontario and Maryland, apparently spread by seed potatoes from Maine. By September 2015, it was being reported in North Dakota, Colorado and Idaho as causing aerial stem rot symptoms.

The American potato industry is now struggling to catch up with the Europeans on how to deal with this pathogen.

Blackleg caused by *D. dianthicola* is different from the typical *Pectobacterium* version. In 2015, potato growers in the eastern U.S., (NY (mostly Long Island), PA noticed significant blanking after planting, and rapid wilting of plants during the season, particularly after very hot weather soon after planting. Infected stems were not mushy, as typically observed with black leg, but were dry, black, and hollow. Tubers were macerated and had a tapioca-like appearance, but did not have the typical, pungent smell associated with *Pectobacterium*-derived black leg.

D. dianthicola can be latent in cool temperatures, but may grow rapidly in warmer temperatures.

D. dianthicola can only survive in the soil three months, but it can survive for more than a year on debris from corn — a common rotation crop with potatoes in the Mid-Atlantic — as well as on brassicas, the family of cruciferous vegetables and canola.

Dickeya solani A new bacterial soft rot bacterium of potato identified in Europe in 2004. It is more aggressive than *D. dianthicola.* As of 2015, it has not been reported in North America.

Diquat An agricultural chemical used to control a wide range of broad-leafed weeds. It is rainfast 30 minutes after application and has a pre-harvest interval of 7 days. It is commonly used as a vine killer for potatoes.

Disc harrow A tractor-drawn implement composed of circular plates arranged on an axle at an angle to the direction of travel. Most usually, there will be two pairs of disc axles arranged symmetrically about the longitudinal axis of travel direction and with the tandem axles at opposite angles to work the soil in two directions with each pass. A drag is commonly pulled behind to smooth the soil. It is used to prepare soil beds for seeding and to control weeds.

Disease An abnormal condition of a plant in which its physiology, morphology, and/or development is detrimentally altered under the continuous influence of a pathogen.

Disease resistance (tolerance) In plants, disease resistance is often defined as reduction of pathogen growth on or in the plant, while the term disease tolerance describes plants that exhibit less disease damage despite similar levels of pathogen growth. Disease outcome is determined by the three-way interaction of the pathogen, the plant, and the environmental conditions (an interaction known as the disease triangle). Defense-activating compounds can move cell-to-cell and systemically through the plant vascular system, but plants do not have circulating immune cells so most cell types in plants retain the capacity to express a broad suite of antimicrobial defenses. Although obvious *qualitative* differences in disease resistance can be observed when some plants are compared (allowing classification as "resistant" or "susceptible" after infection by the same pathogen strain at similar pathogen inoculum levels in similar environments), a gradation of *quantitative* differences in disease resistance is more typically observed between plant lines or genotypes. Plants are almost always resistant to certain pathogens but susceptible to other pathogens; resistance is usually pathogen species-specific or pathogen strain-specific.

Resistance is termed *durable* if it continues to be effective over multiple years of widespread use, but some resistance "breaks down" as pathogen populations evolve to overcome or escape the resistance. Resistance that is specific to certain races or strains of a pathogen species is often controlled by single R genes and can be less durable. Broad-spectrum resistance against an entire pathogen species is often quantitative and only incompletely effective, but more durable, and is often controlled by many genes that segregate in breeding populations.

In potato, a crop propagated by vegetative reproduction, the normal breeding for disease resistance is difficult because outcrossing to improve disease resistance or tolerance may seriously disrupt the highly desireable characteristics of the variety. Therefore, potato may be well suited for

transferral of genetic material such as DNA directly into plant cells or protoplasts to improve disease resistance. This genetic engineering has been tried in potato for resistance to PLRV and PVY as well as late blight.

Dish ring These were used by wealthy homeowners in early eighteenth century UK to protect their kitchen and dining furniture from heat generated when serving boiled or baked potatoes.

Around 1715 mahogany timber began appearing in the UK, being imported from San Domingo and Cuba. Those with means used it to make high-end furniture, replacing their French furniture and old Jacobean oak pieces. The making of mahogany furniture soon reached a very high level of craftsmanship which included a high polish to bring out the beauty of the grain in the mahogany. Oak furniture never required this; it meant that homeowners not only had to treat their furniture with new applications of polish material, but it also meant that they needed to avoid hot temperatures which would ruin the polish and the wood. Table cloths and mats did not serve the purpose.

Interestingly, the Irish who grew and ate more potatoes than anyone in the UK never had this problem. They were so poor that not only did they have no fancy furniture to protect, indeed, they had no furniture at all. They boiled their potatoes in a cauldron with minimal water, poured the tubers into a wicker basket called a 'skeehogue' with the remaining water going to ground, probably outside, they had no indoor plumbing, and served the potatoes on the wicker basket. They oftentimes had no plates or utensils.

Thus the potato ring (most of which seems to have been manufactured in Dublin between 1760 and 1808): for those with fancy furniture, they had made a ring of metal, usually silver and highly ornamented, several inches high, onto which their serving bowl of steaming hot potatoes could be served. The height or distance above the furniture created by this metal ring served to dissipate the heat of the potatoes before it reached the polished surface of the mahogany furniture, and all was well.

We do not know what happened after 1808. Did they simply get thicker placemats to protect their furniture?

See Potato ring.

Distribution of Color Distribution of skin color about the potato tuber (from Salaman). Skin pigment may be distributed evenly over the surface of the tuber, when it is spoken of as self-coloured, or it may be distributed at either pole of the tuber or irregularly splashed over the surface.

Salaman further differentiates the irregularity with two *quite distinct types of splashing*: One, in which the coloration involves and surrounds the eye, and the other in which it rigorously avoids the eye and is diffused over the intervening areas.

Dormancy A biological process in which a plant ceases most growth activities and simply maintains existing tissue. In the potato this extends to the tuber. Dormancy allows the plant (and in the case of the potato—the tuber) to over-winter, barring freezing conditions, and re-sprout in the spring, thereby reproducing and perpetuating the species.

At harvest, potato tubers are dormant. Scientists recognize three classes or types of dormancy: Endodormancy occurs after harvest and is due to the physiological status of the tuber. Even if tubers are placed in conditions favorable for sprouting, sprouts will not appear. As the period of storage is extended, tuber dormancy will break and sprout growth will commence. The loss of tuber dormancy and onset of sprout growth is accompanied by numerous biochemical changes, many of which are detrimental to the nutritional and processing qualities of potatoes.

Ecodormancy is when the normal dormancy is prevented or delayed by environmental conditions such as when potatoes are stored at low temperatures. The length of dormancy can be extended by 20 days to as many as 50 days by lowering the temperature from 48 °F to 42 °F.

Paradormancy is comparable to endodormancy, but the physiological signal for dormancy originates in a different area of the plant than where dormancy occurs. Some potato varieties have stronger paradormancy than others. Tubers with strong apical dominance, i.e., the apical meristem or dominant bud/eye impedes development of secondary buds or sprout development.

Conditions at harvest, vigor of the plant during the growing season, and how fast the potato crop was cooled down in the fall can greatly affect how long a potato will store without sprouting problems. Also, the longer a potato has been stored, the quicker it will sprout once warmed up if no sprout inhibitor has been applied. Sprout inhibitors prolong the storage dormancy period and work best if potatoes are kept cool. A small sprout can start in days to weeks once a tuber has been warmed above 60 °F. Storage tubers will keep about a week at room temperature and for several weeks at 45 to 50 °F. They will keep longer if from a new crop.

The physiology of dormancy remains unclear despite much recent research. It is believed that there are five major plant hormones involved. Abscisic acid and ethylene are involved in the induction of dormancy. Cytokinins are involved in dormancy break, and gibberellins and auxins are involved in sprout development.

Dormancy break The physiological point when a potato tuber ends dormancy and begins the sprouting process. The Cornell Potato Breeding Program has defined dormancy break as the length of time after harvest (in weeks) that half or more of a sample of ten tubers stored in the dark at room temperature has ¼" long sprouts. Typically, dormancy of a clone, advanced selection or a variety is expressed in weeks longer or shorter than the standard variety of the type being tested.

Drill In the UK, a row of planted vegetables or other crops. A vegetable crop planted rows or drills will typically be arranged with space between each row or a series of rows for wheeled implements or for worker access.

In crop science: A farm implement for planting seeds which forms a small furrow, deposits the seed in dribbles, covers the seed, and packs soil over it. It can also deposit fertilizer, lime or other amendments, as well as pesticides/herbicides into the soil, alone or with the seed.

Drought A longer than 'normal' period of dry weather. Drought is a normal, recurring feature of climate. It occurs almost everywhere. Meteorologists and hydrologists have their own precise definitions of drought. Meteorologists compare deficiencies in precipitation to normal levels when they speak of drought. Hydrologists consider stream flow and water levels in aquifers, lakes, and reservoirs along with precipitation. New York state uses elements of both disciplines to determine when a drought is occurring.

The New York State Drought Index compares five parameters to historic or "normal" values to evaluate drought conditions: stream flows, precipitation, lake and reservoir storage levels, and groundwater levels. New York's Drought Management Task Force uses those factors as well as water use, duration of the dry period, and season to assess drought in different parts of the state.

New York also uses the Palmer Drought Index, a measure of soil moisture computed by the National Weather Service. The two indices reveal different aspects of drought. The Palmer Index, with its emphasis on soil moisture, is useful in exploring agricultural impacts. The State Index helps assess the impact on human welfare and the regional economy.

Dry matter The amount of solids in a potato. Potato tubers generally contain about 80% water. The remainder, mostly starch, is called dry matter. See Specific gravity.

Dry rot Generally speaking, dry rot is a generic term referring to several potato diseases, including bacterial soft rot, Fusarium dry rot, and others.

Durable resistance TBD

Early blight *Alternaria solani*

Early dying syndrome The root-lesion nematode *Pratylenchus penetrans* can increase the incidence and severity of *Verticillium dahliae* infection, an interaction known as early dying syndrome. Genetic plant resistance is among the most promising and effective means of controlling losses due to *Verticillium*. The University of Minnesota, Michigan State University, University of North Dakota and the University of Wisconsin are conducting research on breeding resistance into commercial varieties.

Early Harvest In potato, 110 days after planting. See Late Harvest.

Eating potatoes In the U.S., those potatoes intended for direct consumption by consumers. In the potato business, these potatoes are referred to as fresh potatoes or tablestock potatoes.

Emergence In potato growing, this refers to the time between the planting of seed pieces until "plants" emerge from the soil. This can be affected by soil temperature, soil moisture and the health of the seed pieces, most notably the physiological age of the seed pieces. Other factors such as soil-borne and water-borne pathogens may also affect emergence.

Endosperm balance number Abbrev. EBN

Entomology The study of insects and their environments.

Epiphyte In botany, a plant which grows on another plant, but not parasitically.

Epithet, species epithet In taxonomy, the second (uncapitalized) word in the scientific name of a species, following the name of the genus. A complete species name consists of the name of the genus to which the species belongs, plus the specific epithet, plus the author of the species. This is sometimes referred to incorrectly as the 'species'.

The epithet, an adjective, often refers to a place, the plant's characteristics/appearance, or the name of the person credited with discovering it.

Erect In botany, the growth habit of a plant: the posture of a plant whose full-grown stems at the time of maximum growth assume a vertical or nearly vertical position

Erwinia Today, the bacterial genus *Erwinia* refers to original taxonomic classification of pectolytic and non-pectolytic species of Enterobacteriaceae. Since its creation in 1917, all species in this genus have been transferred to different genera at various times as new information was learned. Given its prominence in published literature over the past hundred years and since it is no longer used, one might be well-informed to know the history of *Erwinia* and its classification changes over the years to simplify searches of published literature.

The genus *Erwinia* was separated from Bacillus in 1917 to encompass all members of the Enterobacteriaceae that were pathogenic to plants, including both pectolytic (e.g. *Erwinia carotovora* and *E.chrysanthemi*) and non-pectolytic (*E. amylovora*) species. In 1984, *E. chrysanthemi* was subdivided into six pathovars: *chrysanthemi*, *dianthicola*, *dieffenbachia*, *paradisiaca*, *parthenii* and *zeae*, based on host specificity. Between 1987 and 1998, momentum grew to transfer the pectolytic erwiniae

into the genus, *Pectobacterium*, based on their biochemistry. The transfer to *Pectobacterium* was not made until 1999 after rDNA analysis had swayed the decision.

Later, further analysis of *Pectobacterium chrysanthemi* using 16S rDNA, DNA–DNA hybridization and biochemical characterization showed that it formed a distinct clade from the pectobacteria, and a new genus, *Dickeya*, was proposed (named after the eminent American microbiologist Robert S. Dickey). In 2005, *Pectobacterium chrysanthemi* was transferred to *Dickeya chrysanthemi.*

Erwinia chrysanthemi An old epithet referring to the original taxonomic classification of a bacterium, until recently, considered the pathogen responsible for bacterial soft rot, blackleg and aerial stem rot in potato. In 1984, *E. chrysanthemi* was subdivided into six pathovars: *chrysanthemi*, *dianthicola*, *dieffenbachia*, *paradisiaca*, *parthenii* and *zeae*, In 2005, these pathovars were reclassified into six species of the genus *Dickeya*: *D. paradisiaca, D. dianthicola, D. chrysanthemi, D. zeae, D. dieffenbachia, D. dadantii*.

Today, *E. chrysanthemi*, is considered a synonym for any or all of the abovementioned *Dickeya* spp. It is a confusing situation.

Erwinia carotovora* ssp. *carotovora (synonym of *Pectobacterium carotovorum* ssp. *carotovorum*) A bacterium, considered the primary pathogen responsible for bacterial soft rot in many crops, including potato. In 1999, it was reclassified as *Pectobacterium carotovorum* ssp. *carotovorum*.
See Bacterial Soft Rot. See *Pectobacterium carotovorum* ssp. carotovorum. See Blackleg

Ethnotaxonomy Traditional or so-called 'folk classifications' developed by indigenous peoples to recognize and organize plant information. These folk classifications, in most instances, recognize more distinctions than those captured by modern scientific botanical taxonomies, and they also indicate the high value traditional peoples put on maintaining crop species biodiversity as a strategy to reduce risk of total crop failures. As plant scientists improve their ability to understand the molecular biology, cytology, biochemistry, and genetics of the potato, the more they return to this traditional, natural source to collect ancient wild and cultivated types as well as cultural knowledge about plants and how to use them.

Ethylene a.k.a. Ethane ($H_2C = CH_2$), a coplanar molecule, being the simplest alkene or olefin (a nonaromatic hydrocarbon containing at least one double bond). Ethylene is flammable and is usually lighter than air; it exhibits a pleasant sweet faint odor and has a slightly sweet taste.

Ethylene can be produced by most organs of the higher plants, but production is highest in senescing tissues and ripening fruit. It production also increases during plant wounding and physiological stresses such as flooding and drought stress. Synthesis peaks during the day and is lowest at night. Ethylene was identified as a plant hormone by R. Gane in 1934.

Ethylene is sometimes used to promote bud sprouting in potatoes and other tubers.

Evapotranspiration The loss of soil moisture due to evaporation from the soil surface and transpiration by plants.

Exotherm A chemical or biological reaction that gives off more heat than was required to execute the reaction.

Exotic potatoes See specialty potatoes.

Explant In botany: An *in-vitro* potato plant or plantlet produced by rooting an excised tip of a tuber sprout or an axillary bud from a growing plant which shall serve as a parent for a whole clone or accession of micropropagated plants or plantlets.

Extinct variety A potato variety or cultivar no longer grown anywhere in the world and whose genetic basis is not stored in any seed bank or genebank. These varieties are lost to history and cannot be recovered because their parentage is unknown. See Genebank.

Extract A concentrated or purified substance obtained by first using a solvent, such as water, detergent or buffer, to dissolve this substance when present in a mixture or in cells and then separating the substance from the solvent and the original mixture or cells by centrifugation, filtration, evaporation or other method.

Eyes A collection of several buds on the surface of a potato tuber, one of which will sprout and form a new stem when conditions are favorable. Tuber eyes are the buds from which next season's growth will emerge. Eyes are concentrated near the apical end of the tuber with fewer near the stolon or basal end. Eye number and distribution are characteristic of the variety. The buds (eyes) are found in a spiral pattern on the tuber. The eyes tend to be concentrated at the seed or apical end of the tuber. They are fewer in number and farther apart toward the stem end where the tuber is attached to the stolon.

The buds (eyes) of the seed end possess apical dominance and will normally sprout first, a condition characteristic of buds at or near the apex of all conventional stems. When the apical buds are removed, or die, other buds are stimulated to sprout in the same manner as lateral buds on a woody stem are stimulated to sprout when the "leader" is removed. When whole tubers are planted, generally the buds near the apex will develop. The effect of apical dominance is reduced if a large tuber is cut into smaller seed pieces. There is a noticeable difference in the rate of emergence between stem-end and seed-end sprouts.

Fairly clean A term used in the U.S. Standards for Grades of Potato. In this context "fairly clean" means that at least 90 percent of the potatoes in any lot are reasonably free from dirt or staining and not more than a slight amount of loose dirt or foreign matter is present in the container.

Farmer In New York State, farmer shall mean any person, organization, entity, association, partnership, limited liability company, or corporation engaged in the business of agriculture, whether for profit or otherwise, including the cultivation of land, the raising of crops, or the raising of livestock.

Farmland In New York State, farmland means land used in agricultural production, as defined in subdivision four of section 301 of Art. 25AA of the State Agriculture and Markets Law.

Fertilization Developing healthy potato plants necessary for maximum tuber growth requires that all essential nutrients be supplied at optimal rates. Both deficit and excess fertilizer situations can reduce tuber bulking rates. Nutrient deficiencies limit canopy growth and shorten canopy duration resulting in reduced carbohydrate production and tuber growth rates. Excessive fertilizer applications can cause nutrient imbalances that delay or slow tuber growth rates.

Festkochend German for ‘waxy’. These are potatoes with a low starch content, which hold up well after cooking. They are good for salads, salt potatoes, fried potatoes, and casseroles and soups

Field For seed potatoes: An identifiable area of land on which seed potatoes of a particular variety and class are planted or have been produced.

Filtrate Liquid from a whole culture that has passed through a membrane or a filtering medium.

Fingerling potato Any of many specialty potato varieties named for their finger-like shape. Fingerlings can be prepared like other potatoes; mashed, baked, roasted, grilled, or boiled. They are best enjoyed with mild seasonings to appreciate their subtle flavors. One might cook them with skins on to avoid the difficulty of peeling them.

Depending on the variety, they can be dry and mealy, or moist and waxy. They come in all the standard colors: red, white, yellow, blue. Size varies. Most are perhaps 1 to 2 inches long and 2 to 3 inches long. The Austrian Crescent variety is up to 10 inches long.

Firm Descriptive term for potato tubers that are not shriveled or soft (flabby).

Flavonoids Flavonoids are a subclass of plant polyphenols (low molecular weight phenylbenzopyrones) common to most flowering plants (both flowers and foliage). Over 4,000 flavonoid compounds have been characterized and divided into five chemical subgroups: flavonols, flavones, flavanones, flavan-3-ols, anthocyanidins. Many medicinal effects of foods, juices, herbs are related to their flavonoid content. Flavonoids have powerful antioxidant abilities and are being studied for their anti-cancer potential.

All potatoes contain flavonoids, predominated by compounds called catechin and epicatechin. White-fleshed varieties contain up to 30 μg/100 g FW, while red- and purple-fleshed varieties have twice as much.

Flavonoid concentrations (anthocyanins) in potatoes are not destroyed by cooking or processing. Indeed there is evidence that food preparation can even increase the concentration and the antioxidant activity.

Flavor A complex characteristic of cooked potato tubers including taste, aroma and texture. Potato flavor is exceedingly difficult to evaluate, let alone describe. Recent research has determined that potato flavor is milti-gene dependent making it very difficult to quantify.

It has long been known that potato flavor varies widely among cultivars, indicating that genetic variation exists. Furthermore, it has been equally long-recognized that flavor is influenced by the production environment, the length and temperature of post-harvest storage and the method of cooking. One can only conclude that this is a complicated matter if there ever was one.

Traditionally, for at least two hundred years, potato breeders ignored flavor altogether except to avoid ‘off-flavor’ cultivars (which would never sell in the marketplace anyway) and growers focused their offerings upon those varieties that would sell in the marketplace regardless of flavor. One must therefore conclude that potato flavor has received short shrift in the grand scheme of things. While that may have been the right thing to do during the nineteenth and twentieth centuries when yield, production quality and disease resistance traits were paramount, it may finally be changing in the twenty-first century.

In recent years, potato breeders at USDA and in New York State (Cornell University) have recognized that marketplace demands are beginning to require a better tasting potato. They have released several varieties which not only meet or at least come close to the traditional yield, production quality and disease resistance requirements, but

which also taste good. See cultivars such as Adirondack Blue, Adirondack Red, Peter Wilcox.

Flavor can be analyzed using sensory evaluations or by biochemical analyses neither of which (not surprisingly) yield definitive results useful to consumers. Sensory evaluations can be (and usually are) skewed by biases of personal and cultural preferences; biochemical analyses are statistical comparisons of more than 420 volatile compounds and several non-volatile compounds associated with potato flavor, none of which mean anything to consumers or potato connoisseurs.

Sensory evaluations, as subjective as they are, can be made useful if one recognizes that humans can only discern salt, sweet, sour, and bitter. On this basis, many sensory evaluations have been designed using the following criteria: mealiness (a measure of texture), sweetness, overall potato flavor intensity (a measure of the flavor 'perceived' as "potato", off-flavor, and overall acceptability.

As everyone knows, potatoes have a very subtle flavor, some call it neutral, so much so that one might even wonder why one would think about such a thing as the flavor of a potato. Of course this subtlety is both the great advantage and the disadvantage of potatoes. This subtleness makes the potato compatible with and complimentary to myriad other foods as well as making it extremely versatile by itself. Yet at the same time, it tends to make consumers think they are all the same and that there is no reason to shop around for specific potatoes for specific purposes. Nothing could be farther from the truth.

To make matters worse, consumers have little knowledge to guide them (accurate information about potatoes is difficult to obtain from any source whether it be for cooking or for growing). U.S. grocery stores do not inform consumers of the difference between potato varieties. In fact, they do not differentiate between varieties, and more so, they do not even tell consumers that there are varieties, so how could a consumer even know? Because of the dearth of information in the marketplace about varieties, the whole issue has been dumbed-down to three things: baking potatoes, boiling potatoes and all other potatoes (called general-purpose potatoes), and consumers are told to use russets for the first, round whites or reds for the second, and are left pretty much on their own for the others.

Generally speaking, the 'dumbed-down' situation in the U.S comes down to this: There are three kinds of potatoes: Dry, mealy potatoes: This amounts to Russet Burbank and its progeny, Shepody, Russet Norkotah and Ranger Russet. These varieties are essentially baking potatoes, but some of which are also suitable for frozen french fries and mashing and each of which has been approved by McDonalds for use as frozen french fries.

At least some researchers have recognized the value of combining sensory evaluations with biochemical analyses. That is, they would start with a sensory evaluation of multiple cultivars and using the results of that initial study, they would evaluate those tubers using biochemical analyses in an attempt to correlate the sensory with the biochemical results. Surprisingly, this is state-of-the-art 2010.

Florida test

An integral step in the seed potato certification process in New York state. Seed growers seeking certification must submit one or more representative samples from each seed lot or from each field for planting in the Florida test plot to test for accumulation of virus and viroid diseases. Florida test results shall show a total less than five percent virus (mosaics, leaf roll, other virus) and spindle tuber viroid as well as 0.25 percent varietal mixture and zero percent bacterial ring rot for certified seed. For Foundation Seed, the results shall be less than 0.5 percent of the above viruses and viroids and the same tolerances for bacterial ring rot and varietal mixture. Tags for foundation seed cannot be issued until winter test results are available at the end of January each year.

As of 2016, NYS (NYSIP) winter tests will be conducted in Hawaii. **See Winter test**.

Floury potatoes In the UK, same as U.S. term, mealy. Floury is a term commonly used to refer to the texture of the cooked flesh of a potato. It is a potato type rather than a variety. Floury potatoes are typically used for baking, mashing and deep-frying as they have a soft, dry texture when cooked. The tubers often burst spontaneously and on application of a fork break to pieces and crumble. The exposed flesh often glitters in the light. They are not preferred for boiling because they tend to disintegrate. Popular varieties of floury potato include King Edward and Maris Piper. See Mealy.

Flush-Through Production System For seed potatoes: A system of production in which seed material is allowed to remain in the system only for a limited number of generations. Most flush-through systems use the following nomenclature: Prenuclear, Nuclear, Generation 1, Generation 2, Generation 3, Generation 4 and Generation 5; where Prenuclear is laboratory production. Nuclear is greenhouse production and Generations 1-5 are the first and subsequent field increases.

Foil-wrapping Many ill-informed chefs and cooks wrap their potatoes in aluminum foil for baking. This is a bad idea if one wants a real 'baked' potato, noted for its relatively dry fluffiness. It is only a good idea if one wants a soggy 'steamed' potato. The problem is that aluminum foil retains the moisture exuded from the potato as it is cooking in the oven and will end up 'steaming' the flesh. One ends up with a soggy 'steamed' potato.

The skin of the potato was designed by Mother Nature as the perfect material for its existence from its life underground to its life above ground in storage and to its life as a food for humans and animals. The skin is designed to exude moisture as the ambient temperature increases in order to preserve its integrity sufficiently to produce a new generation the next Spring when it wants to grow the next generation.

This is a good thing when Mother Nature is preserving the tuber to last until the next Spring so it can set sprouts and grow a new crop of potatoes. It is not necessarily a good thing when humans put these tubers in the oven to bake them for human consumption. In the absence of aluminum foil, the tuber not realizing it is in the oven will exude moisture trying to preserve itself until Spring in order to grow the next generation. All of this moisture hits the aluminum foil and cannot 'get away'. Moisture content inside the aluminum foil builds up and begins 'steaming' the tuber flesh. This is a different process than 'baking' the tuber flesh. It results in a quite different final product. (Personally, I will not eat a potato baked in aluminum foil—it is not a 'baked' potato, but a soggy 'steamed' potato, not worth putting in my mouth.)

According to the immutable laws of thermodynamics and heat transfer, a potato tuber wrapped in aluminum foil will at some point become saturated with moisture and it will become soggy. If left to its own devices, without aluminum foil, the moisture would escape into the oven, the tuber would dry out to the point that its skin would become impervious to moisture transport and thusly lock in a certain amount of moisture making the tuber flesh quite delectable and tasty. Aluminum foil messes up the normal scheme of things.

If one wants to wrap one's 'baked' potatoes in aluminum foil, please do so "after" the baking is done. This will have a far better chance of preserving the 'baked' characteristics of one's baked potatoes and it will preserve its heat content

Food desert

In the U.S., food deserts are defined by the federal government as areas in which at least a third of the residents do not own cars and live more than a mile from a large grocery store. They are also designated by a lack of access to fresh fruit, vegetables and other healthy whole foods. The areas are defined to have a poverty rate of 20 percent, or higher, or family income 80 percent below the area's median income.

Food deserts are served primarily by small stores that sell sugar- and fat-laden foods that are a big part of the obesity epidemic, according to the U.S. Department of Agriculture. More than 8 million people in the U.S. live in such areas and lack food security. A high percentage are children.

Food miles

A phrase referring to the distance food travels from where it is grown to where it is purchased or consumed by the end user. Food miles have become part of the vernacular among certain food system professionals to describe farm-to-consumer pathways of food. Food miles first gained importance in the U.K. as a simple indicator of the environmental, economic, and social consequences of food production for consumers. It is gathering cache among 'informed' consumers in other industrialized countries. In the U.S., it is only recently (2007) being used in 'buy-local' programs as a way to reduce greenhouse gas emissions.

Many statistics citing food miles are based upon Weighted Average Source Distance (WASD). This calculation combines information on the distances from production points to points of sale and the amount (weight) of food product transported. Using this protocol with potatoes, the comparison of 'local' versus 'conventional' sources is remarkable. In a study conducted in Iowa in 2001, locally produced potatoes traveled only 75 miles, while those obtained from 'conventional' sources traveled 1,155 miles. In 1969, one national U.S. estimate of food miles traveled cited an average distance of 1,346 miles. In 1980 another survey by John Hendrickson noted that fresh produce traveled 1500 miles.

Consumers should not necessarily use 'food miles' alone as rote convention when deciding what to buy. Food miles are merely a distance calculation. It does not account for cost, nor does it reflect quality, freshness, flavor or taste. Neither does it account for greenhouse gas emissions created during transport from farm to table. Rigorously considered buying decisions will factor in these and other considerations such as purposeful support of local farmers and the local economy.

It is perhaps unnecessary to point out that cost is usually the first consideration in buying decisions. The relationship between food miles and cost is complex and not necessarily intuitive. The price of fuel will almost always be dwarfed by cost of labor, economies of scale and large investments in specialized production and handling equipment. Furthermore, the cost of fuel is more a function of the type of transport than it is of distance. Comparing cost per mile of a ship-load of bananas travelling 1,500 miles versus a small truck traveling 100 miles will be enlightening. Large-scale specialized operations located far away will generally be able to sell at lower prices than small, family-run operations located close by. This is commonly referred to as supply chain efficiency. This is not meant to demean food miles, but only to point out that supply chain efficiency is a complex matter not fully represented by food miles.

More sophisticated algorithms have been developed to factor in some of these considerations. Some food-mile algorithms include consideration of greenhouse gas emissions. This is sometimes called Weighted Average Emission Ratio (WAER). A few algorithms attempt to account for weight carried during transport in the calculation, i.e. comparing the efficiency of a ship to a tractor trailer to a small box

truck or a pick-up truck. Still fewer attempt to account for total energy efficiency of the entire supply chain. Some have pointed out that no algorithm includes the effect of the 'local loop' where one might drive one's personal car 12 miles to a local farm. The food-mile calculation would result in a very low number, but the effect on the environment may be worse than going to the nearby supermarket.

Unfortunately, even in the supermarket, it is difficult for consumers to make informed choices. Labeling on produce can be misleading, vague, or lacking entirely. Fresh produce is often sold 'loose' with no labels. Some is sold, legally, under a packer's label but with no indication of where it was grown. Federal requirements for mandatory 'Country of Origin Labeling', known as COOL, were made law in 2002, but have never been implemented because of intense lobbying by corporate agribusiness, supermarket chains, and strong US trading, partners such as Canada, Mexico, and Australia. Even when the growers name and address are on the packaging, one still does not know how long since it was harvested.

The U.K. has begin using 'carbon' labels on many products to advise consumers of the greenhouse gas emission factor. The U.S. is years away from such labels.

Foundation seed In New York state, foundation seed is the highest quality potato seed available. Foundation class seed meets stricter tolerance requirements than certified (see Florida tests, i.e. Winter tests) and is used primarily by potato breeders to grow their newest varieties to such volume that they could be grown by commercial growers via seed growers to plant certified seed acreages and by those growers desiring the highest seed quality. Among other requirements, growers applying for foundation certification must enter their entire potato acreage into the certification program, must pass the Florida tests for foundation seed, and must be free of bacterial ring rot for at least two consecutive years.

All foundation seed in New York state is limited generation certified. All sources of foundation seed must originate from pathogen-tested, tissue culture sources.

Fresh market Potatoes that are grown and sold for direct consumption without processing of any kind. See Tablestock.

Frost-injury (Freezing), a.k.a. Low temperature injury Surprisingly, despite the potato having been cultivated for hundreds of years, scientific research on the conditions required to freeze a potato tuber in soil has been conducted only since about 2001. Farmers and gardeners have long been cognizant of the fact that potato tubers are susceptible to frost damage at low temperatures. Yet it is equally clear that the precise temperatures and conditions under which frost damage occurs in potato tubers buried in soil is very complex and not fully understood. Farmers and gardeners alike have been amazed the survivability of tubers under extremely cold conditions and at other times the complete failure of tubers to survive what seemed like survivable conditions.

Everything in the field or garden is a factor affecting how much frost damage will occur to tubers still in the field freezing air temperatures: Soil type, soil moisture, thickness of soil cover, i.e. depth of tuber set and effectiveness of hilling, vegetation cover (potato vines or weeds), amount of organic matter in soil, snow cover, length of time at freezing air temperatures, length of time at freezing soil temperatures, protection from wind (or lack thereof), sky conditions (radiational cooling), and probably tuber variety. Each of these have significant effects on the rate of heat transfer from the soil and thusly affect the soil temperature at tuber depth—the real issue. It is essentially impossible to create these real-life conditions in the laboratory. It is therefore no surprise that this has not been studied rigorously until recently.

Nonetheless, it has been determined that potato tuber flesh freezes at temperatures ranging from 29.5 °F to 28.6 °F. Below about 27 °F, extensive tuber mortality occurs. Yet, as amazing as it seems, even this is not a sure thing. It has been shown that potato tubers can be supercooled to about 19.5 °F without freezing so long as they are not jarred or handled in any way until they warm up.

A long-standing potato grower's rule of thumb says to leave potatoes in the field undisturbed so long as the soil is frozen. Touch a supercooled potato, it will instantly freeze and die. Leave it alone, it may warm up and survive. In some ways, science is still catching up with the every-day knowledge of old-time potato growers.

It is well documented that potato tubers are approximately 80% water which is contained both within cells, i.e. cellular (intracellular), and between cells (extracellular). A tuber is usually killed when the water within the cells (intracellular) freezes for more than a few hours. For freezing of water to occur (change from liquid to solid state), heat must liberated from the liquid (an exothermic process, referred to as an exotherm) at the rate of the latent heat of fusion (144 Btu/lb for pure water; potato tissue is probably a different number but still close to this). During this 'freezing process' the temperature of the water will remain at 32 °F. The temperature cannot fall below this until all liquid has been transformed into solid (ice), i.e. the completion of the phase change.

The temperature at which an exotherm occurs is referred to as the nucleation temperature, and the stabilization of temperature following an exotherm represents the actual freezing point of the tissue.

Most living organisms including potatoes (plants) have cryoprotectants (anti-nucleating proteins, polyols and glucose) to protect themselves against damage by sharp ice crystals. Most plants can safely reach temperature of -4 C to -12 C without undue damage. Some landrace and wild species of potatoes (plants) are quite resistant to freezing.

The physics behind the freezing a potato tuber is interesting, at least to a thermodynamicist and probably to a botanist, because of the non-homogeneity of potato tissue which consists of both cellular and intracellular tissues which behave quite differently thermodynamically. The net result is a homeostatic process intended to extend the life and the survivability of the potato tuber until the next spring when it can grow a new plant and new tubers and continue its heritage into the next season.

The onset of ice formation in a potato tuber is initially limited to extracellular ice formation which releases the latent heat of fusion causing the temperature to rise temporarily (though still remaining below freezing). The formation of extracellular ice draws water from inside the cells and during prolonged freezing periods will lead to intracellular dehydration. Eventually, as the temperature continues to fall (or the time below freezing becomes prolonged), intracellular freezing commensurate with the release the latent heat of fusion will occur and the tuber will become lethally 'frozen'. This is a homeostatic process which even though it leads to intracellular dehydration and increased intracellular osmolarity from hyperconcentrated solutes is intended to preserve life (homeostasis). Its purpose which it does quite well does indeed significantly delay intracellular freezing, and hence delays the 'death' of the tuber. To be precise, while intracellular freezing is not itself lethal to the tuber, intracellular dehydration usually is.

Therefore the things to understanding frost damage or low-temperature damage to potato tubers is crucial for preserving tubers in late-season harvest and for elimination of volunteers in subsequent seasons.

Tubers or portions of tubers that have been frozen at temperatures below 29° F are soft and watery. Frozen tissues tend to disintegrate and will eventually dry out. Symptoms of chilling and freezing can, but do not always, occur in the same tuber. Do not dig if a frozen crust is present on the ground. After a hard frost, discard any green tubers.

Recent research shows that the key to storing potatoes with field frost damage is to promote formation of a closing layer at the boundary of healthy and dead tissue within the tuber. This is best accomplished by maintaining a pile temperature of 50 °F for two weeks before lowering the temperature to normal storage temperatures. During this two-week period, if one has CO_2 control on the ventilation system, set the maximum threshold at 1500 ppm to ensure abundant fresh air into the pile. The bottom line: put a lot of ventilation air on them to dry the tubers, but do not over-do it.

Fry color The U.S. (North American) industry-established color of potato chips. The USDA has published a chip color chart with seven grades: 000 – 00 – 0 for light-colored chips and 1 – 2 – 3 – 4 for dark-colored chips (000 = ultra light, 4 = very dark). Potato varieties suitable for chipping will result in a 'golden' or possibly a 'light' chip, i.e. USDA 0 or 1 with an occasional 'dark golden' (USDA 2) chip. Ideally, according to this standard, potato chips should be statistically uniform in color.

Frühkartoffeln German for 'new potato", but can be considered any one of the three types of cooking potatoes. They are harvested while immature, that is without curing the skin for storage. They are considered a great delicacy in Germany, served boiled in their jackets with butter and dill. See also **New Potatoes**.

Functional foods Foods that provide health benefits above and beyond basic nutrition. While basic nutrition has traditionally focused on those essential nutrients required for normal growth and development, functional foods provide secondary benefits from phytonutrients found in plants.

There are three types of functional foods: 1. Those products that naturally contain a beneficial bioactive phytonutrient, e.g. Welch grape juice or Cheerios (bioflavinoids and whole grains, respectively). 2. Those products "fortified" with a beneficial bioactive compound, e.g. Tropicana Pure Premium orange juice with added calcium. 3. Those products that have been developed or engineered for bioactive benefit, e.g. Gatorade and Red Bull beverages.

While all foods are functional at some physiological level, it is the position of the American Dietetic Association that 'functional foods', including whole foods and fortified, enriched, or enhanced foods, are those which have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis, <u>at effective levels.</u>

Knowledge of the roles of physiologically active food components, from phytochemicals, phytonutrients and zoochemicals, has changed the role of diet in health. Functional foods have evolved into a real asset as food and nutrition-science has advanced beyond the treatment of deficiency syndromes to the reduction of disease risk.

Foods can no longer be evaluated only in terms of macronutrient and micronutrient content alone. The availability of health-promoting functional foods in the US diet has the potential to help ensure a healthier population. However, each functional food should be evaluated on the basis of scientific evidence to ensure appropriate integration into a varied diet.

Fungible In law, freely exchangeable for or replaceable by another of like nature or kind in the satisfaction of an obligation; something that is exchangeable or substitutable, designating goods, such as grain, any unit or part of which can replace another unit, as in discharging a debt; capable of being used in place of another.

Generally speaking, harvested potatoes are personalty (as opposed to realty) and are considered fungible goods, the exception being small volume specialty and heirloom varieties traded by growers to knowledgeable buyers and markets. It has been argued that

potatoes still in the field are not fungible goods, but 'specific crops' as long as they are growing or to be grown.

Fungus (pl. fungi) A multicellular lower plant lacking chlorophyll, such as mold, mildew, smut, or rust, that lives on nutrients it draws from other organisms. Fungi are either parasites or saprophytes. The fungus body normally consists of filamentous strands called mycelium and reproduces through dispersal of spores.

Fusarium A fungus (actually, several fungal species: *F. solani*, *F. sambucinum*, *F. avenaceum*, *F. culmorum*, *F. oxysporum*) which exists in nearly all soils and will consequently be present on the surface of nearly all potato tubers. *F. sambucinum* would seem to be the most wide-spread, while *F. solani* would seem to be the most aggressive.

This fungus (fungi) will result in rotting of potato tubers, if entry to the flesh is allowed through defects in the skin of the tuber. All *Fusarium* infections will result in a dry-rot of the tuber. Consequently, it is important to minimize bruising and defects to the skin of tubers during handling. Soft-rot or moist-rot of potato tubers will also occur if bacteria invade the tuber via the surface defects.

Fusarium dry rot An important post harvest disease of potato tubers that causes significant losses in storage and transit of both seed tubers and those for table consumption. It is also a major cause of seed-piece decay after planting.

Fusarium dry rot is caused by several species of the soil borne fungus *Fusarium*. In the Northeast, the most important is *F. sambucinum*, followed by *F. solani*. These fungi are common in most soils where potatoes are grown and survive as resistant spores free in the soil or within decayed plant tissues. Although some infections may develop on tubers before harvest, most infections occur as the fungus enters tubers through harvest wounds. Small, brown lesions appear at wound sites 3-4 weeks after harvest and continue to enlarge during storage, taking several months to develop fully. The disease develops fairly rapidly at temperatures above 50 °F, but lesions will cease enlarging below 40 °F. The fungus is only dormant at these low temperatures, however, and will resume growth when tubers are warmed.

In 2003-04 investigators discovered severe dry rot caused by *Fusarium graminearum* in a commercial processing storage in North Dakota. These results have epidemiological implications in the persistence, spread, and management of *F. graminearum* in cereals and potatoes because potatoes are often used in rotation with other hosts of *F. graminearum*, including wheat, barley, oats, rye, and corn

Fusarium wilt A vascular wilt disease in potatoes caused by the fungi *Fusarium eumartii*, *F. oxysporum*, *F. avenaceum*, and *F. solani*. All of these fungi live in the soil. They are capable of living saprophytically, in the absence of a host plant, and usually persist for many years. They are quite specific to potatoes, so there are no alternate hosts for the Fusarium wilt diseases.

FW Abbrev.: Fresh weight. In biochemical testing (bio-assays), this is the weight of a fresh vegetable or fruit sample (as opposed to a dried or dehydrated sample, i.e. powder). For potatoes, the standard is 100 g FW.

Garden variety In Canada: A potato variety which has been specifically exempted from registration or for which registration has been cancelled because of minimal production and exclusively intended for personal consumption by home gardeners. Production of a garden variety is limited to 1 hectare (2.47 acres) per seed potato farm unit and prohibits sale to table and

processing markets. Garden varieties are exclusively intended for personal consumption by home gardeners.

Garden varieties often have limited commercial production potential and value, but are of great interest to home gardeners. By including garden varieties in the seed certification program, disease-free seed tubers are available for backyard gardeners and protects commercial growers by eliminating these crops as a source of inoculum for potato disease.

On-farm or garden-center sale of certified seed of garden-variety potatoes is restricted to containers of 10 lbs or less.

Any grower whose total production of a garden variety exceeds 1 hectare (2.47 acres) will be considered a commercial crop and be subject to registration requirements.

Genome The genetic information for an organism, consisting (in the case of viruses) of one or more species of either RNA or DNA, but not both

Genotype The genetic constitution of an organism.

Genebank A place where samples of genetic diversity are stored, along with identifying information about them. Genebanks safeguard genetic diversity, which is vital to global food security. Such samples may be stored in very cold, low-humidity places in order to keep them viable for long periods of time, or they may be continuously grown out and replaced.

The United States Potato Genebank is located at Sturgeon Bay, Wisconsin. It currently holds more than 4300 germplasm accessions representing 146 species of *Solanum*.

The International Potato Center (CIP), Lima, Peru, has the largest genebank of potato and sweet potato in the world. This collection, featuring thousands of samples of cultivated and wild potatoes, allows the CIP to help produce better adapted and higher yielding pest and disease resistant potato varieties.

Genus In taxonomy, the rank above epithet (species) and below family; the generic name of an organism listed first in the binomial nomenclature. It refers to a group of species of plants that share certain structural characteristics as determined by botanical study. The genus name, a noun, may come from mythology, literature, or other sources which refer to something the plant resembles.

German potato salad Hot potato salad, usually made with bacon, onion, and vinegar dressing, was associated with German immigrants and therefore often called "German potato salad." Interestingly, during World Wars I and II, German style potato salads were called ‘hot potato salad.’

Germplasm A collective term for genetic stocks. As with many of the terms used with biodiversity research, germplasm means different things to different people. By one definition, it is all the seeds, plants and plant parts. By another, it is only those parts that are useful in breeding more organisms. Agricultural scientists may think of germplasm as seeds and plants that are useful in breeding new cultivars. Some characterize germplasm as the total amount of genetic diversity within a given group.

Germplasm type In taxonomy, within the category of germplasm, there are at least four types of germplasm: Cultivated, Wild, Weed, Undermined.

Globodera pallida One of the two Potato cyst nematode (PCN) species. Common name: White potato cyst nematode, Pale potato cyst nematode, Nématode blanc de la pomme de terre, Wit

aardappelcysteaaltje. Synonyms: *Heterodera pallida, Heterodera rostochiensis* Wollenweber *in partim.* See Potato cyst nematode.

Globodera pallida is currently found throughout Europe, in Cyprus, India, Pakistan, Algeria, Tunisia, Panama, the high Andean region of South America (Bolivia, Chile, Ecuador, Peru and Venezuela), and New Zealand. In North America it was limited to Newfoundland, Canada, until April 2006, when it was reported in Idaho, USA.

Globodera rostochiensis One of the two Potato cyst nematode (PCN) species. Common name: Yellow potato cyst nematode, Golden potato cyst nematode, Golden nematode, Nématode doré de la pomme de terre, Kartoffelnematode, Nemátodo dorado, Geel aardappelcysteaaltje. Synonyms: *Heterodera rostochiensis* Wollenweber. See Potato cyst nematode.

Globodera rostochiensis is currently found throughout Europe, Asia, parts of Africa, Costa Rica, Panama, the high Andean region of South America (Argentia, Boliva, Brazil, Chile, Colombia, Ecuador, Peru, Venezuela), Australia, New Zealand. In North America, it is limited to Newfoundland and Vancouver Island, Canada, and New York state. (It has apparently been eradicated in Delaware.)

Need to add new information on Ro1 and Ro2, no potato varieties resistant to Ro2. Transgenic potatoes and loss of resistance.

In New York state, Golden nematode (*Globodera rostochiensis*) is a quarantined pest. There, it is required that only non-host crops or golden nematode resistant potato varieties can grow on land where golden nematode is known.

Glufosinate-ammonium An agricultural chemical used most often as a desiccant. It is gaining popularity among potato growers for vine kill. It is rainfast within 4 hours of application, has a re-entry period of 12 hours and a PHI of 9 days.

Glycemic index The glycemic index (GI) is a numerical ranking of carbohydrate-containing foods based on their potential to raise blood sugar levels. High-GI foods are quickly digested and absorbed, producing a rapid rise in blood sugar and insulin levels. Low-GI foods, on the other hand, are slowly digested and absorbed, producing a smaller, more gradual rise in blood sugar and insulin levels. The glycemic index (GI) is a numerical system of measuring how much of a rise in circulating blood sugar a carbohydrate triggers–the higher the number, the greater the blood sugar response. So a low GI food will cause a small rise, while a high GI food will trigger a dramatic spike. A GI of 70 or more is high, a GI of 56 to 69 is medium, and a GI of 55 or less is low.

It was originally developed as a dietary strategy to help people with diabetes gain better control over their blood sugar levels. Today the GI is an accepted part of medical nutrition therapy in Canada, Australia, and much of Europe and its use has expanded to include roles in treating obesity, cardiovascular disease, and various other health problems.

The GI of a food is influenced by a variety of factors including the degree to which a food is processed; how long the food is cooked; the kind of starch, sugar, or fiber the food contains; and the foods acidity. In general, anything that speeds the rate at which a food is digested and absorbed will raise its glycemic index.

The glycemic index tells you how quickly a carbohydrate-containing food turns into sugar, but it doesn't tell you how much carbohydrate is in a serving of a food.

In potato, the GI varies widely, ranging from moderate to very high, even within the same variety. This can be very confusing for consumers who often have no way to know what variety they are buying.

New potatoes have a GI of 57.

Glycemic load A relatively new way to assess the impact of carbohydrate consumption that takes the glycemic index into account, but gives a fuller picture than does glycemic index alone. A GI value tells you only how rapidly a particular

carbohydrate turns into sugar. It doesn't tell you how much of that carbohydrate is in a serving of a particular food. You need to know both things to understand a food's effect on blood sugar. That is where glycemic load comes in. The carbohydrate in watermelon, for example, has a high GI. But there isn't a lot of it, so watermelon's glycemic load is relatively low. A GL of 20 or more is high, a GL of 11 to 19 inclusive is medium, and a GL of 10 or less is low.

This assumption turned out to be too simplistic since the blood glucose (glycemic) response to “complex” carbohydrates has been found to vary considerably. A more accurate indicator of the relative glycemic response to dietary carbohydrates should be glycemic load, which incorporates the relative quality of carbohydrates characterized by glycemic index.

What’s more, *there are inconsistencies in how the glycemic index is calculated*. And some experts say that because the glycemic index is based on such a small quantity of food (50 grams) — less than the amount you’d typically eat — it understates the impact high-carb foods have on your blood sugar, while overstating the impact of low-carb foods.

(GL) and recommend that it be used as a dietary guide instead of the glycemic index because it accounts for the amount of food you are consuming as well as the way you combine your foods.

A food with a low glycemic index may have a high carbohydrate content or vice versa; this can be accounted for with the glycemic load.

Foods that have a low GL almost always have a low GI. Foods with an intermediate or high GL range from very low to very high GI.
New potatoes have a GL of 12.

Preparation	Glycemic Inde = 100)	Serving size, g.	Glycemic lo serving
Baked potato, white with skin	69 +/- 5	150	19

Glycoalkaloids

A class of naturally occurring chemical compounds found in potato plant foliage and the skin of the tubers. The major glycoalkaloids are: α-solanine, α-chaconine, β_2-chaconine, solandine, and caffeine. In potatoes these compounds have antimicrobial and anti-pest properties, and at elevated concentrations they can give rise to off-flavors or burning sensations in cooked potatoes. Collectively this class of compounds is referred to as total glycoalkaloids (TGA).

Ingestion of high amounts of TGA can cause illness: headaches, diarrhea, cramps, and in severe cases coma and death in humans. Toxicity depends on the amount ingested. Consequently, one should not eat potato stems, leaves and flowers. Poisoning from potatoes is extremely rare.

Exposure to sunlight and fluorescent lighting (ultraviolet radiation) will cause elevated TGA levels in potato tubers. High TGA levels may also be caused by harvesting immature potatoes, bruising, skinning, improper storage temperature control, wet conditions prior to harvest, chilling or freezing. See Greening.

Since the potato tuber is a modified stem, it possesses the ability to carry on photosynthesis and turn green. Very little light is required to stimulate the tuber to produce chlorophyll pigments. While the chemical reactions are independent of each other, the appearance of the green coloring serves to indicate the coincident accumulation of TGA in the tuber skin.

The various compounds making up TGA are important constituents making up the flavor of a potato. Since the skin contains the highest concentration of glycoalkaloid, peeling removes most, but not all of the glycoalkaloids. Some argue that peeling removes most of the flavor as well. Hence many prefer to eat the skin with their potatoes.

Glycoalkaloids are heat-stable, so cooking will not remove the toxicity or the bitterness.

Glycoalkaloid content varies with the cultivar. The concentration is highest early in tuber development; small immature tubers will have the highest glycoalkaloid (14-28 mg/100 g) levels. Mature tubers typically contain 2-6 mg glycoalkaloid/100 g fresh weight.

If TGA levels are between 10 and 20 mg/100 g fresh weight, tubers will be bitter when eaten and are potentially toxic at levels greater than 20 mg/100 g. The acceptable concentration is less than 20 mg/100 g. Above that level the bitter flavor will be very apparent.

Generally speaking, any commercially available potato will not have TGA levels high enough to worry about unless the tuber skin and flesh is green. Moderately green tubers should not be eaten without first taste testing the peel of several raw tubers. Bitterness or a burning sensation indicates that TGA levels are too high and the potatoes should be discarded. In red-fleshed and purple-fleshed potatoes, it is more difficult to visually determine whether the tubers have been ‘sunburned’. Peeling the skin may reveal greening of the flesh just below the skin. The taste test is a better indicator.

Many landrace and wild varieties being used in potato research programs have inedible tubers due to exceptionally high levels of TGA Breeders are trying hard to reduce

the TGA to acceptable levels and yet keep the desirable traits as they strive for new and improved potato varieties.

Gnocchi (pronounced nyo' kee) A traditional, northern Italian dumpling made of potatoes and flour. It is made from wheat flour and steamed potatoes and is usually served with pesto or tomato sauce.

Golden nematode See *Globodera rostochiensis*

Good Agricultural Practices a.k.a. GAPs. Generally speaking, at the farm level, GAPs are voluntary self-audited programs to assure food safety. But in reality GAPs have a wider scope. GAP programs (federal and state) have been developed to help farmers/growers review their on-farm practices of producing, processing and transporting plant and animal farm products in such ways as to safeguard those products from contaminants and pathogens. At the same time GAP programs can also protect the environment and the farmers/growers themselves and their workers.

GAPs focus on four primary components of production and processing: soil, water, hands, and surfaces. Mainly, GAPs promote simple common sense coupled with an educational awareness program. In essence, GAPs

In NYS, GAPs are promoted by the NYS Department of Agriculture and Markets, but actually implemented by Cornell University Cooperative Extension.

Grade See Grade Standards.

Grade Standards These are U.S. official standards of conformance to ensure uniformity in the market place for potatoes. These standards cover many factors including varietal characteristics, uniformity of shape, maturity, cleanliness, limitations on defects, damaged, and diseased tubers, size limitations. Grade standards for tablestock include the following grades: Extra U.S. No. 1, U.S. No. 1, U.S. Commercial, U.S. No. 2, and Unclassified. Grade standards for seed potatoes are slightly different and include only one grade: U.S. No. 1. Cull potatoes are those not meeting any of the above grades. Culls can still be sold to the public if they meet certain standards. Typically, grade standards are issued by states, but most states simply adopt the federal regulations issued as United States Standards.

Grading The process of sorting potatoes according to U.S. grade standards for sale. While sorting according to size has long been mechanized with various sizing machines, the sorting of potatoes for quality against defects remains essentially a manual operation. Each potato must be examined visually and manually by a human (sometimes more than one) as it passes by on a moving conveyor of rollers so that all sides of each tuber are examined as it passes.

New technologies are coming into the potato packing industry. As of 2009, optical sorters are being used for sizing and x-ray sorters are now screening for internal defects. Visual inspection by humans is now the third step in the sorting process at state-of-the-art potato processing facilities.

See Grade Standards.

Graip In the U.K., a spading fork, sometimes called a garden fork. It is used for loosening and lifting soil in a garden or farm and is used similarly to a spade. Its tines are usually shorter and thicker than for a pitchfork, are flat and wide rather than thin and round, and are more closely spaced. The handle is shorter than for a pitchfork and usually has a *D* handle. This

fork is also useful for lifting potatoes from the ground. This tool is different from a potato hook whose tines are at 90 degrees to the handle.

Graying This refers to the discoloration of potatoes after cooking.

Greening The process of forming chlorophyll in the skin and outer layers of potato tubers when exposed to sunlight and ultraviolet radiation from fluorescent lighting. In high concentration to exposure to sunlight, when a potato looks green or is actually green, that is an indication that is higher in concentration of α-solanine and/or α-chaconine or some other indicator of See Green potatoes.

Green jeans Trousers made from organic cotton and given their indigo finish with a special group of ingredients that include mimosa flower and potato starch. Levi's first introduced the "green jeans" in 2007, and sold them for a hefty price, over $200 US Dollars (USD). The company hopes that in the future they can create less expensive organic brands that would be more alike in price to their standard jeans.

Green potatoes There are no green potatoes—this may be the only color that potatoes do not come in. However, potatoes will turn green if exposed to direct sunlight or the ultraviolet radiation from fluorescent lighting. If they came in from the field green, that means they were not covered with enough soil to prevent sunlight penetration. The white potato is really a modified stem so it has the ability to carry on photosynthesis (and turn green). It takes very little light reaching the tuber to stimulate chlorophyll production. Note: even purple- and red-skinned tubers will green under exposure to UV light, though it will be difficult to discern.

The green coloration also indicates an accumulation of a group of compounds called glycoalkaloids. If eaten in small amounts, green potato skin and flesh may cause a mild digestive upset to those sensitive to it. It is said to be toxic in large amounts, but it is unclear how much that would be. Any tubers showing more than a superficial green coloring easily removed by peeling should be thrown away.

Greening can be prevented entirely by keeping sunlight and UV away from tubers. Prevention schemes include planting seed pieces at the proper depth, adequate hilling to assure coverage of developing tubers with soil (This is especially important with those varieties which exhibit high tuber set, i.e. tubers development high in the hill and needing additional care to assure adequate soil coverage)**,** tarping of bulk trucks between field and storage.

Growing Degree Days Growing degree days (GDD) provide a useful means of relating crop growth and insect development to temperature. Numerous methods for calculating GDD exist. In its most basic form, it is computed by subtracting a base temperature from the average temperature (usually rounded to the nearest degree) for the day. Degree days are accumulated throughout the season for seasonal totals. The base temperature in the standard calculation is 50 degrees Fahrenheit, unless specified otherwise.

86/50 method: This is an adaptation of the normal base 50 growing degree days. The difference is that maximum temperatures above 86 °F are set to 86 ° and minimum temperatures below 50 °F are set to 50 before the calculations are done. The base temperature is 50 degrees Fahrenheit, unless specified otherwise. This type of GDD is commonly used in applications related to corn growth and development.

Baskerville-Emin method: this method of GDD is superior in some applications when spring and fall minimum temperatures fall below the base temperature.

Grow out To start plants from seeds. From time to time, agricultural scientists grow out germplasm stored in their gene banks to test the seeds' viability.

Growth cracks Growth cracking is a physiological disorder of the potato tuber in which the tuber splits while growing. The split heals but leaves a fissure in the tuber. Growth cracks generally start at the bud or apical end of the potato and can extend lengthwise. Growth cracks can vary in severity from appearing as a surface abrasion to a split through the tuber. The severity depends on the stage of growth the initial cracking occurred.

Even though cracking does not usually predispose the tuber to rotting, growth cracks can negatively impact potato tuber quality. Growth cracks make fresh-market tubers unattractive. Severe growth cracks can even impact the quality of chip processing potatoes

The reason why growth cracks occur is not well defined. However, growth crack incidence increases when growing conditions are uneven or sudden environmental changes occur. Critical environmental conditions include both soil moisture and temperature. Growth cracks increase when relatively poor growing conditions are followed rapidly by relatively good growing conditions. There are differences in the susceptibility of potato varieties to growth cracks.

To reduce the incidence of growth cracks, maintain proper soil moisture during the season. This is especially important during the bulking stage when the plants are large and tubers are rapidly expanding. Large plants and expanding tubers require relatively more soil water to maintain good growth.

Growth habit In botany, the tendency of a plant to grow in a certain shape and to attain a certain mature height and spread, sometimes called posture. Growth habit is generally described as low-growing, tall, erect, prostrate, spreading, trailing, bushy, etc.

In potato, growth habit depends on species and cultivar. Potato plants can exhibit an erect or upright growth habit when the stems grow straight up or at angles steeper than 45 degrees. Semi-erect or spreading plants are those whose stems are angled at 45 degrees or less. Prostrate growth habit is exhibited when stems trail out full length on the ground. Decumbent growth habit is exhibited when stems trail on the ground, but are bent up at the ends. A few species have a rosette or semi-rosette habit which is exhibited when all or most leaves are arranged at or near a base of short stems and are near the soil surface in a circular or spiral arrangement.

Growth stages Growth of a potato plant occurs in several stages: sprout development, plant establishment, tuber initiation, tuber bulking, and tuber maturation. Timing of these growth stages varies depending on environmental factors such as elevation, temperature, soil type, availability of moisture, cultivar, and geographic location.

Guatemalan tuber moth (*Tecia solanivora*) The Guatemalan potato tuber moth is a serious pest in Colombia and other potato-growing areas. This pest is not in North America, but since its first report, it is spreading to different regions and it’s hard to control.

A heavy infestation of Guatemalan tuber moth larvae can destroy a potato crop. However, recent (2016) research using Pastusa Suprema, a potato variety grown commercially in Colombia, if just a single tuber is affected, the plant will overcompensate by sinking more resources into the other potatoes.

Researchers discovered that tubers eaten by the moth larvae sent alarm signals aboveground to activate defense responses in the leaves. Plants with infested potatoes had

increased levels of glycoalkaloids – bitter-tasting plant toxins – and chlorogenic acid in the leaves.

When added to insect diet at concentrations similar to those found in potato leaves, chlorogenic acid, α-solanine, and α-chaconine all reduced *S. exigua* larval growth. When researchers reared fall armyworm and beet armyworm larvae on these leaves, the larvae gained less weight than when they fed on unexposed plants. This response may help the Pastusa Suprema plants to maintain healthy foliage with high levels of photosynthesis, so they can overcompensate for the tubers lost to moth larvae.

But the defensive effects don't run both ways. Tuber moth larvae showed no ill effects when fed on potatoes whose leaves had been chewed by beet armyworm larvae.

Haploid Having a ploidy of one.

Haploid number In potato, the haploid number basis is 12.

Haplotype TBD

Heat necrosis See Internal heat necrosis.

Heel end The end of a potato tuber attached to the stolon which is attached to the stem, a.k.a. the basal end, i.e. the opposite end from the apical end.

Heritage variety See Heirloom variety.

Heirloom variety A potato variety that once had widely recognized popularity and commercial importance, i.e. considerable ancestry and history of use, but which has been supplanted in the marketplace by newer varieties. Many such varieties are now grown and sold only in tiny niche markets; some are in danger of going extinct. It must be stated that some heirloom varieties will hardly be missed, while others may be of genetic importance whose loss would be a detriment to the potato world. Various governmental and private seed banks and genebanks are attempting to place them in repository for future researchers.

Hiller A mechanical device or implement used to move loose soil from the space between the potato rows and deposit it beneath and against the potato stems to form a long, continuous 'hill' the full length of the row. This soil covers and protects potato tubers growing near the surface from frost damage and greening.

In the old days, hilling was done by hand with a hoe. Modern hillers are tractor mounted and operated hydraulically. Rotary hoes, discs, moldboards and power hillers equipped with a metal mould are commonly used to shape loose soil into a hill. The hilling implement should be adjusted to produce a wide, flattened hill ideal for protecting the tubers from sunlight, late blight spores and frost.

Hilling Hilling is the only tillage operation necessary in the production of potatoes after planting. The objective of hilling is to control weeds, to maintain coverage of soil over the growing tubers to prevent greening, to minimize infection with late blight, to minimize frost damage, to improve drainage in the area of tuber formation, and to facilitate harvest.

To effectively control weeds, hilling must take place before the weeds get past the two true leaf stage. Hilling can be performed pre- or post-emergence. Regardless of the

hilling implement, emerged plants should not be covered with soil. This will set the plants back and delay growth.

Historic barn In New York State, Real Property Tax Law (RPTL) Section 483:

HMGR1 Reductase genes called 3-hydroxy-3-methylglutaryl CoA reductase I (abbrev. HMGR1) found in the leaves of the potato plant. HMGR1 is involved in the in the biosynthesis of glycoalkaloids, especially in response to tuber herbivory. Recent research (2016) has shown that when Guatemalen tuber moth feeds on underground potato tubers, the leaves of the plant above begin accumulating HQT and HMGR1, transferase and reductase genes, to make chlorogenic acid, α-solanine, and α-chaconine. This accumulation of chlorogenic compounds slowed the growth of *S. exigua* larva.

Hollow heart The odd, dark-colored cavity that sometimes appears in the center of a potato tuber. This is a physiological disorder caused by less-than-desirable temperature or water conditions during the growing season. During dry periods, tuber growth will slow, but if a sudden rainfall occurs after such a prolonged period, immediate tuber growth will commence and may result in a hollow space in the center of the tuber. There is really nothing wrong with the potato and it is safe to eat.

Home-fried potatoes, home-fries A food dish made with potatoes that are sliced (or diced) raw and then fried in butter or oil and seasoned with a variety of ingredients such as salt, pepper and onions and/or green/red bell peppers. Some add bacon chips or diced ham for a meat combination. Many home-fries are made with left-over potatoes. Moist (salad) potato varieties are preferred because they hold their shape.

Horizontal resistance Also known as multi-gene resistance because this type of resistance is controlled by many genes. Because of the large number of genes involved, it is much more difficult to breed varieties with horizontal resistance. Unlike vertical resistance, horizontal resistance generally does not completely prevent a plant from becoming damaged. This type of resistance may slow the infection process so much that the pathogen does not grow well or spread to other plants. Additionally, horizontal resistance is generally effective against all races of a pathogen. It is durable resistance.

Horizontal resistance confers incomplete but more durable protection: it does not break down as quickly or as suddenly as most vertical resistance. Horizontal resistance involves many host physiological host processes acting as mechanisms of defense and which are beyond the limits of the capacity of the pathogen to change, i.e. beyond the probable limits of its variability. Horizontal resistance is present universally in wild and domesticated plants and operates against all races of a pathogen, including the most pathogenic ones. Varieties with horizontal partial resistance remain resistant much longer than varieties with vertical resistance. Consequently, horizontal resistance cannot fail to the extent that vertical resistance fails.

Host A host is the organism on which a parasite lives. The host often (but not always) dies as the parasite reaches maturity.

Hot potato Variously: a party game, a television game show on NBC in 1984, a 1976 martial arts movie starring Jim Kelly, the name of a song (at least two different songs by two different artists), an action puzzle video game released in 2001 in which the player must simultaneously drive a bus and clear the roadway of alien potato beings.

A more interesting use of this phrase according to Zuckerman originated around 1820 in London where street vendors called “baked ‘tato men’” sold baked potatoes in winter not only for eating, but also for people to use as handwarmers. However, Salaman suggests that hot potato handwarmers had been around since ‘prior to the last quarter of the eighteenth century’. His research includes a personal study of Staffordshire glassware called ‘potato bottles’. The thought at the time was that these were to be used as ‘hip’ flasks for gin. But Salaman argues convincingly that the shape of a potato bottle is awkward to be placed in anyone’s pocket, but that it is perfect to carry in a mittened hand or a muff as was common in the late eighteenth and nineteenth century. He argues that these were not filled with alcohol at all, but with hot water or hot sand and carried as an artificial ‘hot potato’ and used to keep one’s hands warm.

Hot potato routing In electronics: a form of routing in which the nodes of a network have no buffer to store packets in before they are moved on to their final predetermined destination. In normal routing situations, when multiple packets contend for a single outgoing channel, packets that are not buffered are dropped to avoid congestion. But in hot potato routing, each packet that is routed is constantly transferred until it reaches its final destination because the individual communication links cannot support more than one packet at a time. The packet is bounced around like a "hot potato," sometimes moving further away from its destination because it has to keep moving through the network. This technique allows multiple packets to reach their destinations without being dropped. This is in contrast to "store and forward" routing where the network allows temporary storage at intermediate locations. Hot potato routing has applications in optical networks where messages made from light cannot be stored in any medium. Also referred to as deflection routing.

HQT Genes in potato plants called hydroxycinnamoyl-CoA quinate hydroxycinnamoyl transferase. These genes are involved in the biosynthesis of chlorogenic acid, especially in response to tuber herbivory. Recent research (2016) has shown that when Guatemalen tuber moth feeds on underground potato tubers, the leaves of the plant above begin accumulating HQT and HMGRI reductase genes to make chlorogenic acid and the glycoalkyloids, α-solanine, and α-chaconine. This accumulation slowed down the growth of *S. exigua* larva.

which are involved in chlorogenic acid and steroidal glycoalkaloid biosynthesis, respectively, also increased in response to tuber herbivory. Leaf metabolite profiling demonstrated the accumulation of unknown metabolites as well as the known potato defense compounds chlorogenic acid, α-solanine, and α-chaconine. When added to insect diet at concentrations similar to those found in potato leaves, chlorogenic acid, α-solanine, and α-chaconine all reduced *S. exigua* larval growth.

Hundredweight One hundred pounds, abbrev., cwt. It is a common unit of measure in the potato trade.

Hybrid The offspring of two individuals differing in one or more heritable characteristics. See Cross.

Idaho potato ‘Idaho potato’ and its variants are protected trademarks of the Idaho Potato Commission. Idaho potato used to refer solely to the Russet Burbank variety, but it now includes Norkotah, Ranger Russet, and other varieties grown in Idaho. Legally, ‘Idaho potato’ can only refer to any potato grown in Idaho.

In the culinary world, regardless of commercial and legal restrictions, the phrase 'Idaho potato' potato is synonymous with Idaho baker, Idaho russet, 'baking potato', and 'russet potato', regardless of where they are grown.

Idaho baker See Idaho potato.

Imidacloprid A systemic neonicotinoid, a chloro-nicotinyl insecticide, with soil, seed and foliar uses for the control of sucking insects including rice hoppers, aphids, thrips, whiteflies, termites, turf insects, soil insects and some beetles, including the Colorado Potato Beetle. It has no effect on nematodes and spider mites. It was patented in the U.S. in 1988 by Bayer Cropsciences (part of Bayer AG) and introduced to the U.S. marketplace in 1994-95 under trade names Kohinor, Admire, Advantage, Gaucho, Merit, Confidor, Hachikusan, Premise, Prothor, and Winner.

Formulations are available as dustable powder, granular, seed dressing, soluble concentrate, suspension concentrate and wetable powder.

The chemical works by interfering with the transmission of stimuli in the insect central nervous system. Specifically, it causes a blockage in a type of neuronal pathway (nicotinergic) that is more abundant in insects than in warm-blooded animals (making the chemical selectively more toxic to insects than warm-blooded animals). This blockage leads to the accumulation of acetylcholine, an important neurotransmitter, resulting in the insect's paralysis, and eventually death. It is effective on contact and via stomach action. It is readily taken up by the plant and is further distributed acropetally with good root-systemic action.

Imidacloprid is taken up by plant roots and diffuses in the plant by the xylem; its systemic properties then rely on insects ingesting the insecticide (*e.g.,* by sucking plant fluids). Its IUPAC name is 1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine. Its C.A. name is 1-[(6-chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine. Its CAS number is 138261-41-3. Its molecular formula is C9H10ClN5O2.

Imidacloprid was initially quite effective against Colorado potato beetle in very low dosages, but in some areas (Long Island) after only two or three years, the CPB exhibited resistance to it. By year 2000, researchers were expressing amazement that CPB throughout the eastern USA had already acquired resistance to it.

Indeterminate growth In botany, a type of growth habit. Plants having a viney growth habit and which continue producing floral buds after flowering initiation; plants that continue to grow indefinitely. Opposite of determinate growth habit.

In potato, indeterminate growth habit tends to be in the late season varieties. Typically, late season varieties will have higher yields than determinate (early-season) varieties. Tubers can grow all along the stem (below ground). See also Determinate growth.

Inflorescence In botany: A cluster of flowers.

Insecticidal activity In biology, a term referring to a substance having a detrimental effect on a target insect, including but not limited to death, increased mortality, or inhibiting the incidence, growth, development or reproduction of a target insect.

Inspection An official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary

regulations. This includes visual examination as part of a federally recognized quality assurance program.

Instar The larval or nymph stage of an immature insect between successive molts.

Integrated pest management A pest management strategy that focuses on long-term prevention or suppression of pest problems through a combination of techniques such as encouraging biological control, use of resistant varieties, and adoption of alternate cultural practices such as modification of irrigation or pruning to make the habitat less conducive to pest development. Pesticides are used only when careful monitoring indicates they are needed, according to pre-established guidelines, treatment thresholds, or to prevent pests from significantly interfering with the purposes for which plants are being grown.

Internal discoloration (after frying) In U.S. (North American) potato chip industry, dark potato chips are an anathema. Uniformly light-colored potato chips are the desired goal of all potato chip manufacturers. Consequently, any graying or after-cooking darkening (blackening) of potato tubers is to be avoided.

Many potato varieties are suitable for making potato chips directly from the field, but historically, only a few have been suitable for making chips from storage. Potato tubers are metabolically active during storage and this is most readily seen as they begin to sprout. Storage temperature affects fry color. Colder storage temperatures slow sprouting and prolong dormancy, but produce darker fry colors. Many chipping varieties require a warm-up period (approximately two weeks) to avoid dark chips.

Considerable effort is being applied to develop potato varieties (cultivars) which produce light-colored potato chips directly from storage.

Internal heat necrosis Abbrev. IHN. A physiological disorder resulting in necrotic tissue in the pith (parenchyma cells) of potato tubers. This tissue will darken and become unsightly, rendering the tubers unmarketable even though the tubers are still edible. Susceptibility is commonly associated with localized calcium deficiency within the tuber, but research is showing that other factors are involved.

IHN is associated with high soil temperature at or near harvest, especially after late season drought stress. Some research is showing that high nighttime temperatures increase incidence. IHN develops in storage over the first few months. Tubers display no outward signs of IHN. Necrotic material appears as light tan, dark yellow to reddish brown flecks or specks; these may be dark brown or black in the most severe cases. They resemble the necrosis seen with chilling injury. Flecks usually cluster near the center toward the bud end and can appear similar to blackheart. The flecks are firm; there's no breakdown or rot. Vascular tissue is usually not affected.

Flecks fry brown. Fries and chips will be speckled around their center.

IHN is also referred to as tuber internal browning, brown fleck, heat necrosis, internal rust spot, chocolate spot, internal brown spot, mahogany browning, and physiological necrosis.

Internal necrosis TBD

International Code of Botanical Nomenclature The set of nomenclatural principles and rules used to standardize and classify plants in a taxonomic hierarchy, abbrev., ICBN. This system is commonly referred to as Linnaean nomenclature or traditional nomenclature. The Greek botanist, Theophrastus (3rd century BCE), is recognized as one of the first to formally

classify plants. Linnaeus (1753) is credited with initial efforts to standardize plant names and to classify all known plants. After considerable taxonomic work by a century's worth of botanists and taxonomists, De Candolle (1867) devised a set of nomenclatural rules and published them as *Regles de la Nomenclature Botanique*. It is these rules, updated by several revisions that became the ICBN. The ICBN is amended every six years by the International Botanical Congress, the last being in 1999 and issued in 2000.

This nomenclature applies solely to wild plants. From the beginning, botanists and taxonomists paid scant attention to cultivated plants and this code relegated them to a 'mere' appendix which as time went on became untenable. In 1953, the International Code of Nomenclature for Cultivated Plants, abbrev., ICNCP, was published.

International Code of Nomenclature of Cultivated Plants A set of nomenclatural principles and rules used to standardize and classify cultivated plants in a taxonomic hierarchy, abbrev., ICNCP.

In ICNCP all landrace populations of cultivated potatoes have been recognized as a single species, *Solanum tuberosum*, with eight subspecies (cultivar groups): Ajanhuiri, Andigenum, Chaucha, Chilotanum, Curtilobum, Jucepczukii, Phureja, and Stenotomum.

Recent research indicates that these eight subspecies might be more properly divided into four cultivar groups. Time will tell whether this comes into common usage.

International Year of the Potato 2008 A program of the United Nations aimed at raising awareness of in importance of the potato—and of agriculture in general—in addressing the issues of global concern, including hunger, poverty and threats to the environment. Focus on the potato

Intolerant A host plant that is heavily damaged at relatively low population levels of a pathogen.

In vitro Literally, 'in glass'. Usually refers to organisms grown in an artificial, non-living environment such as test tubes or other lab ware.

***In vitro* plantlets** Plantlets grown in laboratory test tubes. Pathogen-free, nuclear seed stock for potatoes originates in state and/or university-run or private laboratories where strict protocols are used to ensure a clean, controlled environment and pathogen-free plantlets. From the laboratory, most plantlets will be transplanted in greenhouses for the next generation (prenuclear). Tubers raised in the greenhouse will be planted the following year outside in fields for the first nuclear generation.

IPM See Integrated Pest Management.

Irish lunker A nineteenth century US colloquialism for the Lumper? See Lunker.

Irish potato Term commonly used by settlers in nineteenth century United States to differentiate *Solanum tuberosum* from the sweet potato.

Irrigation Irrigation is necessary in most western states to achieve profitable potato yields. Allowing soil moisture to drop below critical levels reduces or stops canopy and tube growth during the stress period and for several days thereafter. This effectively shortens the tuber bulking period and can also cause a variety of internal and external tuber defects. Excessive irrigation can also reduce the tuber growth by restricting plant physiological activity and nutrient uptake and increasing disease susceptibility.

Jacket potato In the UK: a baked potato.

Kartoffel German for potato.

Keeper In potato, this refers to how well tubers will keep over the winter in storage given optimal conditions of cool temperatures, high humidity, ventilation and other factors. It is associated with dormancy. A potato that 'keeps well' is said to be a good keeper.

Knishes Small, baked pastries made from mashed potato or from wheat flour and filled with potatoes, onions, eggs and beef sausages.

Land-grant university A state college or university started from federal government grants of land to encourage practical education in agriculture, home economics, and the mechanical arts.

Lamoka Since 2015, the benchmark standard for chipstock potato varieties out of long-term storage in USDA / Snack Food Association (SFA) Chip Variety Trials.

Landrace A cultivar originating as a product of the first stages of mass selection (being distinct from modern plant breeding). Landraces are generally confined to a specific region.

Many landrace potato species and cultivars are grown by indigenous people of the Americas. Andean landraces are grown at mid- to high-elevations in the Andes from western Venezuela to northern Argentina. Chilean landraces are grown on the Chonos Archipelago of south-central Chile. Landrace potatoes grown in Mexico and Central America are post-Columbian introductions.

Landrace populations of potato are highly diverse with a great variety of tuber shapes as well as skin and flesh colors. Various landrace species exhibit resistances to frost, insects, mycological and bacterial pathogens, but whose tubers are essentially inedible due to high concentrations of α-solanine. Plant breeders are trying to incorporate these natural resistances into plants and tubers with good culinary characteristics.

Landraces were formerly called indigenous or primitive cultivars.

Landscape simplification In ecology, the change from landscapes dominated by natural habitats into landscapes dominated by agriculture. Typically landscape simplification has been shown to dramatically affect the richness and abundance of the organisms that interact with plants, such as pollinators, herbivores and natural enemies. Landscape simplification not only reduces the flow of essential ecosystem services, such as pollination and pest control, but can ultimately result in yield losses for farmers.

Landscape simplification has been shown to be associated with changes in pest pressure on crops. Although in some systems pest pressure is not affected or reduced by landscape simplification, there are several instances showing that landscape simplification leads to an increase of pest pressure on crops.

In addition to changes in pest pressure, landscape simplification has been shown to be associated with better soil conditions. Agriculture is usually practiced in regions with better growing conditions for plants and therefore it is common that areas with higher quality soils also have simpler landscapes given their higher likelihood of being used for agriculture.

Late Blight A disease caused by the pathogen *Phytophthora infestans*. It is easily spread by wind-borne spores or infected tubers, a late blight attack first shows up as a few grayish spots on the plant's foliage, followed by a cottony film. The leaves show signs of necrosis and the plant dies within a few days.

Late blight of potato is among the most important plant diseases of potato crops worldwide. This pathogen is feared by farmers around the globe due to its ability to

quickly destroy entire fields of potatoes and tomatoes. The pathogen affects foliage and stems, reducing the photosynthetic capacity of the plant and leads to tuber yield reduction. In addition, late blight can infect fruits and tubers, which adds to total losses in marketable yield.

Economically, late blight represents 10 to 15 percent of the total losses in annual potato production. The annual economic value of these losses including cost of crop production is $3 billion US.

See *Phytophthora infestans*.

Latent TBD

Late Harvest In potato, 150 days after planting. See Early Harvest

Lateral Pressure of Potatoes Stored in Bulk The static load applied to a vertical wall by a bulk pile of stored potatoes. This load is a function of the height of the pile. The value of this load can be calculated from the following: $L = 17.8 + 8.52\ H - 0.18\ H^2$, where: L = lateral force, lb/ft^2 and H = the depth of potatoes in the bin, ft.

Leaf hairs All potato plants have leaf hairs (trichomes) in varying amounts and types. Some, such as the wild species *S. berthaultii*, have glandular leaf hairs which exude a sticky substance that can 'catch' small insects that come in contact with the 'glue-like' substance. Research has been ongoing to develop this as protection from insects since the 1960s.

In 2006 a potato variety called King Harry with sticky leaf hairs as a deterrent to leafhoppers was released by Walter de Jong and Cornell University.

Leafroll See PLRV.

Leatherskin A blemish of red-skinned potato varieties in which a pattern of slightly elevated reticulations is exhibited on the skin surface. Areas with these reticulations will be rendered brownish in color. It is thought that environmental conditions leading to plant stress during tuber development contribute to this problem.

Lenticel A spongy area present in the corky surfaces (periderms) of stems, roots, and other parts of vascular plants. It appears on the surface as a lenticular (lens-shaped) spot which acts as a pore. These structures allow for the exchange of gases between the internal tissues and atmosphere to occur across the periderm, which would otherwise prevent this exchange of gases. The name lenticel, pronounced with a soft *c*, derives from its lenticular shape. In the potato, the number of lenticels per tuber is dependent on tuber size, but independent of cultivar and dry or wet moisture growing regimes.

Excessive soil moisture will cause lenticels to enlarge. Prolonged excessive soil moisture will cause permanent blemishes on the tuber skin as the enlarged lenticels become brown and corky.

Sunken lenticels are caused when lenticels infected with soft-rotting bacteria turn brown and sink resulting in a pocked surface. If such infected tubers are kept in a warm, moist environment, decay will continue until the entire tuber is destroyed.

Limited generation seed production During potato production, seed or commercial, the plant is constantly exposed to sources of contamination by disease-causing pathogens. The probability of a seed tuber or seed lot becoming contaminated with pathogenic organisms increases each consecutive year a seed lot is in production. To minimize this, seed certification agencies have enacted regulations that restrict or limit the number of years the seed lot can be eligible for the seed certification process. This system is referred to as limited generation. Limited generation systems are handled differently in each seed production state.

Additionally, the name of the seed class or number of the seed lot generation varies considerably among seed certification agencies.

Seed lots are limited in the number of years that they can be produced in the field after the tissue-culture derived material has left the laboratory or greenhouse. This varies from five to nine years, depending upon the seed production area. Seed certification agencies differ in what term is used to describe the generation of the seed lot. Much of this variation is influenced by whether or not the tissue culture plantlets or minitubers were produced on a state or provincially operated farm or on individual seed grower farms. Maine, New York, Wisconsin, and Canada all operate state seed farms.

In general, seed produced from these farms does not receive a generation number until it leaves the state seed farm and is grown by individual seed potato growers. Most seed certification agencies also have specific criteria relating to disease tolerances and other regulations for each successive field planting. Since this can be very confusing, even to seed certification personnel, commercial growers are encouraged to contact the certification agency responsible for seed certification in the production area in question.

Line Selection One of the common techniques of potato improvement along with traditional breeding (hybridization) and genetic engineering. It has been used for many decades perhaps centuries to improve tuber appearance and production characteristics. Also called strain selection, sub-clonal selection and intraclonal selection. See Selection Process

Locally grown A marketing gimmick suggesting that fresh produce is grown in the vicinity of where it is being sold. Unfortunately, it is a good idea in search of a definition.

There is no federal definition of local, and due to the diversity of crops and growing regions around the country, it is unlikely there ever will be. Most states do not have regulations pertaining to local food. Vermont defines 'local' as grown within the state or within 30 miles of where it is sold. Massachusetts has similar restrictions for what it calls 'native' food. New York has no regulation defining 'local' fresh produce.

Therefore, retailers, distributors, and other purveyors of fresh produce are free to come up with their own definitions of what is 'locally grown'. Since 'locally grown' is an increasingly important factor among consumers' buying decisions, most retailers will take every advantage to promote their fresh produce. Indeed, many of the largest retailers from Wal-Mart to Whole Foods are increasingly devoting more shelf space to 'locally grown' products. The problem is the retailers often have a far broader definition of 'local' than consumers.

Wal-Mart considers anything local as long as it is grown in the same state as it is sold.

Whole Foods considers local to be anything produced within seven hours driving-time of one of its stores. They say this amounts to about 200 miles.

Seattle's PCC Natural Markets considers local to be anything from Washington, Oregon and southern British Columbia.

Wegmans sources most of its local produce from growers within 100 miles of a store.

In 2009 Frito Lay launched a marketing initiative focusing on the 80 'local' farmers who grow potatoes for its chip plants in 27 states. Not only that but they incorporated a tracking number into the product code on each bag of potato chips. Consumers have only to type in the first three digits of the product code and their zip code and out pops the location of the chip plant.

Many retailers leave it up to individual store managers.

Farmers' markets often have their own rules for members bringing their own produce versus bringing produce purchased from other growers outside the area.

Consumers, on-the-other-hand, when surveyed, defined 'local' as within 100 miles (50%), within the same state (37%).

It is clear that there is a huge disparity between retailers and consumers regarding what is 'local' and what is not.

All the above notwithstanding, New York State does have its 'Pride of New York' program promoting agricultural products grown by NYS growers and food products processed within New York State. Look for the 'Pride of New York' label and at the very least you will know it was produced in New York State.

The only other guide suggested here is *caveat emptor*, i.e. buyer beware, that is, anyone seeking to obtain truly locally grown fresh produce must ascertain for himself/herself whether the produce is indeed local or not. Ask retailers and sellers where their products came from, read the labels, always question retailers/sellers when the answers do not make sense. Put them on the spot.

Long-day In botany, long-day refers to the photoperiod at latitudes distant from the equator. Long-day plants are those requiring the longer daylight hours of the latitudes distant from the equator.

Long white potato Any of several varieties of oblong to oval shaped potato with a thin skin, tan to light tan in color and with very subtle eyes. They have a medium starch level and when cooked their texture is firm and creamy. They can be cooked using most any method of preparation, such as baking, boiling or frying. They are largely grown in California and can be found in the spring and all through the summer. The most common variety is White Rose, but there are many others.

Lot For seed potatoes: A population of certified seed potatoes of one variety and class that is identified by one certificate number.

Lumper An historic heirloom potato variety introduced in the U.K. around 1806. It is an inconsistently round-oval, sometimes knobby, white-skinned variety with deep eyes. Flesh is white and waxy, but taste is poor and culinary use is limited. It was grown widely in Ireland before the 1845-50 famine because it was prolific and reliable. It was nearly wiped out by *Phytophthora infestans*. It was brought to North America by Irish immigrants. Today, it is rarely grown, but is kept for posterity in several genebanks.

Lunker A potato variety name found commonly in mid-nineteenth century New York agricultural reports. Could it be a mid-nineteenth century New York potato farmer colloquialism for the Lumper? See Lumper.

Maceration In plant pathology, the softening and breaking down of tissues, usually when infected by bacteria or fungi or both. It is more commonly known as 'soft rot'.

A plant or a tuber or fruit or a bulb can become infected as seed or from direct inoculation into wounds or natural openings (stomata or lenticels). When a plant or tuber or fruit is infected and the conditions are favorable, the bacteria immediately begin feeding on liquids released from injured cells and start replicating. As they replicate they release more and more pectolytic enzymes that degrade and break down (digest) cell walls. And, because of the high turgor pressure within the cells, this maceration effectively causes the cells to explode and die providing more food for the bacteria.

As they gorge on intracellular fluid, the bacteria continue to multiply and move into the intercellular spaces, with their cell-wall-degrading enzymes ahead of them preparing the plant tissues for digestion. Often the epidermis is left unscathed, keeping the rotten flesh contained within until a crack allows the ooze to leak out and infect others around it.

Maillard reaction

Marketable yield Officially, the weight of all tubers harvested that are between 2 and 4 inches in diameter; measured in hundred weight (cwt). Actually, this must be adjusted to exclude those tubers which do not meet grading standards, i.e. culls.

Mashed potatoes Boiled potatoes, with a small amount of milk added, that have been mashed to a smooth fluffy consistency. The potatoes are mashed with a ricer, hand potato masher or with an electric beater. Mashed potatoes can have garlic, onions, herbs or spices added to give them a distinct flavor. They are generally served as a side dish along with gravy, sauce or butter on top. Puréed potatoes are often made as a version of mashed potatoes. Any dry, mealy variety will make superb mashed potatoes.

Mature In reference to tubers, this means that the skins of the potatoes are generally firmly set and not more than 5 percent of the potatoes in the lot have more than one-tenth of the skin missing or "feathered."

Maturity Immature tubers are very susceptible to skinning and shatter bruise when harvested. Mature tubers can be achieved by delaying harvest up to three weeks after vine kill. The actual time required for tuber maturation and skin set is influenced by environment, cultivar, plant vigor, fertility, and the presence and severity of foliar diseases.

Mealy Literally, like meal (i.e. any coarsely ground and unbolted grain such as corn meal), powdery, dry, soft, etc. With potatoes, it is a description of texture. Mealy potatoes are highly regarded as baking potatoes and equally highly regarded for deep frying, such as french fries. Mealy potatoes are high in starch and low in moisture, i.e. they have high specific gravity and are therefore high in dry matter. That means they bake well and will turn out light and fluffy when mashed. They are slow to brown when fried.

When a high-starch potato is baked, the starch inside the potato absorbs water from other parts of the potato and swells, making a space between cells, leading to the dry, mealy texture. When a potato is deep fried, pan fried, or roasted, the starch on the surface expands in the dry heat, sealing the edges and the surface, creating a crisp crust and keeping the interior moist.

The classic mealy potato is the Russet Burbank which replaced the Green Mountain for that title in the mid-twentieth century. There are many mealy potatoes to choose from today. Check for high specific gravity. See Floury.

Medulla The storage tissue of a potato tuber, generally referred to as the flesh. There is an outer and an inner medulla in a tuber. The outer medulla, also called storage parenchyma, is the principal storage tissue of the tuber. The inner medulla, or pith, extends toward each eye, forming continuous tissue that connects all the eyes of the tuber.

Mehlig kochend German for floury or starchy potatoes. These potatoes bake up light and fluffy, mash and puree easily, and break down in soups to give a broth body. Blue/purple-skinned/fleshed potatoes tend to be starchy and can be baked or microwaved with success.

Meristem The fast growing tip of a potato tuber sprout. It is approximately the size of a flake of black pepper.

Meristem tissue culture A process by which meristem cells are dissected out of potato sprouts under a microscope and planted in test tubes before viruses from the air or from infected tissues of the parent tuber can get to them. The sprouts are propagated under sterile conditions then planted in fumigated soil to produce seed stock.

Potato plants produced by meristem-tip culture are generally uniform in nature, and rare variants are usually attributed to spontaneous mutation.

Meristem tissue culture has revolutionized nuclear seed stock development. Most certification agencies currently operate tissue culture laboratories that produce the initial

stocks of pathogen-free planting material. A number of private companies throughout the United States, including the Uihlein Seed Farm, produce meristem-derived, pathogen-free seed.

The tissue culture procedure involves the removal of the small growing point or meristem, approximately the size of a flake of black pepper, from a tuber sprout or stem of a potato plant. The meristem is placed in a test tube or other vessel with media containing all of the necessary macro- and micro-nutrients, carbohydrates, growth regulators and salts required for growth and development into a plantlet. Once the plantlet is growing, it is ready for nodal cutting and pathogen testing.

A nodal cutting from a tissue culture plantlet is a stem segment containing an axillary growing point and a leaf. Since a tissue culture plantlet has its own leaves, it is capable of producing its own food. Therefore, the nodal cutting is placed on a different medium that promotes root and shoot development. The nodal cutting process will be repeated many times in order to increase and obtain the number of tissue culture plantlets needed for minituber production.

During the initial nodal cutting process, pieces of the plantlet are retained for laboratory testing for the presence of disease-causing pathogens. Each plantlet of each variety is exhaustively tested for the pathogens causing soft rot, blackleg, ring rot and spindle tuber. In addition, each plantlet is tested for potato leaf roll virus, potato virus Y. potato virus X, potato virus S. potato virus A, and potato virus M. At this stage, 100% of all tissue culture seed stock is tested for disease-causing pathogens. During latter stages of seed stock development, seed certification agencies test 0.5-25% of the plants.

Once the laboratory has produced the desired number of plantlets for each variety, they are ready for tuber production. These plantlets can be planted outdoors directly into the field, if great care is taken, but are most commonly planted into beds in a greenhouse or screen house for minituber production. Under the controlled conditions of a greenhouse or screen house, the plantlets can be carefully cultivated and monitored. Several months after planting, minitubers can be harvested and stored until the following growing season. Minitubers range in size from 1.3 - 5.1 cm (0.5 - 2.0 in). Microtubers, tubers produced in tissue culture medium, are also being marketed for their use in the production of disease-free seedstocks. At the current time, microtubers appear better suited for planting in greenhouses and screen houses rather than in the field due to their extremely small size.

Minitubers or tissue culture plantlets planted into the field are the initial source of certified seed potato lots. These lots will be multiplied and increased until a sufficient quantity is available for commercial use. During the increase process, the seed lots are subjected to visual field inspections and further disease testing. The number and intensity of which is greatly dependent upon the certifying agency in which the seed is being produced. However, all states and Canadian provinces have either a voluntary or mandatory limited generation system, depending on the seed production area.

Mertect 340F A fungicide produced by Syngenta (EPA 100-889), active ingredient: thiabendazole: 2-(4-thiazolyl) benzimidazole, a.k.a. TBZ, 42.3%. It is a post-harvest treatment for Fusarium tuber rot, a.k.a. Fusarium dry rot. Please note that up to half of the fungus population may be resistant to this fungicide. Application rate: 0.42 fl oz to 2,000 tubers on a conveyor line with tumbling action. If additional treatment is need before shipping, mist the tubers at the same rate or dip tubers for 20 sec. in a solution containing 0.42 fl oz per gallon of water.

Metabolite A substance that takes part in the process of metabolism, which involves the breakdown of complex organic constituents of the body with the liberation of energy for use in bodily functioning. The various compounds that take part in or are formed by these reactions are called metabolites.

Microorganism An organism of microscopic size, such as a bacterium, virus, fungus, viroid, or mycoplasma.

Micropropagation Generation of new, disease-free potato plants from tiny pieces of meristem tissue.

Microtuber Same as minituber except much smaller in size. Due to their extremely small size, microtubers are best suited for planting in laboratories, greenhouses and screen houses.

Minituber A small tuber produced under aseptic laboratory or greenhouse conditions from a small potato plant generated by micropropagation from tissue culture plantlets. Minitubers range in size from 1.3 to 5.1 cm (0.5 to 2.0 in.). They are the initial source of certified seed potato lots. These lots will be multiplied and increased until a sufficient quantity is available for commercial use.

Growth chambers developed at NASA may revolutionize production of minitubers. These self-sustaining chambers provide lighting, temperature and humidity controls and a pathogen free environment, essentially a perfect growing environment. These chambers have the capacity to reduce the time from nuclear generation of seed to commercial production by as much as five years.

Mr. Potato Head A plastic toy invented and patented by George Lerner of New York City in 1952. His toy was based on a earlier toy called "make a face" that used a real potato. Lerner designed his all-plastic toy as a prize for cereal premiums. Lerner sold Mr. Potato Head to the Hassenfeld Brothers of Rhode Island, who owned Hasbro Inc., the toy company. Hasbro sold the first Mr. Potato Head with a Styrofoam head as a base for the facial plug-ins. However, instructions were included that suggested the use of vegetables and fruits instead of the Styrofoam.

Moist Moist potatoes are those with low dry matter content. The starch composition tends to have a low amylose to amylopectin ratio. Such potatoes, when baked, tend to have a moist texture. They are best used boiled because they tend to remain intact. They preferred in salads because they will hold their shape.

Moisture penetration TBD

Monoculture A planting, usually large, of a single species (cultivar) of a food crop. Such a set-up may be efficient, allowing the farmer to plant, fertilize, and harvest on a set schedule, but it leaves the entire field vulnerable to attack by a single variety of pest or pathogen.

Morphological characters Those physical characteristics used by botanists to distinguish plant species and varieties from each other. These include growth habit, leaves, stems, flowers, and in potato, tubers and sprouts. Unfortunately, these features can be modified, to varying degrees, by environmental conditions making definitive assessments difficult. Even so, observations of foliage, flowers, tubers, and sprouts are quite helpful in proper identification.

Mosaic In plant pathology, a common symptom induced in leaves by many plant virus infections in which there is a pattern of dark green, light green (yellowish-colored spots) and sometimes chlorotic areas on leaves. It can also present as leaf distortion and brown/black line patterns on veins or shoots. This pattern is often associated with the distribution of veins in the leaf. In monocotyledonous leaves it shows as stripes.

Potato viruses X, S, M, Y, and A all decrease yields by creating a mosaic chlorosis on the leaves, thereby limiting photosynthesis. Control of such viruses includes roguing, seed selection, and insect vector control.

Even so, in the potato world of years past, mosaic issues generally referred to PVY infections which were easily identified visually by the mottling of the leaves as described above. But in recent decades, PVY has evolved beyond this and its visual identification is no longer possible. PVY can now infect potato plants and show no evidence of mosaic few symptoms in the plant, but can decrease saleable yield by significant amounts.

Mottle A diffuse form of the mosaic symptom in plant leaves in which the dark and light green are less sharply defined. This term is frequently used interchangeably with mosaic.

Mouse potato The online version of a couch potato, as in, one who sits for an extended period of time in front of the computer screen just surfing around. Instead of using the thumb to press down on the remote control, the pointer finger is constantly called upon to surf from one website to another. The origin of the neologism 'mouse potato', obviously a play on words between a (computer) mouse and a couch, is unknown.

Multivoltine adj. In biology, referring to those organisms having more than two broods or generations per year.

Mutant An individual or clone that exhibits a genetic mutation. Often called a sport.

Mutation The abrupt appearance of a new, heritable characteristic as the result of a change in the genetic material of one individual cell. A stable, heritable change in the nucleotide sequence of a genetic nucleic acid (DNA, or RNA in viruses, viroids, etc) typically resulting in the generation of a new allele and a new phenotype. Mutations are usually deleterious in wild plants, but crop mutations, if recognized and propagated, occasionally have agricultural value.

NE-1231 Project An ongoing project with collaborators in nine states (FL, MD, ME, NC, NY, OH, PA, and VA). The overall goal of the project is to develop new potato cultivars that are better adapted to the diverse growing conditions of the northeast, mid-Atlantic and southeastern US. It is a collaborative project utilizing existing strengths and resources of the potato breeding community in the eastern US. Its overall goal is to develop attractive, high yielding, disease- and/or insect- resistant potato varieties for fresh, processing, and/or specialty-type potato markets that can be produced by growers in the Eastern United States. The project involves 9 states, 4 breeding programs and over 40 scientists based in the Eastern US. The NE-1231 project is the successor to NE-1031, NE-1014, NE-184 and NE-107.

Necrosis In botany, the death or decay of plant tissue accompanied by dark brown discoloration. It usually occurs in a well-defined part of a plant, such as the portion of a leaf between leaf veins or the xylem or phloem in a stem or tuber. See Tuber necrosis.

Nematode More or less elongate, spindle-shaped, worm-like animals ranging in size from less than a millimeter to several meters in length, living as saprophytes in soil or water or as parasites of plants or animals. Called eelworm, in the U.K. and Europe. See Golden nematode, Pale cyst nematode.

Neonicotinoid A class of insecticide.

New potato Any potato tuber regardless of size and variety that is harvested before maturity, that is, while the vines are still green (senescent) and before the tubers have stopped growing, and most importantly, before skin-set has occurred. While tubers are growing (bulking) their skins are very thin, delicate, and actually floating on the tuber, growing at the same rate as

the tuber allowing expansion to occur without damage to the skin. In this state, the skin is exceptionally delicate and easily damaged.

And since the tubers are immature, they have a very thin, delicate, parchment-like skin which may be missing in spots due to its fragility during transport.

A consumer can distinguish whether a potato is truly new by its skin; immature potatoes have flimsy, parchment-like skins that one can peel off with one's fingers.

New potatoes are prized for their high moisture content, creamy texture, and because they can be cooked whole in their skins. They're especially good steamed or roasted. They're more perishable than other potatoes, so it is important to use them within a few days after buying them. That is why freshly dug potatoes are the tastiest.

New potatoes are prized for their high moisture content and creamy texture. They are especially good steamed or roasted.

Due to their thin skins, new potatoes are far more perishable than other potatoes, e.g. they dry out very easily and are best used within a few days after buying them. Once a potato is dug regardless of maturity, two processes immediately commence: they begin to lose moisture and they begin converting their starch to sugar. Mature tubers manage to slow this process to a rate that allows them to survive until the next season. Immature tubers deteriorate far faster due to their much thinner skins and will not necessarily survive until the next season.

Do not confuse new potatoes with baby potatoes. "New potato" is a much abused phrase.

See also Frühkartoffeln. See also Skin set

New Leaf® potato varieties A range of genetically-modified potato varieties developed by Monsanto Company. Initially, Monsanto developed and received approval from USDA, EPA and FDA for the cultivation of and sale as food and food stuff of a Russet Burbank variety infused with genes from a soil-borne bacterium *Bacillus thuringiensis* subsp. *tenebrionis* (*Btt*) to furnish resistance to Colorado Potato Beetle (CPB). In 1995, New Leaf® Russet Burbank was released first, soon followed by New Leaf® Atlantic, then New Leaf® Superior, and finally New Leaf® Snowden.

New Leaf® potatoes are sometimes called *Btt* potatoes.

In 1998 Monsanto received approval from the US Dept. of Agriculture, EPA, FDA, APHIS, and Canada's CFIA and Health Canada before releasing NewLeaf Plus® Russet Burbank which had combined resistance to both CPB and Potato Leafroll Virus (PLRV).

In 1999 Monsanto received approval of NewLeaf Y® varieties Russet Burbank and Shepody which had combined resistance to both CPB and Potato Virus Y (PVY) from all of the above agencies.

Monsanto created a subsidiary called NatureMark in 1995 to market its NewLeaf®, NewLeaf Plus® and NewLeaf Y® potato varieties.

New Leaf® varieties immediately became desirable in the market place. At the time of the original release of New Leaf® Russet Burbank in 1995, potato farmers were flummoxed by their inability to control the Colorado Potato Beetle which had acquired resistance to all known insecticides and were once again becoming an uncontrollable detriment to their bottom line. With no other alternatives, farmers and seed growers began gearing up with Monsanto's New Leaf® varieties. They quickly proved very effective against CPB without application of any chemical pesticides and shortly after their introduction seed growers found themselves in the unusual situation where it was impossible to meet demand for New Leaf® varieties. They could not increase acreage fast enough. It seemed a huge success for everyone.

NewLeaf Plus® was commercially grown mainly in the Pacific Northwest. It produced healthy potato crops, free of net necrosis with a markedly reduced or zero requirement for insecticide application. Farmers and processors enjoyed most of the benefits of NewLeaf Plus® through reduced production costs.

Commercial production of NewLeaf Y® was localized mainly in the central and eastern United States and Canada where it eliminated seed reinfection by PVY in these regions—a great benefit to seed growers. Farmers benefited not only from higher yields of higher quality tubers in potato crops free of CPB damage and PVY infection, but also a markedly reduced need for pesticide.

U.S. production of New Leaf® potatoes of all kinds peaked in 1999 at 55,000 acres, then fell precipitously. Some sources pretend to not know why New Leaf® failed in the marketplace. For those paying attention at the time, this was not a mystery: It was a confluence of circumstances.

Despite the fact that New Leaf® potatoes were the fastest varietal adoption in the history of the US potato industry, market growth never was as rapid as Monsanto (NatureMark) would have liked. They wanted to recoup their investment since 1986 in GM technology as rapidly as possible. While NatureMark had established royalties and set in place distribution contracts preventing growers from saving New Leaf® seed for the next year to control their cash flow, other factors were beyond their control.

Some growers and others began questioning whether the New Leaf® cultivars, especially New Leaf® Russet Burbank were performing up to par with regular Russet Burbank which is known for clonal variations among seed stock. This concern caused some to run large-scale field trials to compare. Also, there was the requirement established by USDA that a portion of the acreage be planted with non-*Bt* cultivars for resistance management. Not only did these practices reduce the planted acreage of New Leaf® cultivars, but they required farmers to grow both kinds and keep them separate. This was a huge pain-in-the-butt for farmers not used to or set up for doing so.

Another factor was the registration in 1995 of a new insecticide, Imidacloprid, which gave farmers excellent control of CPB and aphids and early season control of *E. fabae*. Imidacloprid offered growers a conventional alternative for CPB control without being limited by varietal selection. Some farmers who had switched to New Leaf® varieties began to return to their normal seed sources to avoid what amounted to onerous requirements set by Monsanto. They believed pesticides were cheaper than the trouble of dealing with Monsanto's GM seed potatoes.

At about the same time, a public outcry against genetically-modified food stuffs began in the U.S—this despite the measures taken by Monsanto, the USDA and Health Canada to address these concerns during the registration and approval process. Monsanto and USDA had extensively discussed food and environmental safety issues throughout the registration and approval process. USDA proposed and Monsanto conducted experiments to expose any potential adverse effects and any potentially harmful traits, especially transencapsidation of unrelated virus RNA with coat protein. No issues were ever identified. Still, as media attention grew, there was some public demand for the segregation of GM potatoes in the marketplace.

Finally, in 1999, fully organized anti-biotech campaigns aimed at consumers began. The large end-users of potatoes in the North American quick serve industry became concerned that their market share might be negatively impacted not in North America, but in Europe and Japan because they were using *Btt* potatoes in their North American markets. Strategies to segregate GM and non-GM potatoes were attempted, but these changes in practice did not add value to their businesses.

Curiously, this reaction occurred despite the fact that NewLeaf Plus® and NewLeaf Y® varieties were approved by all US and Canadian agencies for food export to

Japan, Mexico, and Australia. Furthermore, New Leaf® Superior was approved for cultivation in Bulgaria, Romania, and Russia.

In July 1999, Gerber's and Heinz banned all genetically engineered (GE) ingredients from their products. In Feb 2000, Frito Lay announced that 95% of its corn would be GE-free and J.R. Simplot cancelled all contracts for NewLeaf® potatoes at its processing plants. The final straw fell in April 2000 when McDonalds began telling its buyers to stop buying Monsanto's GE New Leaf® potatoes.

McDonald's decision to ban GM crops from its food chain had a major impact. After the 1999 season the processors decided they could not afford the market risk associated with GM potatoes. Potato processors, also under pressure from export markets in Europe, were forced to suspend contracts. International trade barriers were more substantial for GM potatoes than other technology adoptions. Thus, more than 60% of the USA market was closed to GM potatoes. This led to the processors and commercial growers discontinuing use, hence the loss of a market for NatureMark's potatoes. One additional factor that led to the rapid demise was that only 3% of the USA potato acreage was *Btt* potatoes; Closing this part of the market had little impact on potato supplies and didn't lead to widespread market disruption.

By March 2001, recognizing the U.S. marketplace was clearly against it, Monsanto quietly began withdrawing its New Leaf® potato from its remaining contractual obligations. NatureMark was dissolved after the 2001 season.

Despite all of the above, New Leaf®, NewLeaf Plus® and NewLeaf Y® potato varieties are still approved for use in the US, Canada, Japan, Mexico, Australia, Bulgaria, Romania, and Russia as described above.

For those attempting to follow any liabilities potentially associated with any New Leaf® varieties, please be aware of the following mergers, divestments, reorganizations and other corporate agreements. On 1 Sep '97, Monsanto Company entered into a distribution agreement with Solutia, which at that time, acquired Monsanto's chemical business. On 19 Dec '99, Monsanto Company, then calling itself Pharmacia, agreed to merge with Upjohn, Inc. On 9 Feb 2000, Monsanto Ag Company, the agricultural products business of the original Monsanto Company (now called Pharmacia), became a wholly-owned subsidiary of Pharmacia. On 31 Mar '00, the merger with Upjohn, Inc. became official and Pharmacia's wholly-owned Monsanto Ag Company was renamed Monsanto Company. On 1 Sep '00, Monsanto Company entered into a Separation Agreement with Pharmacia relieving the latter of any liabilities associated with the original Monsanto agricultural products business. On 1 Jul '02, Monsanto Company and Pharmacia Corp. amended the 1 Sep '00 Separation Agreement to clarify respective rights and obligations relating to indemnification obligations.)

New York Seed Improvement Cooperative, Inc.

New York Seed Improvement Project The New York Seed Improvement Project (NYSIP) operates within Cornell's Plant Breeding extension program and consists of two divisions:

Foundation Division: The goal of this division is to develop foundation seed stocks from breeder seed as the base for further production. Plant breeders normally produce only small amounts (i.e., ounces or pounds) of new varieties of seed. The Foundation Division of NYSIP develops breeder seed at larger quantities (i.e., bushels or tons) required as planting stocks for Certified seed growers.

Certification Division: Certified seed is recognized in national and state legislation as seed meeting high standards for genetic purity and quality. In New York, seed certification responsibilities are delegated to Cornell by the Commissioner of the New York State Department of Agriculture and Markets. At Cornell, these responsibilities are assigned to the NY Seed Improvement Project (NYSIP) within the

Department of Plant Breeding and Genetics and Biometry. Trained inspectors from thke project inspect seed fields to make sure they meet the high standards required for certified seed. Harvested seed lots must pass high quality standards. Certified seed, labeled with its distinctive blue tag, provides a standard for seed quality for NY farmers.

Net necrosis Sometimes called internal net necrosis, this disease afflicting potato tubers is the browning of the vascular system of the potato tuber rendering them unmarketable for both tablestock and processing, especially potato chips and French fries. Net necrosis occurs when specific cells within the tuber, the phloem tissues, become damaged and die while others remain unaffected. The resulting characteristic pattern resembles a 'net' or 'netting', hence the name. Symptoms first appear as light to dark brown strands of discoloration in the flesh at the stem end of the tuber. These necrotic strands can continue to progress the length of the tuber either in the field or in storage. Symptoms cannot be detected in the tuber without cutting them in half. Net necrosis is usually caused by PLRV infection borne in the field by green peach aphids. Russet Burbank variety is especially susceptible to net necrosis.

Nitrogen Flush System (a.k.a. NFS). An inert gas (nitrogen) flush system used in packaging of a few 'high-end' potato chips and other snack foods to extend shelf life.

NFS apparatus can be installed in completely automated manufacturing lines of potato chips or other snack foods, but it can equally well be installed in hand-tended kettle cooking systems just ahead of the sealing machine. As a full bag of product approaches the sealing machine, it is flooded with fresh-food grade nitrogen and then immediately sealed by the sealing machine.

By filling the bag with nitrogen, many, if not all biological processes (mold, yeast, bacteria) causing deterioration of the product are halted. NFS results in "best by" shelf life exceeding six months, almost double the shelf life of non-NFS products.

NFS products are gaining popularity in the so-called 'green movement'.

Nuclear material Plant material produced in a aseptic or protected environment.

Nuclear seed stock Generally, this is the first field planting of seed stock for certified and foundation seed potato programs. It utilizes only laboratory-tested, pathogen-free stock which may be tissue-cultured plantlets, greenhouse-produced minitubers, stem cuttings, or line selections. Some certification programs allow a second generation of nuclear seed (planted from the first) to increase volume to meet contract demand.

Nutraceutical properties In potatoes, these generally focus on the antioxidant properties derived from the antioxidants found within the tubers. In general, these coincide with anthocyanins for red and blue/purple varieties and with carotenoids for yellow and orange varieties.

Oca tuber The oca tuber (a.k.a. oca, Irbia, cuiba, New Zealand yam, papa roja (red potato), oca potato) is neither a potato, nor a yam. It is rather a member of the wood sorrel family, *Oxalis tuberosa* – family Oxalidaceae. Oca is a perennial, common to the high-altitude Andes (2,800 to 4,000 m) from Venezuela to northern Argentina, where it is second only to the potato in popularity. It is often prepared as chuño. It is also found in the central highlands of Mexico where it is known as papa roja. It is grown commercially in New Zealand whence all fresh oca in the U.S. comes (at exorbitant prices).

The tuberettes are crisp and moist, thin-skinned, sour-sweet, starchy and waxy with a fruity-vegetable flavor, and quite unlike anything else. They range in a variety of eye-catching colors from yellow to pink, violet, red, and striped.

They are easy to prepare and surprisingly good, but they must be properly prepared before eating to remove the calcium oxalate crystals. Oca is traditionally eaten boiled in soups and stews. Only after proper preparation, can oca be eaten raw, roasted,

boiled, or candied like sweet potatoes. In the Andes, they are left out in the sun for a few days during which time they soften and become less-acid tasting (sweeter). They are also left out to freeze to reduce the acidity. Alternately, parboiling with several changes of water will remove the acidity. They are also left out in the sun for several weeks until floury and less acidic and becoming sweet tasting, similar to dried figs.

Off-type For seed potatoes: different from the cultivar, variety, strain, or selection on the application from certification.

Oomycetes A class of aquatic and terrestrial fungi (subdivision Mastigomycotina) that typically produce oogonia and zoosporangia in which form zoospores having one anteriorly-directed tinsel flagellum and one posteriorly-directed whiplash flagellum. Commonly referred to as 'water molds'.

Oomycetes are members of the Protista kingdom (organisms having both plant-like and animal-like characteristics.

Oomycete A member of the Oomycetes. See *Phytophthora infestans.*

ORAC assay Oxygen Radical Absorbance Capacity assay (commonly referred to as the ORAC assay). This is a test which determines free radical scavenging activity against the peroxyl radical for both water-soluble and lipid-soluble substances. It is one of the measures used to determine the antioxidant capacity of various foods.

Organic potatoes Organic potatoes are those raised without using most conventional pesticides, petroleum-based fertilizers, or sewage sludge-based fertilizers. Federal and state regulations prohibit the use of genetic engineering, ionizing radiation, and sewage sludge in organic production and handling. As a general rule, all natural (non-synthetic) substances are allowed in organic production and all synthetic substances are prohibited.

Labeling standards are based on the percentage of organic ingredients in a product. Products labeled "100 percent organic" must contain only organically produced ingredients. Products labeled "organic" must consist of at least 95 percent organically produced ingredients. Products meeting the requirements for "100 percent organic" and "organic" may display the USDA Organic seal.

Processed products that contain at least 70 percent organic ingredients can use the phrase "made with organic ingredients" and list up to three of the organic ingredients or food groups on the principal display panel. For example, soup made with at least 70 percent organic ingredients and only organic vegetables may be labeled either "made with organic peas, potatoes, and carrots," or "made with organic vegetables." The USDA Organic seal cannot be used anywhere on the package.

Processed products that contain less than 70 percent organic ingredients cannot use the term "organic" other than to identify the specific ingredients that are organically produced in the ingredients statement.

Certification standards establish the requirements that organic production and handling operations must meet to become accredited by USDA-accredited certifying agents. The information that an applicant must submit to the certifying agent includes the applicant's organic system plan. This plan describes (among other things) practices and substances used in production, record keeping procedures, and practices to prevent commingling of organic and non-organic products. The certification standards also address on-site inspections.

Farms and handling operations that sell less than $5,000 a year in organic agricultural products are exempt from certification. They may label their products organic

if they abide by the standards, but they cannot display the USDA Organic Seal. Retail operations, such as grocery stores and restaurants, do not have to be certified.

Organoleptic properties In the world of food science, i.e. food and nutrition, these are the aspects of a food that an individual experiences via the five senses: sight, smell, taste, touch, sound. These qualities will include appearance (size, shape, color, texture), smell (odor, aroma), taste (sweet, sour, bitter, salty, pungent, astringent), touch (texture, mouthfeel, temperature), sound (crunch, pop, sizzle, chop).

Taste is actually a combination of flavors and smells further complicated by mouthfeel and temperature.

Smells are usually classified as odors or aromas. Odor is for unpleasant and aroma for pleasant nature.

Smell and taste combine to result in flavor. The two cannot be separated when assessing flavor. One of the reasons it is so hard to describe flavor precisely is due to the large number of factors involved combined with broad variation of each individual's sensitivity to any particular taste and smell or combination thereof.

Texture may be a visual property or a touch property. Texture may be powdered, soft, smooth, rough, gritty, rubbery or waxy. Texture is a component of mouthfeel.

Organoleptic properties are essential when assessing food safety. They are crucial to consumer acceptance in the marketplace.

Organochlorines A class of pesticides.

Organophosphates A class of pesticides.

Outcross, Outcrossing In plant breeding, the practice of introducing unrelated etic material into a breeding line. Outcrossing increases genetic diversity, thus reducing the probability of an individual being subject to disease or reducing genetic abnormalities.

Out-crossing of transgenes is possible when compatible hybridization partners are found nearby. The most common way of out-crossing is the dispersal of pollen to sexually compatible plants. This can occur by the transfer from crop genes to wild relatives (e.g., rapeseed to turnip rape) or by the exchange of genes between or among crops (e.g., sugar beet to garden or fodder beet, or maize to maize).

In potato, this becomes somewhat more complicated because some potatoes are diploids while others are tetraploids (please know there are also triploids, hexaploids etc.).

Tetraploidy of potato makes its breeding difficult relative to outcrossing.

Overcompensation In entomology, the idea that maternal plants can express compensatory traits in their progeny in response to small amounts of stress by herbivores.

Pachamanca A traditional, festive way of cooking in the Andean region. A hollow in the ground is lined with hot stones on which potatoes, sweet potatoes, maize and meats are placed in layers that are divided by herbs and leaves, often sprinkled with chicha, and then covered with more hot stones and left to cook.

Pale potato cyst nematode See *Globodera pallida*

Papa Spanish word for potato.

Papa criolla A species of potato grown in Columbia, South America.

Papa seca A native product of the Andean Mountains of South America. To make *papa seca* (dehydrated potato) tubers are boiled, peeled, cut into chunks, sun-dried, and then ground into a starchy staple that is eaten with pork, tomatoes, and onions. *Papa seca* is consumed more widely than *chuño* in urban and coastal areas and can now be purchased in local supermarkets.

Parentage The source material for varieties of hybrid origin. The formula consists of the names of the parents connected by multiplication signs (x). The order of the names may be alphabetical, or, when the female parent is known, with the name of the female parent first. If the genus and species are common between both parents, they are omitted and cultivar names are used alone. This is usually the case for potatoes. Example: Parentage of Yukon Gold is Norgleam x W5279-4. (A further example, little known outside of potato breeding circles, is that the W5279-4 is a hybrid of *Solanum phureja* x *Solanum tuberosum* 'Katahdin'.)

Parasite An organism that derives its food from the body of another organism, the host, without killing the host directly; also an insect that spends its immature stages in the body of a host that dies just before the parasite emerges (this type is also called a parasitoid). A certain species of mosquito, for example, is the vector for the tropical disease malaria; the human who is infected by the parasite and its vector is the host. A tick is a parasite that receives its nutrition from human and other animal blood. A saprophyte is an organism that lives off dead or decomposing material.

Pathogen An agent that causes plant disease. It may be biotic or abiotic.

Pathovar In plant pathology, the term *pathovar* is used to refer to a strain or set of strains of phytopathogenic bacteria with the same or similar characteristics, differentiated at infrasubspecific level from other strains of the same species or subspecies on the basis of distinctive pathogenicity to one or more plant hosts.

This was codified in a revision to the International Code of Nomenclature of Bacteria and adopted in 1992.

The name of a pathovar is a ternary or quaternary combination, consisting of the name of the genus followed by a specific epithet, and where appropriate a subspecific epithet preceded by the abbreviation 'subsp.' and finally by the pathovar epithet preceded by the abbreviation 'pv.' (pathovar). Example: *Erwinia chrysanthemi* pv. *dianthicola*, an old synonym of *Dickeya dianthicola*.

Patent Personal property which may be sold to others or mortgaged; it may be bequeathed by a will, and it may pass to the heirs of a deceased patentee.

Peck The fourth part of a bushel, a dry measure of eight quarts. For potatoes, a peck was standardized at 15 pounds; four pecks comprise a bushel. Once commonly used in the potato trade, it is now obsolete.

Pectobacterium spp. A bacterial pectolytic genus of the family Enterobacteriaceae proposed in 1945, but which did not gain acceptance until 1998. In 1999 after rDNA analyses of six species of *Erwinia* showed that they were not properly classified, they were transferred into the new genus of *Pectobacterium*.

Amongst the six transferred were the potato pathogens *Pectobacterium carotovorum* subsp. *carotovorum* (syn. *Erwinia carotovora* subsp. *carotovora*) and *Pectobacterium atrosepticum* (syn. *Erwinia carotovora* subsp. *atroseptica*).

Pectobacterium chrysanthemi In 2005, *P. chrysanthemi* species was elevated to the genus level and renamed *Dickeya* which was divided into six genomo-species (*D. dianthicola*, *D. dadantii*, *D. zeae*, *D. chrysanthemi*, *D. dieffenbachia* and *D. paradisiaca*) and nine biovars which largely resembled the initial *Erwinia chrysanthemi* biovar division.

Pectolytic Adj., In biology, biochemistry and plant pathology: designating or involving degradation of pectins; able to degrade pectins; (of an enzyme) acting as a pectinase.

Pectinolytic

Peduncle The main stalk of inflorescence (blossoms, i.e. flowers) branching from the main stem (culm). The peduncle is normally divided into two branches. Each branch is usually further divided into two other branches forming a so-called cymose inflorescence.

From the branches of the inflorescence arise the flower stalks (pedicels), whose tips merge into the calyx. The pedicels bear a joint (articulation) where flowers or fruits may drop off. In some cultivars this articulation is pigmented. The position of the articulation is a useful taxonomic character.

Peeling efficiency The ratio of the weight of potato chips produced from a given weight of tubers. A high peeling efficiency is in excess of 80%. Many varieties achieve a good efficiency of 70 to 79 percent. Peeling efficiency deteriorates in most varieties during storage.

Perennial A plant that can live three or more years and flower at least twice. Less rigorously, any plant that lives for more than two years. Potatoes in the wild are perennials, the tubers allow them to continue on to the next growing season.

Perfect potato The qualities of the perfect potato are a function of its intended use. There is no one potato variety (cultivar) that is perfect for everything. The characteristics required for baking, frying, chipping, boiling, salads, processing, etc., differ quite substantially from each other. No single potato variety can meet all of those requirements.

Periderm Several layers of corky cells located on the outside of the epidermis of a potato tuber and containing high amounts of suberin. The periderm may contain varying amounts of phytopigments such as anthocyanins and carotenoids giving the tuber its skin color.

Perishable Agricultural Commodity A term specifically defined by the Perishable Agricultural Commodities Act of 1930 to mean fresh and frozen fruits and vegetables.

Pesticide Any substance or mixture intended for preventing, destroying, repelling, killing, or mitigating problems caused by any insects, rodents, weeds, nematodes, fungi, or other pests; and any other substance or mixture intended for use as a plant growth regulator, defoliant, or desiccant.

Pesticide resistance The genetically acquired ability of an organism to survive a pesticide application at doses that once killed most individuals of the same species.

Pest management Any insect or disease that damages leaves can reduce the amount of light intercepted by the canopy and limit tuber growth. Among the most serious of these pests are Colorado potato beetle, late blight, early blight, and Verticillium wilt.

Pests Creatures, often insects that humans consider harmful. Insects, bugs, birds, mammals, rodents, and other creatures that compete with farmers for their crops are invariably called "pests." (They probably have similar feelings about farmers.)

pH A value used to express relative acidity or alkalinity on a scale of 0 to 14 with 7 being neutral. The pH scale is logarithmic which means that a pH reading of 6 is ten times more acidic than a reading of 7.

Crops, ornamentals and turf require careful pH management to optimize production, quality and appearance. The wrong pH will lock nutrients in the soil making them unavailable to plant roots. A pH that's too high or low can make disease, insect and weed problems worse.

See Soil pH.

Phenolics The structural backbone for most antioxidants found in plants. They consist of at least two six-carbon rings (benzene rings) connected by a chain of three carbons. Chemically active functional groups such as oxygen, sulphur, nitrogen, alcohols are attached to the carbons at various positions along the chain or rings. Complex phenolic compounds (flavonoids) may protect plants from insects, disease and environmental stress. They also have anti-inflammatory and antiseptic properties. Some exhibit antiviral properties. The phenols are a broad group of plant constituents ranging from sugar-containing phenolic glycosides to salicylic acid.

Potatoes contain phenolic compounds, most important are the acids. Chlorogenic acid comprises about 80% of the total phenolic acids with vanillic acid and p-coumaric acid comprising the remainder.

Unfortunately, the beneficial aspects of phenolic acids in potato are almost entirely nullified by cooking.

See also Polyphenols.

Phenotype The observable characteristics of an organism such as its morphology, development, biochemical or physiological properties, behavior and products of behavior (such as a bird's nest), either in total or with respect to one or more particular named characteristics.

Phenylpropanoids A diverse group of plant secondary metabolites that number in the tens of thousands and include phenolic acids, flavonols, and anthocyanins. Phenylpropanoids have multiple health-promoting properties and can function as antioxidants, or have anti-inflammatory, hypotensive, anti-cancer effects or promote cardiovascular health. High phenolic potatoes were found to decrease inflammation and oxidative damage in men. Likewise, carotenoids promote cardiovascular health, are chemopreventive, and lutein and zeaxanthin reduce the risk of age-related macular degeneration. Besides their physiological roles, phenylpropanoids and carotenoids influence the nutritional value of potatoes.

Phenylpropanoids are metabolized by digestive and hepatic enzymes, by intestinal microflora, and have a widely varying bioavailability.

Phenylpropanoids are the major source of dietary antioxidants. Consumers have become increasingly aware of phenylpropanoids due to high-profile news coverage on the health benefits of antioxidants, green tea, coffee, red wine and resveratrol, and the general perception that colored fruits and vegetables are desireable in the diet.

Perhaps less well known is that potatoes are an important source of phenylpropanoids; indeed, potatoes are the third largest contributor of

phenylpropanoids in the American diet behind oranges and apples—and that study was based upon white-fleshed potatoes which have only minimal concentrations of phenylpropanoids, mostly chlorogenic acid (CGA) which is a colorless compound and other tuber hydroxycinnamic acids. Thus, there is potential for pigmented potato varieties to contribute a far higher amount of phenylpropanoids in the diet. Yellow-fleshed, as well as purple- and red-fleshed potatoes have far higher concentrations of these compounds, though public acceptance of colored potatoes is still in its infancy.

Furthermore, phenylpropanoids have other important roles in plants, including disease/pest resistance. Scientists are attempting to figure out how to enhance production of phenlpropanoids in potatoes. Tuber phenylpropanoids appear to be developmentally regulated, with immature tubers typically having higher amounts. Baby potatoes are already valued by consumers for their taste and are perceived as a premium product. Along with taste, the higher phytonutrient content of many "baby potatoes" is likely to appeal to many consumers.

Tuber phenylpropanoids are modulated by environmental stimuli and various genes in the pathway are induced by various stimuli. On-going research indicates that northern latitudes have cooler nights and longer photoperiods with unique UV-B and red to far-red light ratios, all of which influence phenylpropanoid biosynthesis. Anthocyanins and flavonols were more abundant in bilberries and white birch from the north of Finland compared to the south. Also regulated by environment are carotenoids, C40 isoprene derivatives that function as photoprotectants in plants. Carotenoids increased in kale with increasing temperature, but decreased in spinach. As with phenylpropanoids, light intensity influences carotenoid expression. Larger xanthophyll pools are found in leaves in sun versus shade, whereas increased zeaxanthin is associated with cold-hardening in evergreens.

Scientists are trying to metabolically engineer parts of the phenylpropanoid and then examine how this affects tuber phenotype, metabolites and gene expression. A better understanding of tuber phenylpropanoid regulation can facilitate development of potatoes with superior nutrition.

Secondary metabolites are well known to be subject to environmental control in plants; however, much remains unknown about environmental effects on tuber secondary metabolites, especially in non-extreme conditions where stresses such as drought or severe disease have not been deliberately or inadvertently introduced

Potato variety Magic Molly has especially high concentrations of phenylpropanoids.

Phoma rot

A disease of stored potatoes in the Atlantic provinces of Canada. Also called pocket rot and buttonhole rot. Tubers are infected by a fungus, *Phoma exigua var. exigua*, through wounds caused by rough handling during harvest and grading operations. Wet, cool soils at harvest will increase the incidence of Phoma rot.

Phoma rot appears as gray to brown circular depressions on the surface of the tuber. Cracks may form in the skin covering the depression and the tissue underneath is black. The diseased tissue is easily removed leaving a cavity bordered by healthy tissue.

Photoperiod In botany, a reference to the number of daylight hours in a day. Photoperiod varies from consistent 12 hours of daylight at the equator up to 24 hours of daylight at the poles. Plants with specific photoperiod requirements are often characterized as short-day or long-day. Various phases or steps in plant development are triggered by cues derived from the photoperiod. Hence, short-day plants will behave quite differently under long-day conditions and vice versa. Curiously, despite its name, this term is actually a response of flowering or tuberization to the length of darkness rather than daylight.

Photosynthesis The process in plants, usually employing chlorophyll, that uses light, carbon dioxide and water into plant sugars and oxygen. Expressed another way, the process plants use to change air and water into food, using the sun's energy.

Physiological age A measure of sprout development in the seed tuber. Physiological age of potato seed is a factor in efficacy and performance of the seed and may have a huge impact on yield. Factors such as temperature and humidity affect how fast tubers age. As storage temperature increase above 40 F the physiological age of tubers increases proportionally. Physiological age also affects internal quality of tubers, i.e. aged tubers will lose moisture, shrink and soften.

Physiologically aged seed tends to produce potato plants with numerous stems that sprout, develop rapidly and die early. High stem numbers usually result in a high number of tubers per plant, which reduces average tuber size by reducing the amount of carbohydrate available to each tuber during bulking. Early death also shortens bulking time and limits overall productivity. By comparison, plants from physiologically young potato seed begins to bulk later than those from aged seed, which may shorten the linear tuber growth phase in areas with a short growing season.

Physiological day, abbrev. P-day A measure of the heat useful for the growth and development of potatoes. Early maturing varieties such as Norland require 800 P-days, and later maturing varieties such as Russet Burbank require 1000 P-days. Insufficient P-days will reduce yield and will affect tuber quality factors such as accumulation of dry matter and fry color.

Physiological disorder A plant disorder caused by factors other than a pathogen; abiotic disorder. Most generally, in potatoes, physiological disorders are related to weather conditions, i.e. excessive rainfall, drought, excessive heat or cold, and such disorders are expressed as tuber defects. Hollow heart, growth cracks, second growth, internal necrosis are common physiological disorders. Susceptibility to such defects varies dramatically among varieties. Some are resistant; some are susceptible. Major efforts by potato breeders over the past few decades have reduced susceptibility to some of these disorders, and this work continues as physiological disorders are of some economic importance to the industry.

Phytochemicals Naturally occurring chemicals found in plants, but which are not nutrients, vitamins, minerals or complex carbohydrates. On-going research indicates that some phytochemicals exhibit important physiologic and pharmacologic effects. Most phytochemicals are considered to be powerful antioxidants. Major classes of phytochemicals include terpenes which include carotenoids and lycopene, phenols which include flavonoids and isoflavones, and thiols which includes the sulphur-containing compounds in cruciferous vegetables and onions.

Phytophthora infestans Commonly known as the late blight fungus, it is actually not a true fungus at all, but is more closely related to kelp and brown algae. It is the most virulent pathogen afflicting potatoes and tomatoes worldwide. It is responsible for $3 billions US in crop losses annually.

Phytophthora infestans is a coenocytic oomycete. Taxonomically, it is believed to be correctly classified as follows: Kingdom Chromista, Phylum Oomycota, Order Peronosporales, Family Peronosporaceae, Genus Phytophthora.

While *Phytophthora infestans* has been studied since its identification in 1863 by Anton de Bary, it is only recently that scientists have begun to understand the full genetic diversity and adaptability of this prolific and highly adaptable pathogen. A review of late blight history may put this in perspective.

It is now known that *P. infestans* can reproduce either sexually or asexually. So far, two main 'mating types', called A1 and A2, have been identified. Historically, it was long held that *P. infestans* originated in the Toluca Valley (central highlands) of Mexico where it had jumped to cultivated potatoes. It is now thought that these two types co-evolved with the potato (*Solanum tuberosum*) and its wild relatives in the Andes. Wherever it originated, many pathologists believe that the A1 mating type traveled from Mexico to the Northeast US around 1840 in a shipload of potato tubers. Before the disease appeared in Ireland it caused a devastating epidemic in the early 1840s in the northeastern United States. From there it traveled to Belgium via another shipload of potatoes in 1844. During these few years from about 1842 on, it destroyed potato crops all over Europe and the eastern US. The destruction and resulting famine wrought in Ireland is known as one of the greatest disasters in human history. (While the true cause of this famine is actually more about political stances and the 'conventional-wisdom' of the time than it is about potatoes and pathenogenic organisms, it nonetheless stands as one of the most remarkable tragedies of the nineteenth century.)

The type A1 pathogen spread itself all over the world. Plant breeders developed some degree of resistance in new potato varieties and potato farmers fought the disease with chemicals. At best, *P. infestans* was held at bay.

This all changed after the severe drought struck Europe in 1976 and its potato crops failed. Potatoes were imported from Mexico to offset the crop losses. A few years later, late blight struck European potato crops with virulence unseen before. It was not coincidence that the blight was worst in those areas near where Mexican potatoes had been shipped. In 1984, the A2 mating type of *P. infestans* was identified in potato crops of Switzerland. With both mating types in the same area, reproduction had occurred both sexually and asexually.

The oospores had thick outer walls perfectly designed to survive in soil, stems, and tubers for long periods, thereby remaining infectious in the fields longer than before This meant that oospores and mycelium propagules were available to serve as inoculum sources of the disease. It also meant that the disease could propagate over wider temperature and humidity ranges. Spore germination was faster and infection efficiency was increased. The window of opportunity for control with pesticides was narrowed significantly. Independently, new populations with similar characteristics were introduced directly from Mexico to the United States and Canada. Late blight was again the world's greatest threat to potato production.

During the early 1990s several exotic strains of *P. infestans* were introduced from Mexico. These strains increased the severity of late blight on potato and tomato because they were more aggressive than earlier ones in the United States and Canada. They initiate infections more quickly and reproduce more profusely, thus causing epidemics to occur more rapidly. To combat these strains it is necessary to use more resistant potato and tomato cultivars and/or to use fungicides more intensively. Unfortunately, resistance of potato foliage and stems is not necessarily related to tuber resistance. For example, though the foliage of the cultivars Allegany and Elba is moderately resistant, the tubers are quite susceptible.

Sexual reproduction also creates a greater genetic diversity in the population, making it more adaptable to changing conditions. Strains of *P. infestans* are already resistant to fungicides.

Pickouts See Culls

Pink Rot Potato disease caused by the soil-borne fungus *Phytophthora erythroseptica*. This generally occurs during seasons of excessively wet weather. Pink rot is often collectively lumped with pythium leak, a fungal disease caused by a different fungus, *Pythium ultimum*. Together, they are called 'water rot'.

Pith The central part of the tuber which branches out to the eyes. See Inner Medulla.

Pitting A method of storing potato tubers over the winter in a shallow pit covered with layers of straw and dirt. In actuality, the term 'pitting' is a misnomer for there is no pit or trench as such. Instead, what one really has is a pile of potatoes which is covered with layers of straw and dirt.
it ought to be called piling there is Instead, to pit potatoes for the winter (often only 6-8 inches below grade) approximately 3 feet wide and equally high. , but which also necessitated the covering of the 'pit' or the tubers with an insulating layer of straw or mulch hay not less than 6 inches thick and over that a layer of soil or topsoil not less than 6 inches thick. This so-called 'pit' was effectively protected from below-freezing temperatures by the straw or hay insulation. It could not be 'opened' up until spring. Therefore, potato growers would have to have two storage areas. One, in a 'pit' awaiting spring, and another in the cellar to be used until Spring arrived.

Pitting will only work if good drainage is provided and if sufficient coverage is applied to protect the tubers from below-freezing temperatures.

Plant establishment 'Plant establishment' refers to the growth period (Growth Stage II) from early sprouting until initiation of new tubers occurs, and this includes development of both roots and shoots. Many growers refer to this stage as vegetative growth. The mother tuber (seed piece) is important during early plant growth, but becomes less important as the new plant establishes its roots and shoots. A well-established root system is important for subsequent growth and can allow for quick regrowth after early season defoliation from frost, hail, or insect damage. This period lasts from 30 to 70 days depending on planting date, soil temperature and other environmental factors, the physiological age of the tubers, and the variety.

Planting date Planting too early can lead to seed piece disease and rot, slow emergence, and decreased plant vigor, which can slow tuber growth rates. Planting too late delays canopy development and reduces the time available for tuber bulking. The optimal planting date varies by region, but in all areas growers should wait to plant potatoes until daytime soil temperature warms to 50 °F or higher.

Plantlets Small plants produced under aseptic culture conditions in a laboratory.

Plant pathology The study of the diseases and disorders of plants. Disease can be defined as a harmful deviation from normal functioning of the physiological processes caused by an infectious agent. In the case of plant diseases, the causal agent maybe a fungus, virus, bacterium or a parasitic flowering plant. (A 'harmful deviation' caused by a non-infectious agent, for example, herbicide or nutrient deficiency, is a disorder.)

Plant spacing In potato planting, this is the horizontal distance between individual seed pieces. Closer than optimal plant spacing affects tuber growth in the same way as aged seed in that it increases tuber density relative to canopy size, thereby limiting the photosynthetic capacity to bulk each tuber. Although total yields may not be reduced, bulking rates of individual tubers decrease, this results in smaller tubers and lower marketable yields. Wider than optimal spacing can lengthen the time it takes to reach full canopy, which reduces carbohydrate supply to the tubers.

Ploidy The number of complete sets (x) of chromosomes in a vegetative (somatic) cell. Vegetative cells normally contain at least two sets of chromosomes.

The chromosome set of the potato consists of 12 chromosomes, thus x = 12. For example, haploid means one set and diploid means two sets. Cells of cultivated potato species may carry between two and six sets of chromosomes; thus cultivated potato species range from the diploid level to the hexaploid level. The expression 2n symbolizes the total of chromosome sets and, therefore, the total chromosome number in vegetative cells at any ploidy level.

The cultivated form of potato in North America and Europe is tetraploid, 2n = 2x = 48.

Ploidy level Ploidy is defined by the number of chromosome sets (x) present in a vegetative (somatic) cell. Vegetative cells contain normally at least two sets of chromosomes (diploid). An identifying genomic characteristic used to distinguish one potato species from another. Ploidy level can also be used to speculate on the hybrid origin of species.

PLRV Potato leafroll virus (PLRV) is a disease transmitted in the field by *Myzus persicae* and other aphids. It can also be carried by infected seed tubers. The leaves roll into cup shapes, even cylinders, and become brittle.

PLRV is a persistent virus vectored by several aphid species of which the green peach aphid (*Myzus persicae*) is the most important. PLRV continually presents major problems in seed potato certification due to viral perpetuation in seed tubers. Because of low PLRV tolerances in certified seed, intensive measures are taken to limit aphid populations. When infected seed is planted, PLRV can cause severe losses in commercial potato crops due to yield reduction and the development of a condition in tubers referred to as net necrosis in some cultivars. Due to increasing aphid populations in northern production regions over the past few growing seasons, the incidence of PLVR is becoming a growing concern and net necrosis has threatened producers of processing potatoes.

Polylactic Acid, Polylactide, PLA Common vegetable resins made from the sugars (starches) of vegetable plants as corn, sugar cane, sweet potatoes and potatoes. Polylactides are a class of biodegradable thermoplastic, aliphatic polyester derived from lactic acid. These resins resemble clear polystyrene with aesthetically appealing gloss and clarity.

PLA was discovered in the 1890s, but only recently found a route to market in the form of bio-degradable packaging. Widespread use of PLA has been slowed by a lack of cracking plants.

Packaging made from PLA is bio-degradable and reverts in less than 60 days in ideal conditions, namely in commercial composting installations. It normally takes 180 days to do so in commercial or municipal composting facilities. It will not degrade in landfills however.

Polymorphism In biology (from Greek: *poly*, meaning "many" and *morph*, meaning "form") is a discontinuous genetic variation where two or more forms, stages, or types exist in the same species within the same population. It can apply to biochemical, morphological, and behavioral characteristics, but must be discontinuous.

Polyphenols A broad class of phytochemical compounds found in plants. Polyphenol compounds are the plant pigments that give fruits, vegetables, teas, and herbs their red, blue and purple colors. These include apples, blueberries, cranberries, eggplants, red currants, grapes, grape juice, purple bell peppers, potatoes, raspberries, red wine, and green and black tea.

Polyphenols found primarily in citrus fruits are collectively known as bioflavonoids. These include rutin, kaempherol, quercetin, hesperidin and narigenin. They are considered to have antihistaminic, anti-inflammatory, antioxidant, anti-clotting, anti-tumor and vascular effects.

A distinct group of polyphenols known as the flavan-3-ols includes anthocyanidins, proanthocyanidins, catechins and tannins. These have been extensively studied for their antioxidant, anti-cancer, anti-tumor and cardio protective effects. Hundreds of studies have been done on green tea catechins to asses their cardiovascular effects. Red wine, grape juice, pine bark and grape seed extracts have been studied for their anti-clotting, antioxidant, cardiovascular and anti-cancer effects.

Polyploidy Potato has a number of ploidy levels ranging from diploid (2n = 24) to hexaploid (6n = 72), and include triploids, tetraploids, and pentaploids. Cultivated potato, *Solanum tuberosum*, is tetraploid (4n = 48), while other cultivated species such as *Solanum andigena*, contain diploids, triploids and pentaploids. The latter are restricted to the high Andes of central Peru and Bolivia.

Popchips™ A type of potato chip made from potato flour, potato starch, safflower oil, rice flour and cooked using a method similar to air-popped popcorn. The result is a chip that is neither fried in oil, nor baked, but rather "popped" using heat and pressure. Using this method, these chips have half the fat of a typical potato chip with no trans fat, no saturated fats, no cholesterol and no preservatives.

Popchips are manufactured by Popchips™ Inc., San Francisco, CA.

Positive Lot, Crop or Field A lot, crop or field, where the presence of a pathogen has been confirmed, based upon recognized tests.

Potash In fertilizer terminology, potash refers to potassium oxide (K_2O). For example, a fertilizer with 0-0-60 analysis will contain 60 percent K_2O equivalent by weight. This is somewhat confusing since the fertilizer material doesn't actually contain K_2O, and plants do not take up K_2O. It's simply the standard that has been adopted and used for many decades now. Occasionally, in scientific literature, percent potassium is used instead of percent K_2O. To convert potassium to K_2O, multiply by 1.2; multiply K_2O by 0.83 to convert to potassium.

Potash fertilizers range from 20 to 62 percent K_2O. They are all water-soluble and therefore agronomically effective. They consist of potassium in combination with chloride, sulfate, nitrate, and other elements. Common potash fertilizer sources include the following:

- Muriate of potash (MOP), or potassium chloride (KCl)
- Sulfate of potash (SOP), or potassium sulfate (K_2SO_4)
- Sulfate of potash magnesia, or potassium-magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$)
- Saltpeter, or potassium nitrate (KNO_3)

In addition to potassium, these fertilizers provide other needed nutrients. For example, MOP contains 60 to 62 percent K_2O and about 45 percent chloride. Sulfate of potash contains 50 to 53 percent K_2O and about 18 percent sulfur. Sulfate of potash magnesia contains 20 to 22 percent K_2O and sulfur and 10 to 11 percent magnesium. Potassium nitrate contains 44 percent K_2O and 13 percent nitrogen.

Muriate of potash is by far the most commonly used of the potash fertilizer sources. It comes in red, white, and colors in between. The question is sometimes asked, "Does the color of MOP make a difference in its agronomic effectiveness?" The answer is an emphatic No. Some crops may be sensitive to the chloride in MOP. Therefore, SOP or potassium nitrate may be the best source for crops such as potatoes, tobacco, fruit trees and others with low tolerance to chloride. Sulfate of potash magnesia is routinely used wherever there is a need for at least two of the three nutrients in that material.

Potassium is a major essential nutrient in crop production. Where it is deficient in the soil or where crop demands during specific growth stages exceed the soil's ability to supply adequate potassium, it must be supplemented through fertilization. All potassium fertilizers are agronomically effective and in most cases will perform similarly. Crop sensitivities, the need for accompanying nutrients, and market availability are factors that should be considered when selecting the best source for a specific situation.

Potato

An edible, starchy, perennial tuber of the Solanaceae family (*Solanum tuberosum*). It is one of the most widely grown commercial vegetables in Europe and North and South America. There are more than 4000 varieties (cultivars) of potato in commercial cultivation. The potato is unrelated to the sweet potato. Synonym: Irish potato.

The potato is an herbaceous plant classified as a dicotyledonous annual, although it can persist in the field vegetatively (as tubers) from one season to the next. In fact, volunteer plants growing from unharvested potato tubers unintentionally left in the field create many problems in pest management as well as deleterious affects on seed certification and commercial potato production.

Being a dicotyledonous plant, the potato has the characteristics of all dicotyledons including stems with vascular bundles placed in a circular arrangement and containing definite layers of xylem and phloem. The potato may be grafted within the species *Solanum tuberosum* as well as upon related species. Frequently one reads of tomatoes being grafted upon potato root stocks to obtain plants bearing tomatoes on the tops and potatoes underground. Such plants generally have no commercial value. Some potato breeders have grafted varieties of potatoes upon tomato stocks (or vice versa) to induce better flowering and seed setting and for disease studies.

The potato is a common plant, *Solanum tuberosum*, or one of its starchy, brown, white, yellow, red, or blue-skinned tubers. It is native to the Andean region of South America, but is now a staple food in most temperate countries. The tubers vary in form from roundish to an irregular oblong shape, have eyes more or less deeply set, and vary in weight up to a pound or more. The plants are raised from the eyes, which are planted in hills or rows. In addition to being used as food, potatoes are extensively used in the manufacture of spirits, starch, etc.

The name is applied to both the plants and the tubers. The plant is grown as an annual herb. The stem can attain a length up to almost 1 m (3 ft), erect or prostrate (decumbent), with pointed leaves and white to lavender to purple flowers. The fruit is a many-seeded berry about the size of a cherry, though many cultivars bear no fruit. Like the stems and the foliage, the fruit contains significant amounts of α-solanine, a poisonous alkaloid characteristic of the genus. Typically, three to six tubers form on the underground stem, although in some varieties there may be as many as 10 to 20, or even more. The tuber skin varies from white to brownish-white, to yellowish, pink to red, blue

to purple to nearly black. It flesh is typically yellow to white, though some varieties are pink to orange to red or blue to purple. Some are splashed with streaks of different colors. The plant, native to the Andes Mountains (but with forms of the species also found native as far north as New Mexico), was first taken to Europe in the mid-16th century by Spanish explorers.

Its early history is difficult to trace, partly because the name *potato* was also used by early writers for the sweet potato (*Ipomoea batatas*) and for other unrelated plants. Spanish explorers are believed to have brought it in the 16th century from Peru to Spain, whence it spread throughout Europe. It was brought to North America by European settlers probably around 1600; thus, like the closely related tomato, it is a food plant reintroduced to the New World.

The potato was first accepted as a large-scale crop in the British Isles. It became the major food in Ireland during the 18th century and was sometimes called Irish potato to distinguish it from the sweet potato. Ireland became so dependent on the potato that the failure of the 1845–46 crop in combination with policies and attitudes of the British government caused a famine resulting in widespread disease, death, and emigration reducing the population of Ireland by half.

The potato was also important in 20th century Europe, especially in Germany and Russia where it kept the populations alive during two world wars. With its high carbohydrate content, the potato is today a primary food of Western peoples, as well as a source of starch, flour, alcohol, dextrin, and fodder (chiefly in Europe, where more is used for this purpose than for human consumption). It grows best in a cool, moist climate. Germany, Russia, and Poland are the greatest potato-producing countries of Europe.

Potatoes are usually propagated by planting pieces of the tubers that bear two or three "eyes," the buds of the underground stems. The plant is sensitive to frost, is subject to certain fungus and virus diseases (e.g., mosaic, wilt, and blight), and is attacked by several insect pests, especially the Colorado potato beetle. Nutritionally, the potato is high in carbohydrates and a good source of protein, vitamin C, the B vitamins, potassium, phosphorus, and iron. Most of the minerals and protein are concentrated in a thin layer beneath the skin, and the skin itself is a source of food fiber; health authorities therefore recommend cooking and eating it unpeeled. Recent research is finding that yellow-fleshed, purple-fleshed and red-fleshed tubers have high concentrations of antioxidants and are thus being promoted for their health and nutritional qualities.

Potato is the fourth most important food crop in the world with 50 billion acres planted annually. Potatoes are the most consumed vegetable in the United States.

Potato bean See yam bean

Potato beetle *Lema trilineata*, one of the most destructive potato beetles until the advent of the Colorado Potato Beetle (*Leptinotarsa decemlineata*) in the 1850s. This earlier version of potato beetle belongs to the subfamily Criocerinae of the leaf beetle family Chrysomelidae (order Coleoptera). About 6 mm (less than 0.25 inch) long, it is yellow with three black stripes on its wing covers. Eggs are laid on the underside of a potato leaf, on which both larvae and adults feed. The larvae are camouflaged by the excrement the beetles pile on their backs. Two generations occur each year, the second of which spends the winter in the ground in the pupal stage.

Potato beetle See Colorado Potato Beetle (*Leptinotarsa decemlineata*).

Potato blight See *Phytophthora infestans*

Potato bottle

Potato bread In baking (cooking): originally, a bread that can be leavened with a primary ferment, formerly made with a sourdough utilizing the action of wild yeasts on a potato mash and producing the typical potato-bread flavor. It is now commonly prepared from a white bread formula to which potato flour is added.

Potato bug See Colorado Potato Beetle (CPB).

Potato cannon See Spudgun.

Potato cellar An underground or partially underground storage facility for keeping potatoes over the winter.

Potato chip In its simplest form: a thin slice of potato fried in deep fat or oil until crisp and then usually seasoned with salt or other flavorings. Often used in the plural.

Conventional wisdom, i.e. the 'potato chip creation myth' says that chef George Crum of Moon's Lake House, Saratoga Springs, NY 'invented' the potato chip in 1853 when Cornelius Vanderbilt (or some other equally prominent customer) sent his order of fried potatoes back to the kitchen because they were not crunchy enough (or not salty enough, or not thick enough, depending on the story). Not known for his diplomacy (some say he was ornery), Mr. Crum supposedly made a new order sliced thinner, fried them until they were crisp, salted 'the hell out of them' and sent them out to the dining room thinking that he would clearly make his displeasure known to his intemperate customer. Instead, he was shocked when the customer asked for more.

Most potato chip historians consider the above story apocryphal since the facts do not support it, and they instead attribute the invention of the potato chip to George Crum's sister-in-law, Katie Speck Wicks who also worked at Moon's Lake House. She is said to have been frying crullers and peeling potatoes at the same time and a piece of potato peel accidentally fell into the hot oil. After fishing it out, Katie and George tasted it and decided it tasted good. They decided to make more for sale. Indeed, it would seem likely that there never was a disgruntled customer at all. (But that would make a dull story.)

Even the Katie Wicks story has several versions. One says that Katie Wicks learned to make the chips from her brother-in-law, Peter Francis, a chef at the Sans Souci Hotel in Ballston Spa, a village near Saratoga Springs. Another says that Cary Moon, the proprietor of the Lake House, or his wife invented the chips. What is not in dispute is that Moon's Lake House promoted potato chips known as 'Saratoga chips' at the time and that at least regionally, the potato chip became a hot item.

In actuality, the potato chip was probably in existence for several decades before 1853. Mrs. N.K.M. Lee published her 1832 cookbook *A Boston Housekeeper* with a potato chip recipe. It happens that she plagiarized it *verbatim* from William Kitchiner's well-known and widely-used cookbook, *The Cook's Oracle*, which was first published in the U.S. in 1822 (widely popular, it had been published in the U.K. since 1817). While one can argue that the Kitchiner potato chip was supposed to be 1/4 inch thick and consequently was probably not served as crisp or crunchy as today's chips, the cooking instructions are more or less the same as for today's potato chips. If Katie Wicks or others are due any credit, it is for making the potato chip thinner and crispier than Dr. Kitchiner's. Certainly, Moon's Lake House must be credited for their promotion of 'Saratoga chips' which are clearly today's 'potato chips'.

Classic chips are the standard potato chip, thinly sliced, cooked in hot oil and salted. Most commercially produced potato chips come off assembly lines run almost entirely by computer software and robots. There is very little human contact with the potatoes from the time they arrive at the chip plant to loading the pallets on the trucks as

the end. Not only is this highly productive, but it assures utmost quality control and consistency of the product.

Rippled or wavy chips are essentially the same as classic, but are generally cut thicker and cut with a ripple. Many consider them more suitable for dips. They are a bit stronger and the ripples hold the dip.

Kettle-cooked chips are made in small batches without a conveyor belt—usually in a basket instead. In the U.K., these are known as hand-cooked. The texture of kettle-cooked chips is known for its extra crunchiness. They can be smooth-cut or rippled.

Baked chips are cooked in an oven rather than fried in oil. They contain less fat and fewer calories than fried.

Handmade chips are those made without automated machinery to peel, slice, or fry the potatoes. They can be of any style: classic, rippled/wavy or kettle-cooked.

Natural potato chips are defined by the US Food and Drug Administration as those containing no artificial flavorings, colors, or preservatives. The USDA definition has no regard for whether the potatoes were grown organically or not.

Light potato chips contain half the fat, or one-third fewer calories than regular potato chips. Typically, they are cooked in a fat substitute such as Olestra.

Reduced-fat chips contain at least 25 percent fewer calories than regular potato chips.

Potato culture The art and science of growing potatoes. All of the generally accepted practices used by commercial growers and gardeners to grow and keep potatoes for sale and personal use.

Potato cyst nematode (PCN) Name commonly given to two species of microscopic cyst nematodes that attack potatoes: *Globodera pallida* and *G. rostochiensis*. These are, arguably, the two most important nematodes with respect to international trade. They are certainly the most important constraint to potato production in the UK and Europe.

Potato cyst nematodes are thought to have co-evolved with their plant hosts (potatoes and other members of *Solanacea*) at altitudes above 2000 metres in Andean regions of South America. Potatoes were introduced into Europe around 1570, but PCN were probably introduced much later, on tubers taken to Europe from South America as part of the search for late blight resistance in response to the blight epidemics of the 1840s. The areas from which potato tubers were sourced in South America would have influenced the species of PCN that they carried. Further introductions were probably made over a period of years, although molecular analyses of European populations of PCN suggest that there have been relatively few introductions. Some of the introductions may have been via routes other than as contaminants of potato tubers, such as in guano shipments transported in old, PCN-contaminated sacks.

In both species, the female forms a hard covering around her eggs when she dies, creating a cyst which protects the eggs and developing juveniles from desiccation, predation and chemical control. Only a proportion of the eggs hatch from the cyst each year, and in *G. pallida* this occurs at a slower rate and with a later annual peak of hatching than *G. rostochiensis*. Most eggs have usually hatched after 7-10 years, but hatching can continue for 25-30 years.

These nematodes have no natural means of dispersal. The infective juvenile nematodes attracted by exudates from roots can only move about one meter in the soil. They are spread to new areas as cysts carried in soil, on seed potatoes, nursery stock, flower bulbs and potatoes for consumption or processing (the latter are mentioned only if there is a risk of their being planted or if care is not taken with disposal of waste soil.)

The introduction of a few PCN cysts will usually go unnoticed for several years until the infestation reaches a level at which it is detected either by pre-cropping sampling

and testing, or, more significantly, the appearance of symptoms such as stunted plants. Thus infested soil can be spread unwittingly within and between farms by normal agricultural practices well before the pest is detected. Surveys have shown PCN to be distributed wherever potatoes are grown, though it is rare in areas used for seed potato production.

It must be pointed out that prior to 1975, the genus for PCN was *Heterodera*. Since that time it has been *Globodera*. However, since both of the pests in question are still 'PCN', this fundamental change does not result in any change in policy. Also, please be aware that in the literature prior to that time, it is impossible to know which species is being referred to. *Globodera* species have round cysts, whilst all other groups (Heterodera and Punctodera) have lemon-shaped cysts. To further complicate matters, the *Globodera* group also includes other species which are not PCN.

Potato dextrin Roasted or calcined flour (starch gum) made from potatoes. Typically sold as an off-white powder. Molecular formula: $(C_6H_{10}O_5)_n$

Potato dextrin is widely used as an adhesive, especially on wallpaper (and formerly on postage stamps and envelopes), to make corrugated paperboard and packaging. It is used for sizing paper and in textiles. In the pharmaceutical industry, it is used as an inactive ingredient or filler in ointments. Potato dextrin is extensively used in coating systems in the food industry where it is used on meat, seafood and vegetables, especially frozen French fries.

Potato dextrin when wet has a decided taste and an unpleasant smell which made it less than desirable for postage stamps and envelopes. This is why wet paperboard boxes and other paper packaging, when wet smells so bad.

Potato dextrin resist A starch made from potatoes for use in the fabric industry. The dextrin acts like a resist or mask when used to make dyed colored patterns and surface designs on fabric.

Dextrin is typically supplied as a powder. It is dissolved in boiling water and allowed to cool to about 90 F and achieving the consistency of mayonnaise, thick soup, or pancake batter. It is then applied to the tightly stretched fabric with a squeegee or spatula or by hand as an even layer or in patterns as desired. The dextrin is allowed to completely dry. As it dries, it shrinks and patterns of cracks and splits will appear. A discharge agent is then applied to remove color from the fabric where it is exposed in the cracks, or a dye is applied to add color to exposed fabric. Or both processes can be performed. The dextrin acts as a resist or mask protecting the fabric beneath it from the above processes. After the desired effect is achieved, the remaining discharge agent and/or dye is rinsed off. Then the dextrin resist is softened with warm water and removed with a solvent.

Potato digger A horse-drawn or tractor-drawn machine designed to excavate potato tubers from the ground, separate them from the dirt and place them on the surface where they can be easily picked up and placed in barrels or bags or crates for later pick up and transport to storage or grading facilities. Later, potato pickers were attached behind the digger so that workers riding on the picker could remove vines, weeds, dirt and grass clods, rocks and other detritus from the tubers which were deposited in burlap sacks at the end of the picker. These sacks were placed on the ground behind the machine for later pick up.

Potato digger An obsolete colloquialism dating from WWI, referring to the Colt-Browning M1895 machine gun, nicknamed the 'potato digger' due to its unusual operating mechanism. This weapon was (is)

an air cooled, belt fed, gas operated machine gun that fires from a closed bolt with a cyclic rate of 450 rounds per minute.

Potato early dying (die) Potato early dying is characterized by wilting, dieback of foliage and premature senescence of the plant. It is generally believed to be caused by an interaction between the root lesion nematode *Pratylenchus penetrans* and the fungus *Verticillium dahliae*.

There is consensus that the fungal pathogen is primarily responsible for the characteristic symptom. But the interaction is complicated.

Potatoes will lose 10 percent to 15 percent of their yield when the initial inoculum of the fungus exceeds 10 propagules per gram or when 200 root lesion nematodes (RLN) per 100 cubic centimeters of soil are present. But when these pathogens occur together, the disease threshold falls to 3 propagules and 75 RLN.

Fumigation is effective because it reduces levels of both pathogens, but it is expensive and reduces the profitability of growing potatoes. About half of Michigan's potato acreage is "seriously challenged" by PED each year.

Nematologists believe a major part of the problem is a messed-up nematode ecology. The root lesion nematode is a plant feeder that attacks potato roots and stolons. Normally, soil contains lots of different types of nematodes, but when potatoes are grown in coarse, sandy, low-organic-matter soils there is little else for the RLN to live on. So when potatoes are planted, only the RLN feasts.

Studies show that soils higher in organic matter are less likely to lead to PED – because there are more nematodes of more kinds and some of them actually feed on RLN.

Potato flour A gluten-free, fine textured flour, made from cooked, dried and ground whole potatoes, including the peel. It is <u>not</u> the same as potato starch. Potato flour has a potato flavor, starch does not.

Potato flour can be used as an ingredient in potato based recipes to enhance the potato flavor and it is often mixed with other types of flour for baking breads and rolls. It is also sometimes as a thickener for soups, gravies, and sauces, but it does not thicken as much as potato starch.

Potato flour is commonly produced in Germany and other countries, slices of cleaned potatoes being dried, ground, and sieved. In Germany, a "potato sago" is produced. The starch cake obtained from the potatoes is crumbled to produce reasonably uniform-size particles that are rounded by tumbling or similar operations, heated to gelatinize.

Potato flower The inflorescence of the potato plant is a broad, flat topped cyme. The primary inflorescence is followed by a second and third order blooming as the previous dies (staggered blooming dates). This can sometimes be used to estimate the maturity of the plant.

Individual flowers are bisexual. They possess all four essential parts of a flower: calyx (sepals), corolla (petals), stamen (male elements: anther, filament) and pistil (female elements: stigma, style, ovary).

Flower color (corolla) can range from creamy white to yellow, pink, light blue, blue, red, purple, or striped with different tones and intensities depending upon the cultivar.

Bumblebees are the primary means of cross pollination; self-pollination most often occurs.

A significant number of potato cultivars are either pollen sterile or fail to set fruit because of some other means.

Potato fruit If established at all, potato fruits are small (to 1 1/4" diameter) and green, resembling a small tomato. The fruit is a berry with seeds in a mucilaginous pulp. Seeds are flattened and ovate, with up to 300 seeds per fruit. Sexual reproduction is the primary mechanism for crop improvement, outside of this, the fruit and seed are of little value.

Potato gun See Spudgun.

Potato harvester Sometime around the mid-1960s, the ubiquitous potato digger was supplanted by a more sophisticated machine that effected a more efficient method of harvesting potatoes. It was the next step in the evolution of potato harvesting equipment. It combined the operations of the potato digger and potato picker and added the feature of placing the tubers directly in trucks or wagons. While the potato digger had been limited to excavating the tubers and placing most of them on the surface of the ground where they were later picked up by hand and placed in barrels or burlap bags left in the field for still later pick up, the harvester placed the tubers directly in a truck or wagon traveling alongside as it traveled down the field. Most harvesters are equipped with de-vining elevators to separate the vines and picking tables where laborers separate the tubers from the stones, dirt clods and the occasional vines, grass and/or weeds. Later harvesters had more sophisticated air blast or air suction fans to help with some of this, but all harvesters dig the potatoes from the ground and place them in trucks, eliminating much of the back-breaking work.

Potato hook A long-handled implement similar to a hoe, except instead of a blade, the working end consists of four or five sturdy steel tines used for the purpose of digging up potato tubers.

Potato inflorescence In botany: a term for flowering, the flower cluster. See potato flower.

Potato knife A knife used during planting season to cut seed potatoes into seed pieces or sets. See Seed Piece and Set

Potato leafhopper An insect pest, *Empoasca fabae*, whose feeding habits inflict significant damage to many vegetable crops, especially potatoes and snap beans. Potato leafhoppers are small and narrow, about 1/4 inch long, and green to yellow in color. They cause discoloration of the foliage—bronzing and necrosis of the edges (hopperburn) and sharply defined whitish speckling. Leafhoppers are known vectors of virus and mycoplasm diseases. Damage varies with cultivar.

Potato masher A kitchen utensil used to puree potatoes after they are cooked or to puree other soft foods for making food dishes requiring a smooth textured ingredient. Potato mashers are typically made of stainless steel or nylon and are available in a variety of different styles, all working equally well. When making mashed potato dishes, mashed sweet potatoes, or to puree ingredients to make baby food, a sturdy masher makes the preparation process very easy.

Potato mildew See *Phytophthora infestans*

Potato mold See *Phytophthora infestans*

Potato mop top virus PMTV is a pomovirus, and it is transmitted by the pathogen which causes powdery scab disease, *Spongospora subterranea*. PMTV is one of the causes of spraing disease, the other being Tobacco rattle virus. "Spraing" means the tuber has an internal rust-brown necrosis occurring in rings or flecks. PMTV occurs more often in heavy, wet soils. Cool

temperatures and wet conditions favorable for the germination of *S. subterranean* spores will favor spread of PMTV.

Viral infection may be reduced in some cases by improving drainage, reducing irrigation, or delaying planting until soils are warmer and drier. Spores infected with virus can survive in the soil for decades. Longer rotations may help reduce the incidence of powdery scab. In the absence of its vector, the virus is rapidly diluted.

Potato peel The skin of a potato tuber. To peel a potato is to remove the skin. In the UK, the potato skin is commonly referred to as the 'jacket'. Baked potatoes are cooked in their skins (dry) in an oven.

Research has shown that conventional thinking attributing the lion's share of nutrients of the potato to its skin is pure folklore. Scientists point out that the benefit of peeling potatoes far outweighs the loss of fiber and riboflavin in the peel. One of the potato's most important vitamins, ascorbic acid (vitamin C), as well as its protein and other nutrients are scattered throughout the potato pulp. Indeed, the peeled potato has been described as one of the most perfect foods with its high quality protein, providing all but one of the essential amino acids, and other important nutrients, including calcium, niacin, several B vitamins, vitamin C, potassium, phosphorus, sulfur, chlorine, magnesium and iron.

See Sprout inhibitor.

Potato picker The potato picker was introduced in the late 1940's and had become quite widely used by the early 1950's. It was towed behind an elevator digger (potato digger) and consisted of a moving elevator chain with a bagging apparatus at the rear. Workers, standing on running boards on either side of the elevator chain, picked off potato tops, rocks and other detritus as the lag chain moved along leaving only the potatoes to fall into the bags. Another worker at the rear removed the full bags, set them on the ground, and installed a replacement bag as the machine moved along. A following work crew picked up the bags, put them on wagons, and took them to the storage building.

Potato ricer A kitchen utensil used to reduce whole soft foods, such as cooked potatoes and carrots into smaller bits. This utensil, much like a garlic press but larger, has an open chamber, which is generally 3 to 4 inches wide. A ram or plunger connected to the handle of the ricer is pressed down onto the food, forcing it through the many small holes in the bottom and, on some ricers, also on the sides of the container. As the food is extruded through the holes, it looks like strands or grains of rice. This utensil is also called a "ricer" and can be found in many stores offering baking utensils

Potato ring See Dish ring.

Potato rot See *Phytophthora infestans*

Potato salad A cold or hot side dish made with potatoes, mayonnaise, and seasonings. It became very popular in the second half of the nineteenth century and is a staple of both home and food-store kitchens.

European settlers who adapted traditional foods to local ingredients introduced potato salad-type recipes to America. This accounts for regional potato salad variations in the United States. Potato salad, as we know it today, became popular in the second half of the 19th century. Cold potato salads evolved from British and French recipes. Warm potato salads followed the German preference for hot vinegar and bacon dressings served over vegetables.

Potato sausage A sausage that is made with ground pork and beef or all ground beef that is mixed with potatoes, onions and only a few seasonings. A traditional sausage from Sweden, potato sausage was often served at holiday celebrations, such as Christmas. It can be boiled, baked, pan-fried, or microwaved, and goes well with a variety of hearty food dishes or soups. This sausage is also called Swedish potato sausage, potato ring, and Swedish-style potato sausage.

Potato scab A diseased condition of potatoes caused by a fungus and characterized by rough, deep-seated scabs on the tubers.

Potato shrink Loss of weight in a potato tuber once placed in storage. Weight loss is due to loss of moisture and carbohydrates. The primary factors contributing to weight loss are storage temperature and relative humidity. Since the two are intimately related, it is probably easiest to consider relative humidity as the primary factor.

Dehydration rate is a function of the vapor pressure differential across the skin of the tuber. Optimal relative humidity is in the range of 90 to 95%. Generally, speaking, one wants to keep relative humidity as high as possible without resulting in condensation, i.e. liquid water. Potatoes stored throughout the winter at 38 to 40 °F and high humidity should not shrink more than 5%. At higher temperatures, shrinkage will be greater.

Potato spindle tuber viroid PSTV can cause a destructive disease of potato and receives particular attention for certified and foundation seed production. It is often transmitted through breeders' progenies mechanically, as well as through pollen and true seed. PSTV consists of a small RNA molecule lacking the protein coat of viruses.

Evidence suggests that chewing insects may be responsible for spread in nature, but humans and their activities serve as the principal disseminator. As the name implies, infected tubers may be spindle or oblong shaped or tend to be more rounded instead of the normal shape for a given variety. Prominent eyebrows are another important characteristic. Foliar symptoms on infected plants are not easily contrasted, making this one of the more difficult diseases to diagnose. The leaflets may be smaller and curve inwardly, giving a stiff upward growth habit. Sensitive tests (i.e., molecular hybridization) are now available to screen true seed and progenies to eliminate the viroid. Use of these tests and the selection of certified seed are important steps in eliminating this disease from potato stocks.

Potato starch Potato starch is a mixture of the long-chain organic polymers amylose and amylopectin, the proportions of which are ordinarily found in potato tubers at a ratio of 1:3. These constituents differ dramatically in their physiochemical characteristics. Amylose is a gelling agent while amylopectin is a thickening agent.

Potato starch has long been used in the paper and textile industries where viscosity is extremely important. Potato starches offer higher viscosity ranges than other starches. The method of preparation of the starch paste, the stirring speed, the hardness of the water used, the pH, the starch concentration and the course of temperature change all affect the measured viscosity. Additional characteristics of potato starch include high water binding capacity, clearer solutions and films, higher elasticity and tensile strength of the films, better adhesion

Culinary uses: Generally, potato starch is used as a thickener or as a binder. Potato starch is <u>not</u> potato flour. Potato flour is cooked and dehydrated potatoes ground

into powder. Potato starch is the product of an extraction process removing the only the starch from the potato.

Potato starch is used in fast food, sweets, sausages, tablets and paper products. In home use, it is used to thicken soups and gravies. Liquids thickened with potato starch should never be boiled. Potato starch has no gluten. It is used in recipes for those who are gluten intolerant.

The properties of potato starch make it a superior thickening agent in dry-mix soups and sauces. Potato starch is a good fat replacer in meat products and a superb binding agent in bakery goods, such as cake mixes, dough, fillings and biscuits. Potato starch also offers good texturing and expansion regulation for directly and indirectly extruded snack food products. Excellent mouth feel attributes to potato starch usage in sweets, gums and liquorices, potato products, dairy and ice cream products, desserts, soups and sauces

Potato storage A building specifically designed to store potatoes over the winter. See Storage. See Potato shrink.

Potato tuber An enlarged portion of an underground branch of a stem called a stolon or rhizome. Technically, these underground stems of the potato most nearly approximate rhizomes, but the term stolon is more common. The stolons have leaf scales located alternately on their surface in the same manner as the above ground stems. The tubers originate from the tips of stolons, and occasionally tubers form along the stolon itself. The potato tubers contain all the characteristics of normal stems, including dormant true buds (eyes) formed at the base of a leaf (rudimentary in this case) with detectable leaf scars (the eyebrows). Lenticels or stem pores, through which air penetrates to the stem interior, are plainly found on most tubers. Lenticels often become enlarged to objectionable size when soils are overly wet and access to air is restricted.

Botanically, the tuber is a thickened stem, having the cells mostly filled with starch as a reserve food for the next year's plants.

Botany aside, the potato tuber is the part of a potato plant that is familiar to nearly everyone. It is a common food procured cheaply and prepared in myriad ways. It is healthful and nutritious. It is grown as one of the staple crops of the world.

Potato tuberworm (moth) *Phthorimaea operculella*, one of the most important potato pests in the world. It causes two kinds of damage: it infests fields and infests the plants, it also infests the tubers in storage places and in the cellar where it burrows into the flesh and ruins their fresh market value. If ideal conditions exist in the cellar, insects will reproduce. Overlapping generations will subject tubers to continuous damage.

Though severe damage to young plants is rare, high numbers of worms in very young plants may result in stand reduction or stunted plants as a result of leaf and stem mining. The typical damage results from larvae mining in the tubers. Small larvae usually enter the tuber at the eyes. Small deposits of frass can be seen in webbing around an eye where a larva has begun to tunnel. Frequently, the larvae feed just below the surface of the potato leaving a dark tunnel. Occasionally they bore deep into the tuber. In either case, the tunnel is filled with excrement and can be described as a dirty tunnel compared to the clean tunnels made by wireworms or other soil-inhabiting insects. Tubers that are exposed as a result of shallow setting or cracks in the soil are most frequently infested. The longer the tubers remain in the ground after vine kill, the more damage that can be expected. Tuberworms do not tunnel through stems and roots into the tubers.

Potato vine That part of the potato plant growing above the ground: stems, leaves, blossoms and fruit.

Potato virus A Potato virus A (PVA), which causes mild mosaic, has a number of characteristics in common with PVY and belongs to the same virus group. Symptom severity will depend upon the potato variety, and environmental factors. Many varieties (Katahdin, Kennebec, Sebago) reportedly react to infection with hypersensitivity (field resistance) as mentioned under PVY. Control of this aphid-transmitted virus disease is through the use of disease-free seed, insecticides, and resistant varieties.

Potato virus M Potato virus M (PVM) occurs in New York, but its importance in yield loss is uncertain. It is aphid transmitted in a non-persistent manner and is tuber-borne. PVM may induce symptoms referred to as paracrinkle. PVM may be most important when found as mixed infections with other viruses.

Potato virus S Potato virus S (PVS) is of increasing importance in potato. It remained unknown until the 1950's because its symptoms are very inconspicuous. PVS can cause yield loss up to 20%. Seed potatoes are not yet certified for PVS, which contributes to its widespread distribution.

Most potato cultivars are symptomless. On some cultivars, if infected early in the season, will show a slight deepening of the veins, rough leaves, more open growth, mild mottling, bronzing, or tiny necrotic spots on the leaves.

PVS is a carlavirus, and is non-persistently transmitted by aphids, including *Myzus persicae*, the green peach aphid. It is also mechanically transmissible, and transmissible through tubers.

PVS is very difficult to detect using visual cues. Insecticides are ineffective in controlling non-persistently transmitted viruses. Crop oils may be used early in the season. Plants tend to be resistant to infection by PVS later in the season. Prevent mechanical spread within the field by sanitizing tools and minimizing movement through the field. Rogue any symptomatic plants.

Potato virus X Potato virus X (PVX) is one of the most widely distributed viruses of potatoes because no symptoms develop in some varieties (latent mosaic). The full extent of damage with PVX is not recognized. Mixed infections of PVX with other viruses like PVY and PVA cause more damage than PVX alone. PVX is tuber-borne and is readily mechanically transmitted by human activities. Tobacco, pepper, and tomato are additional hosts for this virus.

Potato virus Y Potato virus Y (PVY), sometimes known as ‘Leaf Drop Streak’, is one of the most important viruses infecting potatoes. It is the type-species of the *Potyvirus* genus, the type-member of the largest group of plant viruses. It is a positive strand monopartite RNA virus that infects primarily solanaceous plants including potato, tomato, tobacco, and pepper. PVY occurs as a complex of virus strains that can be distinguished by reactions on tobacco and potato cultivars.

It is readily spread by aphids, mainly *Myzus persicae*, in a non-persistent manner. Since it is sap-transmissible, PVY can also be transmitted mechanically by machinery, tools, and damaging plants while walking through the field. Aphids remain by far the most efficient means of transmission. It may result in severely depressed yields.

PVY is tuber-borne and can interact with other viruses such as PVX and PVA to result in heavier losses. Symptoms caused by PVY infection can vary depending upon the potato variety grown. A rugose mosaic symptom is characteristic for some varieties, but is most commonly ascribed to a mixture of PVY and PVX. Other varieties produce a general mosaic or a hypersensitive (severe necrotic) reaction. Necrosis may progress to total leaf collapse, with the dead leaflet clinging to the stem. Some varieties with a strong

hypersensitivity reaction display field resistance, and the progeny from such plants may be healthy. Besides infecting potato, PVY affects other solanaceous crops (tomato, pepper) and weeds (nightshade, ground cherry).

Several strains of PVY have been identified that differ by the symptoms they cause in potatoes and tobacco. PVY^{O} is the common strain and in potatoes causes mild to severe mosaic symptoms, leaf and stem-necrosis, leaf drop or veinal necrosis. In potatoes with Ny and Ne genes it triggers a hypersensitive response.

PVY^{C} causes stipple streak.

PVY^{N}, the necrotic strain, generally causes mild foliage symptoms, but necrosis in the leaves of susceptible potato varieties. It is serologically distinguishable from $PVY^{O/C}$; its coat protein sequence is phylogenetically distinct from $PVY^{O/C}$.

Mixed infections of common strains and the necrotic strain are common, and the genomes (genetic material) can mix, producing hybrid strains (i.e. $PVY^{N:O}$ and PVY^{NTN}). PVY^{NTN} strains can cause tuber necrosis and ring spots and are of increasing importance in New York. Diagnosis can be difficult, because there are antibodies to PVY^{O} and PVY^{N}, but immunological methods (ELISA, Enzyme Linked Immunosorbent Assay) cannot distinguish PVY^{NTN} from these two virus strains. Additionally, not all PVY^{N} isolates will react with PVY^{N} – specific antibodies, while some PVY^{O} isolates will. Symptoms alone cannot distinguish these virus strains, as symptoms vary with age, time of infection, temperature, and the genetics of both the virus and the plant host. Necrotic symptoms in tubers often increase after storage. Some varieties such as Russet Norkotah and Shepody rarely show symptoms, but can carry the virus and serve as reservoirs for aphid transmission. Yukon Gold is particularly susceptible to tuber necrosis.

Since PVY is a non-persistent virus and is transmitted quickly by aphids, the use of insecticides to control spread is generally not effective. The best strategy to control PVY is to use seed potatoes certified to have low virus content. Mineral oils can be used to reduce spread by aphids, but must be re-applied at frequent intervals to be effective. Minimize mechanical spread by sanitizing equipment and reducing traffic through the field. Infected plants can serve as a source of inoculum for the rest of the field, so rogue (pull out and dispose of) symptomatic plants. Solanaceous plants such as tomatoes, peppers, nightshade and ground cherry can harbor the virus and serve as a source of inoculum. Avoid planting potatoes next to weedy ditches and hedgerows, and practice good weed control within the field. Varieties with some resistance or tolerance to PVY are Eva, Dark Red Norland, Belrus, HiLite Russet, Kennebec, Monona, Norwis, and Sebago

Potato War

War of the Barvarian Succession, 1778-79. A political/military conflict during which Frederick II of Prussia prevented Joseph II of Austria from acquiring Bavaria.

After the death of the Bavarian elector Maximilian Joseph (1727–77), his successor, Charles Theodore (1724–99), ceded Lower Bavaria to Austria. Frederick II responded by declaring war, and in July 1778, he and his brother, Prince Henry, led a two pronged invasion of Bavaria with 160,000 men. Austria had set up strong defensive positions, and despite a month of maneuvering and advancement, the Prussian/Saxon forces could find no weaknesses in the Austrian forces. Frederick was unwilling to risk an attack without assurance of victory. For the next two months, the invading forces became frustrated by problems of supply, disease and the strong Austrian positions. Troops spent much of their time concerned with cutting communications and denying the enemy supplies. Short on supplies themselves, the soldiers foraged for potatoes and other crops; hence, the conflict was nicknamed the "potato war." Frederick

withdrew his forces in October as winter weather approached. From then on, the war was fought largely behind the scenes at the negotiating table. After Russian and French mediation, the conflict was resolved at the Congress of Teschen, 13 May 1779. Austria and Prussia then signed a treaty giving Austria a fraction of the territory originally occupied.

Potato wart disease *Synchytrium endobioticum*. This bacterium is the causal agent of potato wart disease, the most important world-wide quarantine plant pathogen infecting potato.

Potato water A culinary term referring to water that potatoes have been boiled in. It is generally found in older recipes, but it is by no means an obsolete term. Peeled potatoes release starch into the water when they are boiled. Potato water can then be used as a substitute for milk where it makes bread and other baked goods deliciously moist.

To make potato water, wash and peel 2 or 3 medium sized potatoes. Cube the potatoes and add to pot. Cover potato cubes with water and boil for about 20 minutes or until potatoes are soft. Remove from heat and drain potato water into a liquid measuring cup. Let it cool to warm before using in your recipe as a replacement for milk. The cooked potatoes can be mashed with a forked and added to potato bread recipes in place of flour.

Potato water can be refrigerated for up to 24 hours. After this time, the potato water sweetens and can spoil the taste of your bread.

Potato whiskey A strong, fiery liquor, having a hot, smoky taste, and rich in amyl alcohol (*fusel oil*); it is distilled from potatoes or potato starch.

Powdery scab Damage is similar to that caused by scab, but the texture of the lesions are powdery. In storage, powdery scab may lead to dry rot, and infections can spread in storage. *Spongospora subterranea*

Prebiotic

Pre-harvest interval (PHI) The time period specified on product labels of agricultural chemicals that must pass between application of the chemical and the harvest of the crop.

Pre-nuclear For seed potatoes: Pre-nuclear seed stock are those explants, microtubers and minitubers produced in aseptic culture, disease-tested as required by definition, and inspected as required by representatives of the official state certification agency.

Presentation A term from the culinary (food) arts having to do with the preparation and arrangement of food to best showcase prepared food and dinnerware to simultaneously catch the eye and stimulate the palate. When designing an effective presentation of an entrée, the chef will effectively arrange the main entrée surrounded with food items of contrasting or similar colors and shapes as well as aromas and flavors and often will use sauces and condiments to great effect. Presentation brings together the science of food preparation with the sensual aspects of aroma and flavor. Food presentation is truly an art; the best chefs are artists in this regard.

Pressure bruise A flattened or depressed area on a potato tuber. It develops in large piles of potatoes in storage, usually from tuber dehydration caused by dry conditions before harvest or by inadequate humidification in storage. Tubers with pressure bruises may not be acceptable in the fresh market.

Primary bloom The first production of flowers on a potato plant, occurring after 8 to 12 leaves have been formed on the main stem and generally coinciding with the beginning of the tuber growth phase.

Pringles™ A brand of potato snack produced by Proctor & Gamble. They are thin, "saddle shaped" chips made from potato flour, corn flour, wheat starch, rice flour, maltodextrin, salt and dextrose. The precise percentages of each ingredient has varied from time to time and are are not identical in the range of flavors because the flavoring may affect the salt content. These dry ingredients are mixed with water and emulsifier and made into a smooth dough. After rolling the dough out thin, Pringles are cut out, shaped and quick-fried with the addition of oil and salt. Chips are then cooled and flavors added.

Being all the same shape, the chips can be tightly stacked. Consequently, Pringles are packaged in tubular, air-tight, cardboard cans with plastic lids. Consumers love these cans because almost all of the chips arrive unbroken. Proctor & Gamble loves these cans because shipping costs are comparatively cheaper—they are not transporting bags of air across thousands of miles.

In late 1969 or 1970, U.S. potato chip manufacturers, under the PCII and the Weaver Potato Chip Co., brought suit against General Mills (Chipos™) for describing engineered prefabricated chips as 'potato chips'. A similar suit was later brought by PCII against Proctor & Gamble for their engineered, prefabricated chips, Pringles™.

The initial suit found in favor of engineered, prefabricated chips, which are now called 'potato chips' in the US. While General Mills' Chipos™ did not find traction in the marketplace, Proctor & Gamble's Pringles™ did.

In 2007?, a similar lawsuit was brought against Proctor & Gamble in Great Britain. After a lower court in July 2008 initially decided that Pringles were not potato chips thus protecting them from the value-added tax, an appeals court in May 2009 decided that they are potato chips and are indeed subject to the value-added tax.

Proanthocyanins A group of flavonoids including those polyphenolic compounds giving flowers, fruit and vegetables a blue, purple, or red color. Proanthocyanins are power free radical scavengers.

Probiotic

Processing potato Those varieties of potato grown primarily for dehydration, frying and chipping, and frozen potato uses. The best are those with low water and high solids, i.e. high specific gravity. Typically, processing potatoes are those that are not up to grade for the fresh market due to size, misshapen tubers, or bruising.

High-solids potatoes tend to absorb less fat or oil when fried. The best potatoes for processing into fries or chips are those that convert starch into sugar very slowly. During frying, low-sugar potatoes are unlikely to darken and develop an unwanted burnt-sugar flavor.

Prostrate growth habit A plant growth habit in which the plant growth is close to the ground, i.e. the stems lay upon the ground.

Pyraflufen-ethyl An agricultural chemical recommended for use as a desiccant. It was introduced to the marketplace in 2009 as a vine kill agent for potatoes. It is rainfast in one hour and has a restricted entry interval (REI) of 12 hours and a PHI of 7 days.

Pyrethroids A class of pesticides.

Pythium leak a.k.a. 'leak' or 'shell rot', pythium leak is an infection of potato tubers caused by a soil-borne fungus, *Pythium ultimum*. It is sometimes collectively combined with 'pink rot', an infection by the soil-borne fungus *Phytophthora erythroseptica*, and characterized as 'water rot'.

Pythium leak appears internally as a lesion with a sharply defined reddish-brown to black border surrounding gray or brown watery rotted tissue. Squeezing the tuber enhances the appearance of the watery condition.

Pythium leak invades the tuber only through wounds that occur during harvest. Avoid harvesting potatoes when soils are especially wet or when flesh temperatures are high (> 68 F), as leak development under these conditions is very rapid. Adjust harvesting equipment to keep digger chains fully loaded and minimize drops to 6 inches or less.

Most potato varieties should be assumed to be susceptible to pythium leak, but research has shown that some varieties are particularly susceptible. These varieties include Russet Norkotah, FL 1533, Red LaSoda, Dark Red Norland (often used as a susceptible standard), and NorDonna

QSR Quick service restaurant, i.e. fast-food restaurant(s). Sometimes called quick serve. Fast-food industry is also called the quick serve industry.

Quarantine Legal restriction of the movement of plant pests (or the products that may be harboring them) into areas where they do not occur.

Race A subspecies group of pathogens that infect a given set of plant varieties.

Raclette A cheese and potato dish served in Switzerland as a relaxing and sociable meal. A raclette meal is not a fast-food experience.

Recipe A set of instructions or advice for preparing food.

Reconditioning A technique used before processing for those potatoes that do not respond well to quick warming from cold storage. After tubers are taken out of cold storage, and before they are processed, these tubers are reconditioned, that is, warmed gradually for several weeks to lower the levels of sugar that accumulated while in storage. High sugar levels will cause dark colored chips and fries and will have other adverse affects on processing.

Red River Valley A major North American potato-growing region centered along the Red River in North Dakota and Minnesota.

Reducing sugar A monosaccharide or disaccharide sugar that can donate electrons to other molecules and can therefore act as a reducing agent.

A sugar is only a reducing sugar if it has an open chain with an aldehyde or a ketone group. Monosaccharides which contain an aldehyde group are known as aldoses, and those with a ketone group are known as ketoses. Reducing sugars can be detected by Benedict's test.

Reducing sugars include glucose, dextrose, fructose, glyceraldehyde and galactose. Lactose and maltose also have a reducing form. Sucrose and trehalose are non-reducing disaccharides.

In potatoes the heat of frying will induce a reaction between the reducing sugars (glucose and fructose) and the amino acids which results in browning. This reaction is called Maillard’s reaction. It is undesirable in french fries and potato chips.

This allows the sugar to act as a reducing agent, for example in the Maillard reaction and Benedict's reaction.

In glucose polymers as starch and starch-derivatives like glucose syrup, maltodextrin and dextrin, the macromolecule begins with a reducing sugar, a free aldehyde. More hydrolysed starch contains more reducing sugars. The percentage reducing sugars present in these starch derivatives is called dextrose equivalent.

Reducing sugars are responsible for sugar end disorder in potatoes. This will result in darkening.

Resistance The ability of an organism to exclude or overcome, completely or to some degree, the effect of a pathogen or other damaging factor. It usually infers that some varieties or cultivars of a plant species are susceptible, i.e. there may be different levels of resistance among cultivars.

Resistant Able to tolerate conditions (such as pesticide sprays or pest damage) harmful to other strains of the same species.

Resistant starch Most of the carbohydrates in the human diet are starches. Starches are long chains of glucose found in grains, potatoes, and other various foods. Not all starch consumed by humans gets digested. Some passes through the stomach and the small intestine and ends up in the large intestine. This starch is called resistant starch. It functions kind of like soluble, fermentable fiber.

Not all resistant starches are the same. There are four basic types, each different from the other:

- Type 1 is found in grains, seeds, and legumes and resists digestion because it's bound within the fibrous cell walls
- Type 2 is found in some starchy foods, including raw potatoes and green (unripe) bananas
- Type 3 is formed when certain starchy foods, including potatoes and rice, are cooked and then cooled before they are eaten. The cooling turns some of the digestible starches into resistant starches via a process called retrogradation
- Type 4 is man-made and formed via a chemical process

Resistant starch, once it reaches the colon, becomes food for the microbiome living there. The bacteria in your intestine (the gut flora) actually outnumber the body's cells 10 to 1 — so, in that respect, it might be said you're only 10% human.

Whereas most foods are digested in the stomach and absorbed in the small intestine to feed the body's cells, the fermentable fiber and resistant starches feed the other 90%.

There are hundreds of different species of bacteria in your intestine. In recent decades, scientists have discovered that the number and type of bacteria have a profound impact on human health. Resistant starch feeds the friendly bacteria in the large intestine, having a positive effect on the type of bacteria as well as their number. When the bacteria digest resistant starches, they form several compounds, including gases and short-chain fatty acids (SCFAs), most notably butyrate.

Resistant starch and the resulting butyrate suggest a number of beneficial effects in the human body:

- It reduces the pH level in the colon, potently reducing inflammation and leading to beneficial changes that should lower risk of colorectal cancer\
- The short-chain fatty acids that aren't used by the cells in your colon travel to your bloodstream, liver, and the rest of your body, where they may have various beneficial effects
- Due to its therapeutic effects on the colon, resistant starch may aid various digestive disorders. This includes inflammatory bowel diseases like ulcerative colitis and Crohn's disease, constipation, diverticulitis, and diarrhea

- In animal studies, resistant starch has also been shown to increase the absorption of minerals
- Many studies show that resistant starch improves insulin sensitivity and lowers blood sugar levels, especially after meals
- Resistant starch has fewer calories than regular starch and may increase feelings of fullness and help people eat less.

However, the role of resistant starch and butyrate in human health and disease has only recently been identified. More study is required to affirm whether strong recommendations can be made relative to the above.

In the meantime, if one wants to add resistant starch to one's diet (there would seem to be no down-side to doing so), it is relatively easy. Foods high in resistant starch are as follows, starting with potatoes:

- Raw potato starch: A white powder that looks similar to regular flour. It is one of the most concentrated sources of resistant starch, with about 80% of the starches in it being resistant. For this reason, you only need 1–2 tablespoons per day. Potato starch is often used as a thickener or added to smoothies, overnight oats, or yogurt
- Cooked and cooled potatoes: It's best to cook potatoes in bulk and allow them to cool for at least a few hours. When fully cooled, cooked potatoes will contain significant amounts of resistant starch. In addition to being a good source of carbs and resistant starch, potatoes contain nutrients such as potassium and vitamin C. Remember not to reheat the potatoes. Instead, eat them cold as part of homemade potato salads or other similar dishes
- Flaked oats: Three-and-a-half ounces (100 grams) of cooked oatmeal flakes may contain around 3.6 grams of resistant starch. Oats, a whole grain, are also high in antioxidants. Letting your cooked oats cool for several hours — or overnight — could increase the resistant starch even more
- Cooked and cooled rice: One popular preparation method is to cook large batches of rice for the entire week. Not only does this save time, but the resistant starch content is also increased when the rice is left to cool over time. Brown rice may be preferable to white rice due to its higher fiber content. Brown rice also provides more micronutrients, such as phosphorus and magnesium
- Sorghum and barley: Although grains are sometimes mistakenly believed to be unhealthy, natural whole grains can be a sensible addition to your diet. Not only are they a great source of fiber, but they also contain important vitamins and minerals such as vitamin B6 and selenium
- Beans and legumes: Each contain around 1 to 5 grams of resistant starch per 3.5 ounces (100 grams) after they have been cooked. Both should be soaked and fully heated to remove lectins and other antinutrients. Good sources are pinto beans, black beans, garden peas, fava beans
- Green bananas: Additionally, both green and yellow bananas are a healthy form of carbs and provide other nutrients such as vitamin B6, vitamin C, and fiber. As bananas ripen, the resistant starch transforms into simple sugars such as fructose, glucose and sucrose. Therefore, it is best to buy and eat bananas within a couple of purchase

- Corn starch: Similar to potato starch, it is a highly condensed form of resistant starch. It can be easily added to yogurt or oatmeal

Restaurant potato A size of potato. See Chef potato.

Retailer A term specifically defined by the Perishable Agricultural Commodities Act of 1930 as being any person engaged in the business of selling any perishable agricultural commodity at retail. Retailers are required to be licensed when the invoiced cost of all purchases of perishable agricultural commodities exceeds $230,000 during a calendar year.

Rhizoctonia The black scurf or "*dirt that won't wash off*" sometimes found on potato tubers. This black scurf or sclerotia is the most readily obvious phase of Rhizoctonia disease or canker caused by the fungus *Rhizoctonia solani*. These sclerotia, or fungal resting bodies, can vary in size from very small, flat, superficial black specks to large, raised, irregularly shaped masses that can cover a major portion of the tuber. These sclerotia have no affect on the interior of the tuber.

R. solani can be either a soil-borne or seed-borne pathogen. The fungus survives in soil as mycelium in decomposing plant tissues. It also survives as sclerotia on tuber surfaces (seed-borne) or in the soil for extended periods. Populations of *R. solani* decline in the absence of a susceptible host although the rate of decline is affected by soil type, rotational crops and possibly the amount of organic matter present in the soil.

This fungus is not harmful to people. It is completely safe to eat the tubers even if you cannot remove all the black material on the tuber skin.

Growers can control rhizoctonia to some extent with 1 to 2 year crop rotations in warm climates and longer rotations in cool climates. Fungicide treatment on seed pieces will protect young sprouts.

Right-to-Farm Laws Laws promulgated by local, county and state governmental entities allowing farms and farmers to conduct the normal, routine business of farming with protection from nuisance complaints from non-farming neighbors and entities. This is based upon the premise that farms and farmers are conducting their business using generally accepted sound agricultural practices.

Ring Rot See Bacterial Ring Rot.

Rösti (pronounced roo'-shhhh-tea) A Swiss specialty: a potato dish similar to hash brown potatoes. In its basic form, it is made from grated potatoes, oil (or fat in one form or another), salt, pepper and formed into patties about five inches in diameter and pan fried. It can also be oven-baked. It can be enhanced with additional ingredients such as bacon, onion, cheese, apple or fresh herbs. In Switzerland, there is some discussion about whether rösti is best made from raw potatoes or from boiled potatoes.

Note: Rösti is the German spelling. Röschti is the Swiss German spelling. It is often spelled Roesti in English.

Rogue Noun, a variation from the standard varietal type. Verb, to remove such undesirable plants (especially those infected with viruses) from the growing crop.

Roguing The manual identification and removal of diseased and abnormal potato plants and volunteers (rogues) from the field during the growing season.

Rolling Mechanical crushing of potato vines to hasten vine death, sometimes used synonymously with vine-killing.

Roots and tubers Food plants whose below-ground parts are harvested and eaten by humans. A tuber is an enlarged section of a root. Potatoes are roots. So are carrots and parsnips

Root pruning

Root vegetables Potatoes are sometimes referred to as, and included with, root vegetables. Horticulturally speaking, only vegetables like carrots, beets, turnips, kohlrabi, radishes, and rutabagas are root vegetables. The potato is not a root vegetable although it grows underground. The potato is a tuber.

Rosetting Abnormal growth caused by certain pathogens in which new potato foliage is stunted and tightly bunched.

Rösti A Swiss dish composed of slightly boiled potatoes that are then grated and fried to make a sort of hash brown.

Rot The softening, discoloration, and often disintegration of a succulent plant tissue as a result of fungal or bacterial infection. See also Necrosis.

Rotation See Crop Rotation

Rotobeater A tractor-pulled machine with PTO-powered rubber flails used to achieve vine kill so that the potato tubers will mature and set their skins in preparation for harvest. This is a mechanical method of vine-kill often preferred by those potato growers averse to chemical methods of vine-kill.

Round-red potato An unofficial, but widely used category of tablestock potatoes. Round red is used by growers, marketers, cooks and chefs, and consumers to describe red-skinned, white fleshed potatoes with low to medium specific gravity. While these potatoes are generally round in shape, some may tend toward oblong. They will usually have a firm, smooth, moist (waxy) texture, making them well suited for salads, roasting, boiling and steaming. Round red potatoes are grown most predominately in the upper Mid-West of the US. See also round-white potato.

Round-white potato An unofficial, but widely used category of tablestock potatoes. Round white is used by growers, marketers, cooks and chefs, and consumers to describe white to tan-skinned, white-fleshed potatoes with low to medium specific gravity and low to medium starch levels. They are considered general purpose potatoes. Round whites are preferred for boiling, mashing, pan-frying, roasting, casseroles, scalloped potatoes, potato salads, etc.

The phrase has come into usage because buyers and consumers have no real way to know the specific gravity, starch level or moisture content of any particular potato variety and because potatoes are rarely sold by variety name anyway. Hundreds of varieties fall into this category. Growers and marketers are generally on their honor when describing their products this way.

Round whites are grown and most often used in the Eastern United States.

Row crops In crop science, those crops grown in rows or planting beds spaced far enough apart to permit the operation of farm machinery between the rows or beds.

Run out An obsolete term used predominately in the nineteenth century before viruses were discovered. At that time, it was used to describe decreasing potato yields over time as viral infections grew in seedstock kept from one year to the next. Its use insinuated a 'weakening' of seedstock over time without an understanding that such 'weakening' was due to an accumulation of viruses in such seedstock. Today, such is avoided by planting potato seedstock free of viral infections.

Russet potato Russet potato generally refers to any white-fleshed potato variety with a cylindrical or oblong shape with rough brown (netted) skin characterized by corky, dark brown checks (russets) and numerous "eyes." The standard russet potato is the venerable Russet Burbank even though it is slowly being supplanted by newer varieties that are easier to grow and which exhibit better flavor. Russet potatoes generally speaking have low moisture and high starch content which make them good for baking and frying.

When cooked, Russet Burbank will have a glistening appearance and a dry, fluffy texture, making them suitable for baking or mashing. They also have a low sugar content so that they will not brown excessively if deep-fried.

Russet potatoes are often called Idaho potatoes or Idaho bakers, even when they are not grown in Idaho. Since they are suitable for almost any type of cooking method: baking, frying, deep-frying, and boiling, they are the most widely-grown potato type in North America.

See Idaho potato.

Russet Brownish, roughened areas on the skin of fruit or tubers as a result of cork formation. Russet potato skin is characterized by rough texture and brown color.

Salad potatoes Salad potatoes are great favorites all year round. These distinctive flavored potatoes have a waxy, fleshy texture. Common term in the UK.

Salt potatoes A tasty treat indigenous to upstate New York though now achieving much wider currency. Generally speaking, salt potatoes are small white-skinned potatoes (preferably new potatoes) boiled whole in their skins in very salty water or brine (4 pounds potatoes to 1 pound salt). When fork tender, drain off the brine and serve dipped in melted butter. Olive oil can be substituted for butter. Small red-skinned potatoes can also be used, and though they taste just as good, some consider this blasphemous.

Salt potatoes are said to have been created by Irish immigrants working in the salt industry in Syracuse, NY, during the mid-nineteenth century.

Saprophyte See Parasite

Scab Any of a wide range of unrelated plant diseases having a roughened, crust like diseased area on the surface of a plant organ. See Common scab.

Scattered Secondary tuber color: when the pattern of distribution is expressed as random in one or more areas around the tuber

Sea potato A species of sea urchin, *Echinocardium cordatum* (Pennant) 1777., in the family Loveniidae, but is commonly called the sea potato or the common heart urchin. It is an echinoderm found in sub-tidal regions in temperate seas around the world.

It is a heart-shaped orb from 6 to 9 centimetres in diameter, yellow-brown in color and coved with felt-like backward-facing spines. It lives in a permanent burrow between 8

and 15 centimeters deep in sandy sediments, especially muddy sands, from the intertidal to the subtidal and offshore to about 200 metres deep. It is a deposit feeder, picking up food particles with its tube feet on its underside.

The sea potato often has a commensal symbiotic relationship with the bivalve *Tellimya feringuosa* attached to its anal spines.

Its dried shells, called tests, are commonly found washed up on beaches. The spines which are part of its skin will have fallen off when the urchin dies. These "bare" shells vaguely resemble potatoes in appearance, hence its common name. This shell is very fragile and rarely survives collection.

Sea potato A species of littoral brown algae (seaweed), *Leathesia marina* (Lyngbye) Decaisne, 1842 (formerly *Leathesia difformis*) in the class Phaeophyceae and the order Ectocarpales commonly sea cauliflower, but sometimes called sea potato (not to be confused with the heart urchin also known as sea potato).

It is smooth, round and irregularly lobed and usually found attached to other seaweeds and sometimes rocks. When young, the organism is solid, but as it matures, it grows and fills with gas becoming hollow and somewhat convoluted and has the appearance of a small leathery brown bag about the same size as a tennis ball which feels like a mass of jelly. The texture is rubbery and the outer surface smooth. If it grows large enough, it can pull up the rock or whatever it is attached to and move to other places by the current or wind.

Sea potato One may occasionally see "sea potato" also referring to a seaweed called *Colpomenia peregrina* Sauvageau, 1927, more commonly known as oyster thief or bladder weed.

C. peregrina is a small brown alga, bladder-like, hollow and membranous, up to 9 cm across. The surface is thin and smooth but often collapsed or torn when older. Olive brown in color and attached by rhizoidal filaments to rock at the base.

Referring to *C. peregrina* as "sea potato" is confusing because *L. marina*, a similar seaweed is also called sea potato. These two seaweeds are similar in appearance but do have characteristics distinguishing one from the other. It would be preferable if *C. peregrina* were simply called oyster thief or bladder weed, and if *L.marina* were called sea cauliflower.

Secondary bloom A second production of flowers on a potato plant, occurring at the end of the mainstem of an indeterminate cultivar; secondary bloom may occur on a determinate cultivar at leaf axils along the mainstem.

Second Growth Malformations of a potato tuber, resulting in irregular or 'knobby' tubers. Secondary growth is a physiological disorder of potato caused by favorable growing conditions following a period of dry weather. Malformed potatoes are graded on the basis of appearance. Appearance is damaged if more than one small secondary growth is present.

Seconds Same as culls.

Seed Botanically, seeds are the result of pollination and sexual fertilization. Apomictic seeds are true seeds produced from maternal tissue only without sexual fertilization. In the potato world, farmers often refer to units of vegetative propagation as seed. Therefore, potato tubers to be planted for a new crop are called seed potatoes. Syn., seed tubers, seed sets.

Seedball, Seed ball

In potato, these are the fruits or seed pods that result from sexual reproduction. Potato seedballs are green and up to 1 inch diameter, but usually smaller. They look like green cherry tomatoes and usually appear in small clusters. The interior of a seed pod has up to 500 tiny seeds distributed throughout a mass of moist tissue. It is sometimes called a berry or potato berry. The tiny seeds are called 'true seed' in the potato world.

A potato seedball will look very similar to a small green tomato which is actually a close relative of the potato (*Solanum lycopersicum* versus *Solanum tuberosum*). Each seed ball contains some two to five hundred true seeds. But despite their similarity to tomatoes, do not eat these berries or fruits. They contain high concentrations of α-solanine as do the vines and leaves of potato plants. α-solanine is slightly toxic to humans and may cause upset stomach and perhaps even diarrhea if ingested.

Modern potato plants which are reproduced using vegetative propagation (seed pieces rather than 'true seed' and which are consequentially grown in large monocultural plots, rarely produce seedballs.

It is possible to grow potatoes from 'true seed', that is, the seeds found within these seedballs. Potato breeders do this routinely to create new varieties from known crosses (known parents). However, no commercial potato growers ever grow potatoes from 'true seed'. Using 'true' potato seeds instead of seed potatoes is akin to fruit tree growers using fru it seeds to grow trees instead of grafting scions onto rootstock. Planting seed potatoes will give you potatoes that have the known and desirable qualities of specific known varieties, while 'true' potato seeds give you potentially new varieties that you could play around with, but because one never knows the parents or how the genes line up, one cannot predict the value of the resulting crop.

Growing potatoes from 'true seed' can be difficult, and the University of Illinois Extension even calls it "*a troublesome and unrewarding exercise*." Please know that professional breeders usually spend some ten to fifteen years selecting new potato varieties from sexual crosses.

Seed Certification

In the US, seed potatoes are officially certified by various sanctioning bodies, typically the state, in various ways. True seed is certified for identity of cultivar, purity of cultivar, freedom from pests, weeds, and disease, cleanliness, and germination percentage. Potato seeds, i.e. tubers and other units of vegetative propagation, are certified for identity of cultivar, purity of cultivar, freedom from pests, and diseases, with special emphasis on diseases that are not carried by true seed, such as virus diseases.

In New York state, the seed potato certification program is a voluntary agreement between the seed grower, the NYS College of Agriculture & Life Sciences (CALS) at Cornell University (the certifying agency) and the NYS Department of Agriculture and Markets (the inspecting agency). Seed growers are required to be members of the NY Seed Improvement Cooperative, Inc. Program administration and record keeping are conducted by the New York Seed Improvement Project in the CALS' Plant Breeding and Genetics and Biometrics Department.

The certification process is intended to produce and make available to the public dependable sources of top quality, disease-free, high yielding seed and to encourage better methods of production. Growers agree to a minimum of two field inspections during the growing season, an inspection during harvest, and once again after grading, but before shipment. All seed lots passing growing-season and harvest inspections are also winter tested in Florida.

In New York state all seed lots generations are tracked according to years removed from nuclear class seed. All foundation and certified seed is produced in a limited production scheme with seed lots limited to a maximum of six years of propagation, five if source is from outside New York state.

All New York State certified and foundation seed potatoes are identified as such on the appropriate, official state-issued seed certification and grade tags: Blue, Yellow or White. Blue tag is the highest quality.

In Canada, potato seed certification is under the general control of the federal government.

Seed field In New York state seed potato certification, 'field' is defined as the entire area occupied by one variety and one seed source of potatoes and which is covered by one inspection report. Fences, ditches, highways or strips planted to other crops may run through the field provided the separation is not excessive and other conditions are similar.

Seed lot In New York state, 'seed lot' is defined as a unit of tubers or plants of a single variety increased clonally from a single source of tubers or plants. If two or more seed lots are co-mingled in the field or in storage, those seed lots will be classified at the lowest acceptable seed class or will rejected from certification.

The intention is to track seed potatoes lot by lot and generation to generation to ensure highest quality and freedom from disease. A seed lot should always be expected to behave uniformly.

Seed piece A section of a whole potato that has been cut into pieces weighting two or three ounces and includes at least one bud or "eye" from which shoots will sprout. Small potatoes weighing approximately the same, usually sold as Size B, are sometimes used whole as potato sets. These cost more, but some growers prefer them because they do not need to be cut, thereby saving labor and minimizing the potential for infection from parasites and soil borne pathogens. See Set.

After the seed pieces are cut, they should be allowed to cure, for several days at temperatures between 55° and 68°F, and a high relative humidity. If temperatures are too high or too low, cut seed pieces will not cure properly, opening the door to decay or an erratic stand in the field.

Seed potato A potato tuber selected for planting the next year's crop. Seed potatoes are generally entered in officially sanctioned foundation or certified potato programs to limit exposure to disease pathogens and to ensure highest quality. Seed potatoes can be potato plantlets, plants, microtubers, minitubers, tubercles and tubers. See seed piece. See Set. See Seed certification.

Seed stock Seed potatoes intended for use as a planting source.

Seed testing Seed offered for sale is usually tested in a seed testing laboratory. The main test is for germination percentage, but other tests can include seed health, presence of disease, identity and purity of cultivar. In New York State, see Florida tests.

Selection process Potato improvement by strain (a.k.a. sub-clonal, intraclonal, or line) selection within a cultivar. Typically, this process results in better tuber appearance (red vs. white, smooth vs. russeted skin) or enhanced production characteristics (heavy vs. light set, early vs. late maturity). Breeders will identify each line selection by number until all of its characteristics are known and proven stable. Only then will it be released as a named variety. Only a minute fraction of line selections are released. This is a very painstaking process which can take as long as fifteen years to come to fruition. Considerable effort has been made to shorten the process without risk to growers with substandard releases. See also Strain and Line selection.

Senescence The botanical process of growing old; the onset of old age. The stage of growth in a plant or plant part from maturity to death, characterized by an accumulation of metabolic products, an increased respiratory rate, and a loss in dry weight. Also, the decline or degeneration resulting from disease stress.

Senescent adj. Growing old, aging, degenerating.

Senescent sweetening In potato tubers, this refers to the breakdown of sucrose into glucose and fructose over time in storage. This is of special interest to those storing processing potatoes for chips and fries. The ratio has

Set In botany, the quantity and position (location) of tubers in a hill.

Re. quantity: Some potato varieties set 'heavy', i.e. there will be a great many tubers, while others will set 'light', that is, there will be only a small number of tubers. While this might seem a simple matter of numbers, it is further complicated by the 'quality' of the tubers produced. It is therefore important to distinguish those varieties, regardless of set, which produce commercially acceptable numbers of merchantable or saleable tubers, those of proper size and without defects. Thusly, some varieties which produce light sets, but with a high percentage of marketable tubers will actually be more cost effective than a variety producing a heavy set, but with a large percentage of pickouts or culls.

Re. position (location): Some potato varieties will set high in the hill and thusly with insufficient hilling will run a risk of exposure to the sun causing sunburn (scald) and unmarketable tubers. Other varieties set deep in the hill, minimizing any risk to sunburn and minimizing risk of freezing late in the season.

See Tuber Set

Set In potato farming and gardening, before seed potatoes are planted, they are cut up into small pieces each weighing two or three ounces and containing at least one eye. These pieces of potato are called sets or potato sets. Small potatoes weighing approximately the same, usually sold as Size B, are sometimes used whole as potato sets. Planting sets by hand is sometimes called planting by tuber unit, though this has a special connotation. See Seed piece. See Tuber set.

Shatter bruise The result of impacts that cause cracks or splits in the potato tuber skin. The cracks may extend into the underlying flesh and present an infection route for pathogenic organisms causing Fusarium dry rot, early blight, and bacterial soft rot.

Shipping Point Inspections Inspection of seed potatoes shortly before or at time of shipment to determine the product complies with seed potato grade standards recognized by the US and Canada seed potato regulatory agencies.

Short-day In botany, a reference to photoperiod, i.e. the amount of daily sunlight. Specifically, short-day refers to the consistently regular 12 hours of daylight and 12 hours of darkness experienced at the equator. This contrasts with long-day photoperiods which have varying amounts of sunlight depending on the season and the distance from the equator.

For potatoes this has long been a source of confusion. It was long supposed that potatoes were initially brought to Europe from the Andes where the plants, *Solanum tuberosum* subsp. *andigenum*, would have been short-day plants, and from which it would have been extremely rare to obtain tubers. Yet, tubers were obtained.

Some plants such as high-mountain potato species have different photoperiod requirements for flowering than for tuber formation. This is further complicated by combining the photoperiod with warm nights versus cold nights.

Similar varietal characteristics According to Art. 12-A of NYS Agriculture and Markets Laws (see Circular 860 Potatoes, "New York State Standards for the Grading, Classifying and Sale of Potatoes") this means that the potatoes in any lot have the same general shape, color and character of skin, and color of flesh.

Size A In New York State: For US No. 1 or No. 2 tablestock potatoes, in accordance with U.S. Standards for Grades of Potatoes (3 June 2011): Potato tubers with diameter greater than 1 7/8" min., but in a lot containing at least 40 percent of potatoes which are 2-1/2 inches in diameter or larger or 6 ounces in weight or larger. There is no maximum diameter or weight.

Size B In New York State: For US No. 1 or No. 2 tablestock potatoes, in accordance with U.S. Standards for Grades of Potatoes (3 June 2011): Potato tubers with diameter greater than 1 ½" and less than 2 ¼". There is no weight requirement. Diameter means the greatest dimension at right angles to the longitudinal axis, without regard to the position of the stem end.

Size C For many decades, a potato industry 'consensus' standard for potato tubers with diameter less than 1 ½" diameter. Size C potatoes were seldom identified as such in the marketplace. Rather, they were, and still are, called baby potatoes or creamers. The revised U.S. Standards for Grades of Potatoes, effective 3 Jun 2011, includes a new size category for Creamer potatoes codifying the old consensus standard. See Baby Potato and Creamer potato.

Size grading The process of separating potatoes into various size groups. This may be done at one or more times during the season. Some are separated out at harvest when placed in storage, others during grading for sale, still later for planting. This is generally done with machines called sizers. Sizes are established by United States Standards for Grades of Potatotes.

Sizer A machine used in a grading line by potato processors or by growers to separate potatoes by size, i.e. diameter. Most usually, this will separate Size A potatoes from Size B, but can also separate Chef size in a third line or even Creamers in a fourth. Each size will drop through appropriately sized rollers or screens onto separate conveyors to be processed according to its size. It is sometimes called a potato sizer.

Sizing See Size Grading. See Size standards.

Size standards The USDA has developed standards for various sizes of potatoes to be sold for tablestock, seed, and processing. Generally, state sanctioning bodies have adopted the federal standards for the sake of consistency, ease of interstate commerce and to avoid confusion in the market place.

Silver scurf A skin blemish afflicting all potato tubers, but which is especially important in red-skinned varieties. Silver scurf is caused by the fungus *Helminthosporium solani.* It was generally inconsequential until the 1990s when high humidity in potato storages and a developed resistance to thiabendazole fungicide became predominant.

Silver scurf shows up as small, light brown circular spots with indistinct borders on affected potato tubers. Affected tuber areas take on a silvery sheen, especially when the surface is wet. The longer mature tubers remain in the soil before harvest, the more severe the problem becomes. Silver scurf results in tuber blemishes and weight loss.

Fluctuations in storage temperature at high relative humidity (>90%) can result in condensation on tuber surfaces, allowing the fungus to sporulate and colonize new tissue. Sporulation is more abundant on young lesions than old ones. Excessive ventilation and handling can cause spores to become airborne and easily infect other tubers. Storage temperatures above 40 F are favorable for silver scurf.

Silver scurf can be managed with careful attention to seed tubers (protected with insecticide/fungicide), crop rotation (reduce soil-borne concentrations of *Helminthosporium solani*), timely harvest (within 2 to 3 weeks of vine kill), and careful management of storage temperature and humidity. The most important field control for silver scurf is planting uninfected seed.

Chemical control with chlorine dioxide, thiabendazole, Oxidant and ozone has been shown to be generally ineffective. Phosphorous acid, azoxystrobin and fludioxinil have been shown to control silver scurf. Phosphorous acid applied as a seed treatment does not work.

Worst case scenario: early marketing may reduce losses from infected crops.

Skinning

Skinning or 'feathering' often results from handling of immature potato tubers, resulting in the skin being scuffed and rubbed off. Tubers with skinned areas that have turned dark (brown) from exposure to wind, sun, or dry air (scald) may be unacceptable for the fresh market.

US Standards for Grades of Potatoes defines skinning in four categories from 'practically no skinning' to 'slightly skinned' to moderately skinned' to 'badly skinned'. The first is a lot with less than 5% of the tubers exhibiting 10% missing or feathered skin. The second is a lot with less than 10% of the tubers exhibiting 25% missing or feathered skin. The third is a lot with less than 10% of the tubers exhibiting more than 50% missing or feathered skin. The last is a lot with more than 10% of the tubers exhibiting more than half of the skin missing or feathered.

Skinning is best managed with good harvesting management practices. Sufficient time must be allowed between vine-killing, desiccation, and harvesting to allow for skin set to occur. With most varieties, especially red- and purple-skinned varieties, this will take 2 to 3 weeks. Harvest too early; skinning will occur on the immature tubers.

Otherwise, skinning is controlled with careful attention to avoiding bumping, bruising, scraping and other handling injuries during harvest and storage.

Skin set does <u>not</u> improve after tubers are removed from the ground.

Skin set

The process of thickening and tightening of the skin (periderm) on the potato tuber. Skin set occurs naturally after the potato plant matures and reaches senescence. The resulting tough, sturdy skin will protect the tuber from injury and infection from bacteria and fungi. It allows natural respiration, yet it prevents moisture loss; it maintains tuber viability and quality for many months.

Immature potatoes have a thin, loose skin. It is very fragile and will not withstand rough handling, or even standard harvesting methods. It is designed to expand as the tuber grows much like the rubber skin of an expanding balloon. Periderm growth is a continuous, dynamic process until plant senescence when bulking ceases.

Skin set is similar to wound healing or 'suberization', yet technically, it is not the same. The skin of the potato tuber is the phellem layer of the periderm. The phellem consists of a matrix of brick-shaped cells with no intercellular spaces. As the plant senesces, the phellum thickens and toughens by laying down a layer of suberin just as in the second step in the suberization process. Unlike suberization, skin set does not improve after tubers are removed from the ground.

Most potatoes grown commercially are vine-killed before harvest to ensure proper skin set and tuber maturation. Most cultivars will achieve full skin set in two weeks. Some cultivars, especially red-skinned and some purple-skinned ones, will require three or even four weeks for full skin set.

See Suberization. See New Potatoes.

Slough, sloughing The tendency of a potato tuber to crack and fall apart or disintegrate as it cooked in boiling water. Generally speaking, it is a function of the starch content. Sloughing tendency will increase with mealiness (starch content, specific gravity). Sometimes even waxy potatoes will slough if boiled immediately upon harvest. This has been attributed to turgidity and that if one waits for the tubers to lose 10% of their moisture, then sloughing does not occur.

Snowden Since 1988, the benchmark standard for late-season chipstock potato varieties in USDA / Snack Food Association (SFA) Chip Variety Trials.

Soil erosion The removal, displacement, or disappearance of soil by water (flooding, rain) or by wind.

Soil pH The pH of a soil affects the ability of plant roots to absorb nutrients. Calcium, phosphorus, potassium and magnesium are likely to be unavailable to plants in acidic soils, while plants have difficulty absorbing copper, zinc, boron, manganese and iron in basic (alkaline) soils. By managing soil pH, one can optimize the desired plant's ability to absorb the necessary nutrients from the soils for best growth and production. Many times, the most desirable pH for a optimal production of commercial cultivars will be least desirable for weeds which complete for space and essential phytonutrients. Therefore, strict pH control is usually very cost effective.

Acceptable soil pH varies by plant type (species) and sometimes even by plant variety. Recommended pH ranges for most cultivars can be found in standard reference books, or better yet at local Cooperative Extension offices and from most major purveyors of seed.

Acidic fertilizers can be used to lower pH and powderized limestone (lime) is often used to raise pH. The type of limestone or fertilizer applied and your soil type can make a difference in how quickly and how much the soil pH will change.

Potatoes grow best in acidic soils, i.e. those with pH ranging from 5.3 to 6.0. However, very acidic soils will result in small-sized tubers.

Soil temperature Soil temperature is a critical factor in the growth and quality of potatoes. The rate of sprout development from seed pieces is dependent on soil temperature. Very little sprout elongation will occur at temperatures less than 43 F; elongation is slow at 48 F and is optimized at about 64 F. The optimum soil temperature for initiating tubers is 61 to 66 F. Tuber development decreases as soil temperatures rise above 68 F and tuber growth practically stops at soil temperature above 86 F. The number of tubers set per plant is greater at lower temperature than at higher temperature, whereas higher temperatures favor development of large tubers.

Solanaceae In taxonomy, the botanical family of the potato. It includes eggplant, peppers, potatoes, tobacco, tomato, pepper, horse nettle, bittersweet, ground cherry, and petunia. The center of origin for all but the eggplant, which originated in India, is the New World.

***Solanum ajanhuiri* Juz. et Buk.** A cultivated diploid potato species found in the highlands of Peru and Bolivia at altitudes of 12,500 to 13,500 feet where generally speaking, potatoes do not grow. Not surprisingly, this species exhibits considerable frost tolerance. It was certainly selected by the Aymará Indians of southern Peru and Northern Bolivia and has been under cultivation for many hundreds of years. Its common name is Ajanhuiri potato. While it has been known to potato breeders since the 1930s, it has been used in breeding programs only since the 1980s.

***Solanum bulbocastanum* Dun.** A wild species of potato found in central to southern Mexico and Guatemala in woods, grasslands, rocks and field borders at elevations of 1,500 to 2,300 metres. It is drought tolerant. It is highly resistant to late blight and is being used in breeding programs attempting to transfer this resistance to cultivated varieties. In 2003, a late blight resistant gene from *S. bulbocastanum* was successfully cloned. The resistant gene, *RB*, was inserted into cv. Katahdin, a susceptible variety. The transformed Katahdin was then resistant to late blight. In 2006, a late blight resistance gene from *S. bulbocastanum* was patented by T. Osumi *et al*. and assigned to the USDA. This gene is alleged to confer horizontal resistance to late blight in potato.

***Solanum chacoense* Bitt.** An extremely polymorphic wild species of potato found in five South American countries: south Bolivia, north and central Argentina, Paraguay, Uruguay, and South Brazil. It is considered a weed in cultivated potato fields and lowland pastures. Its common name is Chaco potato.

S. chacoense is a grandparent of the cultivar Lenape which has exceptionally high specific gravity. Several important processing cultivars such as Atlantic, Gemchip, Snowden, Belchip and Spartan Pearl are progeny of Lenape as well as the purple-skinned Michigan Purple. One of the frost resistant varieties being used in potato breeding.

Solanum commersonii Dun. A wild species of potato with wide distribution across South America: Argentina, Paraguay, Uruguay, Brazil. It is diploid, but some autotriploid forms are known to occur. Plants are sometimes erect, but generally decumbent or rosette. One of the frost resistant varieties being used in potato breeding.

***Solanum curtilobum* Juz. et Buk.** A cultivated potato species distinguished by its semi-rosette growth habit found in the highlands of Peru and Bolivia at altitudes of 12,500 to 13,500 feet where generally speaking, potatoes do not grow. Not surprisingly, this species exhibits considerable frost tolerance. It is known to produce numerous variations in tuber color and form. It was probably selected by the Aymará Indians of southern Peru and Northern Bolivia.

***Solanum desmissum* Lindl.** A wild species of potato (hexaploid, 2n = 72) found in Mexico and Guatemala at elevations from 2,650 to 3,800 metres in pine and *Abies* forests, generally in shade. It is an extremely common and widespread species. It has rosette or semi-rosette growth habit, but occasionally produces a long stem. It is one of the most widely used wild species in potato breeding.

In the 1930s, *S. demissum* was found to have resistance to late blight and frost and several agencies began deriving germplasm from it. VIR alone has used it in 40 released varieties. The USDA has released many varieties containing *S. demissum* germplasm: Cherokee, Early Gem, Kennebec, Merrimack, Onaway, Saco and Superior. In the 1960s as P. infestans mutated, S. demissum germplasm no longer provided blight resistance**.**

***Solanum fendleri* Asa Gray** A wild species of potato found in the USA and Mexico. It has two subspecies: *fendleri* which is the more northerly of the two ranging from Colorado and Texas south to the Mexican states of Baja, Chihuahua and Sonora at 1,600 to 2,800 metres in dry oak-pine forests but not under dense shade; and *arizonicum* Hawkes which has been found in Arizona and the Mexican state of Chihuahua at 2,000-2,550 metres in pine forest clearings and roadsides.

S. fendleri is considered a wildflower in these regions where it is commonly known as Fendler's Horsenettle, Fendler's Potato, Wild Potato. It is sometimes confused with *S. stoloniferum.*

Although small (15 mm diameter), the starchy, potato-like tubers are edible if cooked. They are said to be pleasant eating, tasting somewhat like a sweet chestnut. The raw tubers are a different matter. They are very astringent and were only eaten by the Native Americans when other foods were scarce. When eaten raw the potatoes were mixed with clay. One report says that, after every mouthful of raw potato, a person would take a bite of white clay to counteract the unpleasant astringent effect of the potato in the mouth.

S. fendleri has been used for breeding of resistance to nematodes in potato.

***Solanum jucepczukii* Buk.** A cultivated potato species distinguished by its semi-rosette growth habit found in the highlands of Peru and Bolivia at altitudes of 12,500 to 13,500 feet where generally speaking, potatoes do not grow. Not surprisingly, this species exhibits considerable frost tolerance. It was probably selected by the Aymará Indians of southern Peru and Northern Bolivia.

Solanum morelliforme Corr. Arguably the most primitive living tuber-bearing species of *Solanum*. It is an epiphyte (growing on another plant for support but not parasitic) found growing on mossy branches of oak trees in the cloud forests of central and southern Mexico and Guatemala at elevations of 2000 to 3000 metres.

***Solanum phureja* Juz. et Buk.** One of the two sexually fertile, cultivated diploids of *Solanum* (the other is *Solanum stenotomum*). *S. phureja* 'Yema de huevo' is grown in the mountain valleys of Bolivia and Columbia at elevations far lower (2,600 to 3300 feet) than most cultivated potatoes. It is widely distributed. Its area of cultivation extends from western Venezuela to central Bolivia. It is early maturing and has a very short dormancy (J.G. Hawkes says it has no dormancy period.) which allows two crops in the same year.

J.G. Hawkes distinguishes *S. phureja* by its sparsely pubescent leaf, which is shining in the living state, and its rather irregular calyx with lanceolate lobes. Tubers yield in 3-4 months under short-day conditions and possess no dormancy period. The absence of tuber dormancy indicates that *S. phureja* has become specially adapted to regions that are free from long periods of drought or frost. Hawkes also notes that there are five varieties and four forms of *S. phureja* (as described by Ochoa). Most important are subsp. *hygrothermicum* and *estradae*.

The popular cultivar, Yukon Gold, was selected from a cross between W5279-4 (a yellow-fleshed diploid hybrid of *S. phureja* and haploid cv Katahdin) and Norgleam. Niche-market varieties Mayan Gold, Inca Sun and Inca Dawn are derived from *phureja* germplasm.

***Solanum stenotomum* Juz. et Buk.** One of the two sexually fertile, cultivated diploids of *Solanum* (the other is *Solanum phureja*). It is distinguished from *S. phureja* by the more densely pubescent leaf which is not shining in the living state, tubers produced in 5-6 months or longer and with definite dormancy period. It is considered to have been the first domesticated species of potato and is one of the parents of *S. tuberosum* ssp. *andigena*.

***Solanum tuberosum* L.** This is the cultivated potato species known by everyone the world over. It's center of origin is the equatorial highlands of the Andes Mountains of South America.

When it was brought to Europe in the sixteenth century, it was a short-day plant which meant that tubers were not initiated until the autumnal equinox in late September. Much of the crop was destroyed by frost before maturity. During the eighteenth century, day-neutral potatoes were developed in Europe, partly by plant breeders and partly by natural selection. (For this reason, some argue that the early potatoes brought to Europe were not *Solanum tuberosum*, but *Solanum andigena* and that *S. tuberosum* was brought from Chile to Europe and the US many years later.)

Since the mid-nineteenth century nearly all development work has been to develop disease-free tubers of very susceptible cultivars. As a result, modern potato cultivars have little resistance to many pests and diseases. A few botanists and plant breeders are searching the wilds of South America to find species with resistant characteristics and to breed those into the cultivated potato to gain a measure of horizontal resistance.

S. tuberosum is distinguished from other species of cultivated potatoes by the pedicel articulation placed in the middle third, short calyx lobes arranged regularly, leaves often slightly arched, leaflets always ovate to ovate-lanceolate, about twice as long as broad, never narrow lanceolate as in some forms of *S. stenotomum* and *S. phureja*. Corolla lobes are about half as long as broad. Tubers have a with well-marked dormancy period.

Two subspecies of *Solanum tuberosum* are now recognized: *tuberosum* and *andigena*.

In Europe, *S. tuberosum* has only two wild relatives: *S. nigrum* and *Solanum dulcamara*, neither of which is sexually compatible with *S. tuberosum.*

***Solanum tuberosum* spp. *andigenum* Hawkes** The short-day species (tetraploid with 48 chromosomes) adapted to the short-day conditions prevalent in the mountainous equatorial and tropical regions of Peru and Bolivia where it originated. It was introduced to Europe in the 16th century and persisted there until late blight struck in the middle of the 19th century.

Solanum tuberosum* spp. *tuberosum It was long suggested that catastrophic selection among the survivors of the late blight in mid-nineteenth century Europe gave rise to *Solanum tuberosum* ssp. *tuberosum*. Experimental evidence shows that ssp. *tuberosum*-like plants can be produced through selection from ssp. *andigena*. However, historical records show that, at the time of the late blight, ssp. *tuberosum* was imported to Europe from islands off the coast of Chile. Comparison of plants from the northern hemisphere and from coastal Chile show that they share all or nearly all of the same plasmon sensitivities, whereas they differed from ssp. *andigena* in eight of the nine plasmon sensitivities tested. Thus it is now concluded that ssp. *tuberosum*, cultivated throughout the northern hemisphere, originated in Chile rather than through the transformation of ssp. *andigena*. In other words, our modern cultivated potato, *Solanum tuberosum* spp. *tuberosum* was selected from *S. tuberosum* spp. *andigena.*

***Solanum verrucosum* Schlechtd.** A wild species of potato found in Mexico at elevations of 2,400 to 3,200 metres in pine, fir and oak forests. It has an upright growth habit. It is likely the ancestral form of the *Demissa* species. Plant breeders are using it as a source of resistance to late blight.

***Solanum vernei* Bitt et Wittm.** A wild species of potato used for many years in breeding for its resistance to golden nematode. *S. vernei* is a tall robust plant which produces seed berries.

α-solanine **A** glycoalkaloid chemical found in species of the nightshade family similar to α-chaconine. It can occur naturally in the any part of a potato plant, including leaves, fruit and tubers. It is semi-toxic to humans, but it requires a concentrated amount to induce sickness beyond headaches and stomach aches. α-solanine has both fungicidal and pesticidal properties, and it is one of the plant's natural defenses.

See also α-chaconine

Solids Regarding potato tubers, 'solids' refers to the amount of dry matter in a potato tuber. See Specific gravity.

Somatic hybrid A plant formed from the fusion of leaf protoplasts of a wild species and a tetraploid or diploid potato. In general, as long as both the wild species and the potato parent are fertile, the somatic hybrid can be crossed to a potato cultivar.

Sorting In the potato industry, the act of separating potato tubers into various categories. This might be by size (Size A, B, Creamers, Chefs, count cartons) or by quality (U.S. No. 1, U.S. No. 2, culls, etc). See Grading, Grade Standards.

Sound Agricultural Practices In New York State, those practices necessary for the on-farm production, preparation and marketing of agricultural commodities. Examples of such practices include, but are not limited to, operation of farm equipment, proper use of agricultural chemicals and other crop protection methods, construction and use of farm structures and fences, direct sale to consumers of agricultural commodities or foods and agricultural tourism activities.

Splashed When the distribution of secondary tuber skin color is expressed as the color confined to the areas around the eyes.

Specialty potatoes Those varieties (cultivars) of potatoes not commonly found in grocery stores or mainstream restaurants or other normal purveyors of potatoes for the table. There are two main types of specialty potatoes: Those with unusual skin and/or flesh color or unusual shapes, and those which are considered heirloom varieties (see Heirloom varieties). These unusual characteristics are exploited as marketing ploys to attract sales in niche markets.

Of the first type, it is the unusual skin color, flesh color and/or tuber shapes that attract sales. The novelty and fun of serving something different is the attraction. Skin colors can range from pure white to cream-white to tan to brown, yellow to orange to pink to red, purplish red to purple to dark purple-black. In partially-colored tubers, these colors may be confined to the eyes only, eyebrows only, splashed, spectacled, scattered or stippled. Flesh colors also run the spectrum from white to cream, from pale yellow to yellow to deep yellow to orange, from pink to red to violet or purple. Secondary color may exhibit itself as scattered spots or scattered areas, in the vascular ring, in the medulla, or in all the flesh except the medulla. Some varieties come with combinations of colors and may be described as splashed or splotched.

While coloring of flesh or skin may initially be the attraction, as one delves into the details, one will discover that coloring of potato tubers is an indicator of its antioxidant level and hence its increased value as a functional food. The coloring of potato tuber flesh is an indication of the content of anthocyanins and/or carotenoids, both of which are antioxidants. There is a direct correlation between yellowness of the flesh and total carotenoid content, while redness or blueness of the flesh is an indication of the total anthocyanin content.

Specialty shapes can range from fingerling and cowhorn to oblong and cylindrical for obvious reasons. Many, but not all, specialty varieties are heirloom varieties with origins in South and Central America. It is interesting to note that very few of these are white-fleshed.

Heirloom varieties hold an equal footing in the marketplace with the odd colored and odd shaped potatoes. While it is sometimes difficult to understand why some of these are still being grown, on the other hand, it is nice to see that someone still

remembers and cares about these varieties once held the place of now dominant varieties. One can still buy and eat a Green Mountain, a Rural Russet, a Garnet Chile, a Peachblow,

Obviously, one's geographic location will determine what a specialty potato is. In South America, many of the so-called odd colored and odd shaped potatoes are quite standard and not special in any way. In Europe, the standard potato is yellow-fleshed, while in the UK and North America, it is white-fleshed that is standard. The Congo, a.k.a. All Blue, a blue-skinned, purple-fleshed variety is not uncommon in Scandinavia.

Species

In botanical taxonomy, a much argued-about term. Generally speaking, species are the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means. Some describe species as a group of individuals that are sexually compatible with each other, but not with other members of the same genus or family. A crop species may include a number of different commercial varieties, agro-ecotypes, or pathodemes which are all sexually compatible with each other, but not with other crop species in the same genus or family. However, both inter-specific and inter-generic hybridization are often possible. Somehow, even after over 200 years of study, there remains much confusion about how to define species, at least in botany.

Specific gravity

An expression of density, a ratio of the density of a substance (liquid or solid) to the density of pure water at 4 ºC. In potato, this translates into a measure of the solids in the tubers. Generally speaking, potato tubers contain about 78% water and 22% dry matter. Specific gravity is one of the most important characteristics of a potato variety. It determines its preferred uses in both fresh markets and in processing markets where it has a huge effect on fry quality, baking characteristics, storability, and many culinary attributes.

However, it is the details that matter. Tiny changes in specific gravity have a huge impact on culinary and processing qualities of a potato. Potatoes with high specific gravity, i.e. greater than 1.08, such as Russet Burbank are preferred for baking and mashing and frying. Potatoes with low specific gravity, i.e. lower than 1.07, such as Dark Red Norland, are preferred for boiling and salads. In-bet*w*een specific gravities generally will yield good all-round, general-purpose potatoes.

Sugar and starch content are critical quality factors for processing potatoes. Tuber solids make up about 20 percent of fresh tuber weight. Starch makes up about 70 percent of total tuber solids. Starch is heavier than water, and, therefore, is the primary determinant of tuber density, which is commonly referred to as tuber specific gravity. Starch, tuber dry matter content, tuber solids content, and tuber specific gravity are terms used interchangeably when related to tuber processing quality.

Because specific gravity is related to maturity, late season varieties will have a longer time to accumulate carbohydrates and consequently will generally have higher specific gravity than early season potatoes.

Air and soil temperatures are the primary environmental factors affecting specific gravity. Warm days (80° to 90°F) and cool nights (50° to 60°F) provide optimal conditions for producing high specific gravity tubers. High soil temperatures have a direct effect on tuber physiology and inhibit starch deposition.

Other weather conditions can also affect tuber specific gravity. High evaporative demand caused by low relative humidity, high solar radiation, and/or high wind speed can also reduce photosynthesis. Prolonged periods with overcast skies can reduce light intensity to levels below that required for maximum dry matter production.

Any event or condition that destroys foliage or shortens the growing season can influence tuber specific gravity. Water stress (too much or too little) during tuber growth tends to decrease specific gravity, particularly when accompanied by high temperatures.

To promote high specific gravity, available soil water content should be maintained above 65 percent throughout the tuber growth period until just before vine kill.

Medium textured soils, such as sandy loams, loams, and silt loams, generally produce potatoes with higher specific gravity than very sandy or heavy clay soils. Well-managed loam soils have good water-holding and nutrient supplying characteristics that allow for high rates of growth and tuber dry matter production.

Tillage, planting, or cultivation practices that increase soil compaction and hardpan development can increase plant water stress, restrict root and tuber growth, and decrease tuber dry matter accumulation. In addition, cultivation practices, such as late weed tillage that increase root pruning, can increase plant water stress and reduce tuber quality.

Optimum plant nutrient concentrations in the soil are essential for maintaining high vine and tuber growth rates over the entire growing season. However, applying nitrogen and potassium must be optimized.

When other growing conditions are favorable, increasing nitrogen (N) availability up to the optimum level increases U.S. No. 1 yield and average tuber size without decreasing specific gravity. However, excessive N rates stimulate vine and root growth and delay tuber bulking and maturation.

It is equally important to avoid excessive late-season applications of potash (potassium oxide, K_2O). Starch synthesis and specific gravity increase with increasing K concentration up to an optimum tuber concentration of 1.8 percent. However, at higher K concentrations, specific gravity decreases as tubers begin to absorb more water due to the osmotic effects of increased tissue salt concentrations.

Potato varieties vary widely in their ability to accumulate starch in the tubers. The choice of variety is probably the most critical decision with respect to matching tuber quality with intended market.

Tubers that remain in the soil after vine death can actually lose dry matter as starch is converted back to sugars for use in respiration. This is especially evident when soil temperature is high. Killing green vines while the root system is still actively absorbing water can cause significant amounts of water to move from the roots into the tubers and decrease specific gravity.

The weight in air/weight in water method is one of the common methods of specific gravity determinations. Selected sample units are first weighed in air and then the same unit is re-weighed suspended in water. Specific gravity can then be calculated using the following formula:

Specific gravity = Weight in air/(Weight in air - Weight in water)

The total solids and starch content of potatoes can be estimated from the calculated specific gravity measurements using the following table:

Specific gravity	**Percent total solids**	**Percent starch**
1.062	17.8	11.78
1.064	18.1	12.07
1.066	18.5	12.45
1.068	18.9	12.83
1.070	19.2	13.11
1.072	19.6	13.49
1.074	20.0	13.87
1.076	20.4	14.25
1.078	20.8	14.63

1.080	21.2	15.00
1.082	21.5	15.29
1.084	21.8	15.57
1.086	22.2	15.95
1.088	22.6	16.33
1.090	230.	16.71
1.092	23.3	17.00
1.094	23.7	17.30

There are variations in specific gravity between tubers from the same plant, and even within a single tuber from end to end. There are also variations between varieties, locations (northerly (higher) to southerly (lower) growing areas), season and year of cultivation, but even allowing for all of these variations specific gravity estimates are still a practical way of assessing internal quality and preferred uses.

Relationship Between Tuber Dry Matter and Optimum Use

Specific Gravity	Dry Matter, %	Texture	Typical Uses
Below 1.060 (very low)	Below 16.2	Very moist	Pan frying, salads, canning
1.060-1.069 (low)	16.2-18.1	Moist	Pan frying, salads, boiling, canning
1.070-1.079 (medium)	18.2-20.2	Waxy	Boiling, mashing; fair to good for chip processing and canning
1.080-1.089 (high)	20.3-22.3	Mealy, dry	Baking, chip processing, frozen french fry processing, thickeners
Above 1.089 (very high)	Above 22.3	Very mealy or dry	Baking, frozen french fry processing, chip processing (tendency to produce brittle chips)

Adapted from: Mosley, A.R. and R.W. Chase. 1993. Selecting Cultivars and Obtaining Healthy Seed Lots. In*: Potato Health Management*, APS Press, 1993. pp. 19-27.

Unfortunately, the consumer has no easy way to know the specific gravity of any potato found in the U.S. marketplace. Not only does the U.S. potato industry not promote specific gravity or percent solids or dry matter in the consumer marketplace, it does not even sell its potatoes by variety name so the consumer can know what is what by looking

it up. The potato industry does attempt to differentiate between baking potatoes (mealy/dry) and boiling (waxy/moist) potatoes versus all-purpose potatoes, but this would seem to be mostly lost on the average consumer. *Caveat emptor*.

Spore An agent of reproduction that's formed by one or a few cells. The cells themselves are created by division of parent cells. Spores are a common method of dispersion for fungi and bacteria.

Sport Mutants (spontaneous genetic mutations) within a clone are often called sports (see strain). If a sport is somehow identified in the field (which in itself is a miracle of sorts) and which is segregated from its original normal population and subsequently propagated and increased to production volumes, it can take its place in commercial production as a strain or even a new variety.

Obviously, this will only happen if the mutation results in an improvement in appearance or production characteristics. It is equally likely, or perhaps more likely, that a spontaneous mutation will worsen the appearance or production characteristics or may affect a trait that is not readily obvious by naked eye, and so it will not be selected and propagated, and it will die out.

Perhaps the most famous sport in all the potato world is the Russet Burbank, a russeted variant of Burbank, a.k.a. Burbank's Seedling, which was discovered in a potato field in Montana in 1895 and introduced to the marketplace as Netted Gem by L.L. May & Co. of St. Paul, MN, in 1902. Other sports which have achieved commercial status are Red Norland and Dark Red Norland, Red La Soda, and Red Pontiac which were discovered among fields of Norlands, La Sodas, and Pontiacs, respectively.

Spraing See Tuber necrosis.

Spreading In botany, when describing the growth habit of a plant, spreading is the term describing the posture of a plant whose stems at full-growth about the time of maximum growth topple over and make an angle of 30 degrees to 45 degrees with the perpendicular. Alternative postures are erect or decumbent.

Sprout inhibitor Sprout inhibitors are chemicals applied to potato tubers by many growers, particularly tablestock and processor growers, to help prevent shrinkage, blackening, nutrient loss, susceptibility to bruising and to reduce accumulation of some natural toxic chemicals that accompany sprouting. The most widely used and least offensive sprout inhibitor is chlorpropham (isopropyl N-(3-Chlorophenyl)-carbamate) or CIPC, which is now used on 90 to 95 percent of stored potatoes (over 5 million tons) in the US. Other sprout inhibitors include maleic hydrazide (MH), dimethyl naphthalene (DMN), carvone (Talent), jasmonates, ethylene and hydrogen peroxide. Non-chemical inhibition of sprouting include storage at low temperature, shaded huts and rustic storage.

Only limited data are available on the toxicological effects of CIPC, but animal studies have shown it to have a weak toxic activity. Studies at Cornell's College of Human Ecology have shown that CIPC remains on potato skins in amounts four times greater than government guidelines.

Cornell's nutritional scientists looked at residues in Katahdin and Russet Burbank potatoes cooked with both dry heat (baked with and without foil, and microwaved) and moist heat (pressure-cooked and boiled). In all cooking methods, the highest levels of residue were found in the peels which contained at least 20 times more of the chemical than the pulp. The peel had more than four times the safety level of 50 ppm (parts per million) designated by the Food and Drug Administration. The pulp, however, was

generally below this level. The highest levels in the pulp were found when the boiled potatoes cooked with the peel on, apparently due to the migration of CIPC from the peel into the pulp during cooking.

The scientists concluded that peeling potatoes prior to cooking removes most of the problems associated with toxic substances in the peel.

Research and development of new, more environmentally-friendly alternatives to existing sprout inhibitors is underway. Many of these will use naturally occurring plant compounds and may be approved for use on organic potatoes.

Since virtually all grocery store potatoes are treated with sprout inhibitor, gardeners should note the following advisement from potato experts at North Dakota State University: "Planting eating potatoes from the grocery shelf guarantees total failure, because these potatoes are treated with a sprout inhibitor and will not grow."

To obtain eating potatoes untreated with sprout inhibitor, consumers will have to seek them directly from growers, farmers markets, roadside stands, and other small outlets.

Sprout nip See Sprout inhibitor.

Spud Slang for a potato tuber. It is said to come from an implement called a 'spud' which was used to weed the potato patch. A spud was a small, narrow spade with a sharpened blade, somewhat like a chisel with a long handle, used to cut the roots of weeds without stooping.

Unfortunately, no one knows exactly why spuds are called spuds. As a slang term for a potato, spud first appeared in print around 1845 in E. J. Wakefield's "Adventure in New Zealand," apparently in a discussion of local slang: "*Pigs and potatoes were respectively represented by 'grunters' and 'spuds*.'" The experts' best guess about the origin of spud traces it to a type of short-handled gardening spade known since 1667 as a 'spud' or 'spudd' used for digging up potatoes. It may be that the use of "spuddy" (one who digs with a spud) as a slang term for a potato seller led to the vegetable itself coming to be known as a spud, but at least some connection between the tool and the vegetable names seems certain.

Spudgun An 'explosive' device made usually home-made from plastic water pipe, designed to launch, shoot, or lob a potato or similar object through the air.

Spudware A brand name for plastic dining utensils, i.e. forks, spoons and knives that feel like high-quality plastic, but are made from a biodegradable blend of potato starch and soy oil, marketed by Excellent Packaging & Supply.

These biodegradable spudware utensils are excellent for hot items like soup. They have the look and feel of plastic. The color is natural tan and they have a shelf life of 5 years and are reusable since they are dishwasher safe. Spudware outperforms regular plastic in boiling and microwave testing, and it is biodegradable in your compost pile.

Stamen The male reproductive organ of flowers.

Standard chipping potato The variety against which all 'chipping' potatoes are compared. In the U.S. and North America, this is the potato variety Atlantic.

Starch A linear polymer (polysaccharides) made up of repeating glucose groups linked by glucosidic linkages in the 1-4 carbon positions. The length of the starch chains will vary with plant source, but in general the average length is between 500 and 2,000 glucose units. There are two major molecules in starch: amylose (15-20%) and amylopectin (80-85%). The alpha linkage of amylose starch allows it to be flexible and digestible.

Starches tend to be insoluble in water. They can be digested by hydrolysis, catalyzed by enzymes called amylases, which can break the alpha-linkages (glucosidic bonds). Humans and other animals have amylases, so they can digest starches. Potato, rice, wheat, and maize are major sources of starch in the human diet. The formation of starches is the way that plants store glucose.

In potato, starch makes up about 90% of the carbohydrates and about 70% of the dry matter. It is a mixture amylose and amylopectin in the ratio of 1:5.

Stolon In botany, a shoot which proceeds from a stem above the ground, takes root at the tip, and develops a new plant; a runner or rhizome. The most common textbook example of a stolon is the strawberry (*Fragaria*), in which the mother plant forms plantlets on stolons during spring growth.

Stomate In botany, a breathing pore, usually located on the underside of leaves but may also be present on stems of a plant.

Storage The potato is at its best culinary and processing quality at the time of harvest. Many are delivered directly to consumers, fresh markets and processors soon after harvest for that reason. This is especially true in southern climates where the cost of specialized storage buildings and refrigeration systems for long-term storage is cost prohibitive. However, in the northern U.S. and most of North America, most potatoes are stored throughout the winter at relatively low cost for delivery many months later.

In well-constructed and well-managed potato storage buildings, i.e. potato storages, tubers of many cultivars can be stored in marketable condition for more than 10 months. Storage buildings can be designed with ventilation systems and temperature/humidity/carbon dioxide (CO_2) controls to prevent moisture loss (shrink), decay, and early sprouting (loss of dormancy), while removing respiratory heat. Accurate temperature and ventilation management is critical for long-term storage of high quality potatoes.

When potatoes are initially placed in storage, they must be preconditioned at about 50 to 60 F and high humidity for the first 10 to 14 days. Under these conditions, cuts and bruises heal rapidly and losses from shrink and decal are reduced. Operation of ventilation systems must be fine-tuned to maintain high humidity yet remove the heat of respiration and maintain the acceptable temperature range.

Potatoes placed in storage with pulp temperatures of 45 °F or colder, especially those exposed to field frost must be warmed up to 50 °F for preconditioning. The key to storing potatoes with field frost is to warm them to 50 °F for two weeks to promote formations of a closing layer at the boundary of healthy and dead tissue.

Seed potatoes are generally stored for the winter at 38 to 40 °F with a relative humidity in the range of 75 to 95%, 90 to 95% is optimal. Tablestock potatoes are generally stored at around 40 °F with high humidity. Processing potatoes are generally stored at the same high relative humidity but at warmer temperatures ranging from 50 to 60 °F depending on the cultivar and the intended usage. Strict limits for temperature and humidity will control rates of respiration and keep the tubers in dormancy. This has direct affects on the sugar/starch ratios, sprouting, fry color, and weight loss all of which will promote tuber quality and price at the time of sale.

When potatoes are stored at too cool a temperature, starch is converted to sugar in the tuber. Too much sugar will make potato chips, fries and dehydrated potatoes too dark. Alternately, a too warm temperature increases respiration and decreases dormancy leading to sprouting. Both processes cause weight loss (shrink) and softening of the tubers. It is very important that optimal temperature and humidity is maintained to ensure good prices for quality potatoes depending on their intended use.

To remedy the starch to sugar conversion, cold potatoes from storage can be reconditioned before processing. Reconditioning involves removal from low temperature storage and placement for several days or more at 64-70 °F and 85-90% relative humidity to accelerate the conversion. There is a marked degree of difference between cultivars in their ability to accumulate sugars. Therefore, cultivar selection is important in producing acceptable quality processed potato products.

Light is also severely restricted in storage buildings to avoid chlorophyll development that results in tuber greening and the associated formation of toxic and bitter tasting glycoalkaloids.

Consumers should store potatoes in a cool dry place. Potatoes will keep at room temperature for up to two weeks and longer when stored in cool temperatures. It is not recommended to store in the refrigerator because the cold temperatures will convert the starches into sugar and the potato will become sweet and turn a dark color when cooked. Do not store with onions, the gas given off by onions will accelerate the decay of potatoes. Do not wash potatoes to be stored.

Strain

A controversial subject in taxonomy and botany, see Variety. Nonetheless, in the potato business, strains are mostly treated as varieties (cultivars), even though there is no taxonomic reason to do so.

Generally speaking, in the potato world, a strain is a spontaneous mutation (sport) in a single potato plant within a variety (cultivar) representing an important change in appearance or production characteristics. The most common mutations in potato are those affecting skin color, skin type or texture, plant vigor or maturity.

It must be noted that in order for a spontaneous mutation (sport) to become a strain, it must be recognized for what it is by a keen observer. This, in and of itself, is in many ways, a miracle. Firstly, that single mutant plant amongst thousands if not millions of plants must be identified by an observant grower or breeder and recognized that it is different from the standard. Secondly, its tubers, or even its true seeds, must be segregated from the standard ones, propagated, and subsequently increased to production volume. This is known as the ‘selection process’. It is also called strain selection, sub-clonal selection, intraclonal selection and line selection. Hence, the nomenclature: Norland Dark Red Selection. See Selection Process and Line Selection.

The biggest problem with most strains is that they do not always breed true, they can be unstable and will themselves throw the occasional ‘sport’. The second problem with strains is that there is no way to tell the strain from its source or from another strain of the same variety without sophisticated DNA or chromosomal analysis.

It has been estimated that perhaps half the current potato production in the U.S. consists of mutants, sports, or strains of original varieties that have subsequently superseded the production of the original variety. That statistic is true only because the Russet Burbank, a sport or mutant of the original Burbank, which is rarely grown today, comprises 45% of the US production. Other well-known and widely grown strains are those of LaSoda (Red LaSoda), Pontiac (Red Pontiac), Norland (Red Norland, Dark Red Norland, New Red Norland, Super Red Norland, Norland strain 72), Norgold Russet (Norgold Russet M, Norgold Russet #35 and Norgold Russet #19) and Russet Norkotah (Russet Norkota TXNS 112, TXNS 223, TXNS 278, and TXNS 296).

A recent court case in North Dakota has raised the issue of strains to unprecedented prominence. A grower thought he was buying Norland Reds, but instead got Norland Red strain 72, and when his crop yielded only size B potatoes (Norland Red strain 72 yields only size B tubers), it subsequently became clear what had happened and legal action was taken. The resulting settlement will change the way certifying agencies

identify potato varieties and it should serve as a warning to those buying and selling certified seed to be sure what they are buying.

Straw potatoes Potatoes grated or sliced into tiny sticks and deep-fried.

Subcooled liquid Any liquid cooled to a temperature below its saturation temperature at its existing pressure. It is sometimes called a compressed liquid.

Suberin A waxy substance, resistant to microbial attack, formed in the corky cells of periderm layers of a potato tuber.

Suberization The two-step process of wound healing in a potato tuber. When a tuber is wounded, healing begins in the undamaged cells just beneath the wounded area. This process will begin 1 to three days after wounding. First phenolic compounds are deposited into the walls of the outer two or three layers of intact cells beneath the wound. One of these phenolic substances is called "suberin" and is the origin of the term "suberization." Suberin is a complex fat-based phenolic material that looks much like common bottle cork. It seals off the wound to prevent the loss of moisture and provides protection from bacterial pathogens. This stage will be complete 4 to 7 days after wounding.

The last stage of wound healing involves the formation of a new wound cork or a "phellum" layer. This process occurs within the cells just beneath the new suberin layer, where a series of new cross walls are laid down parallel to the wounded surface. The area where this occurs is a new meristem and is called the "phellogen." After a series of cell divisions, the end result is a layer of flattened, brick-shaped cells usually four to six cells deep. When the cell division phase ends, these wound cork cells also become suberized. The temporary suberin layer collapses because its cells are cut off from the moisture supply within the tuber. This new wound barrier created by the tuber is very similar to the original skin or periderm of the potato tuber both in appearance and ability to protect the healed area.

Under ideal conditions, the wound healing process takes about a week. Suberization usually takes two to four days, and another two to four days for wound cork formation occur. Wound healing also requires temperatures from 50^{0} F to 60^{0} F, oxygen, and high relative humidity. Wound healing rates are actually quite high at temperatures of 70^{0} F or higher, but the activity of most tuber pathogens is so accelerated at these temperatures that the wound healing system cannot react rapidly enough to prevent infection. The whole process will typically be completed within one to two weeks.

Suberize To harden cell walls by a two-step process of converting cell layers to cork. See Suberization.

Sucrose The major free sugar found in immature potatoes. Sucrose is a 12 carbon non-reducing sugar that occupies a critical position in potato tuber development. Translocated to tubers from the leaves, sucrose is the major source of carbons and energy for starch synthesis and potato growth. The sucrose concentration is high in immature potatoes because its rate of trans location to the tuber exceeds its rate of metabolism in the tuber.

During tuber development some of the carbon from sucrose is completely oxidized to CO_2, H_20 and energy (i.e., ATP). A protein inhibitor prevents the enzyme invertase from hydrolyzing sucrose to the two 6-carbon reducing sugars during growth. The invertase reaction becomes active in storage, producing the undesirable reducing sugars from the available sucrose pool. Therefore, high levels of sucrose present in potatoes at harvest, can be detrimental to chip color after only a few days in storage.

(See Senescent sweetening, Sugar end disorder)

Sugar end disorder (a.k.a. Sugar-end defect) One of the more serious physiological disorders affecting market quality of those potato tubers being grown for chipping or french fries. Sugar-end defect is a result of pre-harvest field stress (high air temperature, moisture deficit, water stress) that predisposes potato tubers to accumulate excessive levels of reducing sugars during storage which in turn leads to chip and french fry darkening during processing. Darkening in potato chips and french fries is a serious quality problem and will result in rejection of tubers at the processing plant.

Sugar ends are sometimes described as dark ends (in reference to the dark color at one end of a french fry made from a tuber with sugar end disorder) or translucent ends or glassy ends (in reference to the visually-recognizable, low-starch content at one end of a tuber) or jelly ends (in reference to the rot that transpires in storage).

The principal cause of reducing sugars in potato tubers is high air temperature and high soil temperature (heat stress) during growing season. Air temperatures higher than 80.6 F will result in sugar end disorder in Russet Burbank. A water deficit alone will result in a less detrimental effect. But in combination with heat stress, a water deficit (water stress) will result in a high percentage of sugar ends.

Interestingly, water stress alone at the time of tuber formation does not correspond with more sugar ends, but nonetheless, it seems crucial to avoid water stress during early tuber bulking. (This is important advice to growers using irrigation.)

Consequently, growers need to be aware that encouraging full canopy coverage can lower soil temperature. They also need to know that optimally controlled irrigation systems can keep soil temperatures low enough to reduce the occurrence of sugar ends and also lower the canopy temperature.

Heat stress during tuber formation, especially combined with water stress, results in the accumulation of sugars (and consequently low starch levels) in the stem end (basal end) of the tuber while still in the ground. This type of sugar-end is not reversible by any post-harvest treatment.

A later, mid-to-late season moisture deficit combined with heat stress results in a more dramatic accumulation of reducing sugars, but which is more pronounced in the apical end of the tuber. Unlike early season stress, the mid-to-late season moisture deficit induces sugar-end that can be readily reversed by postharvest reconditioning treatments.

Factors that may lead to sugar end disorder include too little or too much nitrogen fertilizer, high soil temperatures, and transitory soil moisture deficits, especially if these occur during early tuber bulking.

Resistance to sugar end disorder is highly heritable among potato varieties.

Controllable factors which may contribute to sugar ends in potatoes:

- Variety selection: Lemhi Russet, Umatilla Russet, Legend Russet are resistant to sugar end disorder,
- Avoidance of saline, steep, shallow or high-bulking soil types,
- Avoidance of soils with high calcium carbonate content,
- Strict control of irrigation schedule,
- Water tension in silt loam soils limited below 60 kPa seems advisable,
- Fertilization characterized by insufficient or excessive amounts of nitrogen and insufficient amounts of phosphorus can indirectly induce an increase in sugar end.

Sulfuric acid An agricultural chemical used for vine kill. It is highly effective and achieves 100% desiccation of stems and leaves in 3 to 5 days. Skin set begins almost immediately

making harvest possible in the shortest amount of time after application (7 to 10 days depending on the pre-harvest interval (PHI) specified on the product label. It can be applied only by licensed, certified applicators.

Sun-burn, Sun-burning See Greening

Sun scald An injury to potato tubers, separate from greening or sunburn, in which actual structural damage to the tubers occurs. Long-term, direct exposure to intense sunlight will result in tuber tissues appearing 'cooked' with some loss of structural integrity. The skin (periderm) may appear bleached without a distinct green color.

Sun scald can be avoided by the same techniques as those used to avoid sunburn, (greening), that is, planting at the correct depth and adequate hilling to assure coverage of tubers. This is especially important with those varieties which exhibit high tuber set, i.e. tubers developing high in the hill and needing additional care to assure adequate soil coverage.

Supercooled liquid Any liquid existing at a temperature below its freezing point without becoming a solid.

A liquid below its freezing point will crystallize (freeze) in the presence of a seed crystal or nucleus around which a crystal structure can form. However, lacking any such nucleus, the liquid phase can be maintained all the way down to the temperature at which crystal homogeneous nucleation occurs. The homogeneous nucleation can occur above the glass transition where the system is an amorphous—that is, non-crystalline—solid.

Water has a freezing point of 0 °C or 32 °F, but can be supercooled at standard pressure down to its crystal homogeneous nucleation at almost −42 °C or -41 F.

Supernatant In chemistry, the adjective for any liquid above non-soluble solids or precipitates. It means floating above.

Supernate Noun referring to the liquid or the clear fluid above a sediment or precipitate. The solids may reach the bottom of a container by means of settling, sedimentation, precipitation or centrifugation. Use of the word supernatant (adjective) in scientific papers when referring to supernate (the noun) is a common mistake

Susceptible Lacking the inherent ability to resist disease or attack by a given pathogen; not immune.

Susceptibility The inability of a plant to resist the effect of a pathogen or other damaging factor.

Swollen lenticels Swollen or enlarged lenticels (water spot, water scab) is a physiological disorder of potato tubers that develops when tubers are exposed to very wet conditions in the field or storage. Swollen lenticels usually appear as white bumps on the potato surface. These bumps form when tissue below the lenticel swells and bursts through the protective covering of the lenticel. The swelling seems to be related to oxygen deprivation by the watery film covering the lenticel.

Besides giving an unmarketable appearance to the tuber, the major problem is that pathogenic organisms may gain entry to the interior tissues. Potatoes with swollen lenticels are susceptible to bacterial soft rot, pink rot, pythium leak and especially soft rot.

The disorder may be somewhat reversible if the wet period is short, but it usually reduces the storability of the tubers due to soft rot.

Synonym A word identical in sense and usage with another of the same language or a word denoting the same thing as another but suitable to a different context. It is rather in this latter sense that we speak of synonyms amongst potatoes, meaning thereby that one and the same variety (cultivar) may have two or more names, or, more correctly, that two or more different names intended to connote to the public mind so any different varieties are, in fact, but different names for the same variety (cultivar).

Synonymity See Synonym.

Systemic herbicide A chemical that enters the offending plant and kills it by affecting some normal process within the plant. Systemic herbicides can sometimes be applied during planting of a crop.

Tablestock Those potatoes grown and sold for the fresh market, i.e. for consumption without being processed or frozen.

TAC See Total Antioxidant Capacity. The Total Antioxidant Capacity is a total of lipophilic (fat based) and hydrophilic (water based) antioxidant components.

Taclla A foot plow developed by early Peruvian farmers to plant potatoes**.**

Tato man A London street vendor specializing in selling baked potatoes throughout the nineteenth and probably the latter part of the eighteenth century. Salaman reports that the 'hawker of hot potatoes' could be found selling his wares (baked potatoes) during the winter months on the busiest of street corners in London by 1813. He goes on to say that he suspects these vendors had been doing so since the last quarter of the previous century. Zuckerman does not dispute any of this, only emphasizes that the "baked 'tato man'" was on duty by 1820 when the potato was yet a specialty item. He suggests that it wasn't until 1835 that potatoes were commonplace in London and that by 1851 there were 300 vendors plying the streets of London with baked potatoes and selling 10 tons of them daily. Interestingly, they were selling baked potatoes not only to eat, but as hand warmers. The 'tato man' seems to have died out around the time of WWI.

Taxon A systematic group of plants in a hierarchical system.

Taxonomy The science of describing, naming and classifying organisms. It is a rigorous system of hierarchical groupings (taxons) designed to separate all living things into intelligible and descriptive chains (at least to experts). Unfortunately, the system was developed using physical appearance and structure for many of its divisions. New techniques using genetic markers are now showing that many organisms previously thought to be unrelated really are, and vice versa. There is considerable controversy among taxonomists over what to do about this.

For potatoes, there is a degree of confusion over whether wild potatoes are properly classified in the correct species and subspecies. Scientists are undertaking the enormous task of analyzing and reclassifying the hundreds of wild species. They are trying to eliminate subspecies altogether. New techniques may make this possible. Also, there is the matter of classifying cultivated varieties as cultivars under a separate set of rules (really just another layer on top of the Linnean rules).

Additionally, genetic markers are being used increasingly to ensure proper identification of potato cultivars in the seed certification process.

Temperature It is often said that potatoes need hot days and cool nights for optimal yields. Botanists will note that potato vines and potato tubers are competing with each other for limited nutrient resources: Excessive vine growth can result in reduced tuber growth. What they fail to say is that there seems to be a relationship between air temperature and soil temperature that affects the vines and the tubers separately. Several factors can shift the balance between vine and tuber growth, and one of these is temperature. For Russet Burbank, the optimum soil temperature for tube growth is about 61 °F, while the optimum air temperature for vine growth is about 77 °F. However, with a full leaf canopy shading the soil, it is possible to have 77 °F air temperatures at the same time as 61 °F soil temperatures. High soil temperatures will delay tuber growth.

Tertiary bloom The third production of flowers that occurs at the end of the growing stem of an indeterminate potato cultivar.

Tetraploidy The presence in a cell of four haploid sets (23) of parental chromosomes, giving a total chromosome count of 92.

Texture Sometimes referred to as 'consistency', the 'texture' of cooked potato flesh is the primary quality-factor used to determine the preferred use for cooking and processing. Texture is variously described as mealy or watery, starchy (floury) or waxy, dry or moist, high starch or low starch (content). Mealy potatoes are preferred for baking, mashing and deep-frying because they have a soft, dry texture after cooking. Moist potatoes, on the other hand, are preferred for boiling, pan frying, soups, casseroles, salads, roasting and barbecuing.

The texture of the cooked potato is greatly influenced by its dry matter content and also by tuber cell size and the ratio of amylose to amylopectin starches. Culinary and processing uses are strongly influenced by these features.

In general, tubers with a high dry matter, high amylose to amylopectin ratio, small cell size, and low sugar content are preferred for most processing uses and for preparation by baking or deep-frying. Such potatoes tend to slough when boiled.

TGA Total glycoalkaloids. See Glycoalkaloids.

Thermal hysteresis The difference between the melting point and the freezing point of a solution. (For most materials this is the same temperature, and therefore, by definition, there is no thermal hysteresis. There are however some materials, such as agar which have thermal hysteresis.)

Tissue culture Specialized laboratory techniques currently being used to perpetuate disease free seed stock, which can then be stored *in vitro* until needed.

Tolerant A host plant that can support reproduction of a pathogen while sustaining little damage.

Total Antioxidant Capacity Total antioxidant capacity (TAC) refers to a full spectrum of antioxidant activity against various reactive oxygen/nitrogen radicals in the human body. Scientists have been working for many years to develop a way to measure various free radical damage products or antioxidant status. Typically, the assays developed so far are a measure of the combination of lipophilic (fat based) and hydrophilic (water based) antioxidant components. Paradoxically, these TAC assays do not measure total antioxidant capacity.

In general, they measure predominantly the low molecular weight, chain-breaking antioxidants, excluding the contribution of antioxidant enzymes and metal-binding proteins.

Total yield Total weight of all harvested tubers from a field. Interestingly, at least one researcher has pointed out that due to myriad improvements in the US potato industry, yields per acre have increased at the rate of 4.4 cwt/year for the past half century.

Travel speed The forward, horizonatal ground speed of a potato harvester. This will vary according to the soil type, the soil moisture, the slope of the terrain and the amount of soil, grass, weeds, and potato vines being handled by the harvester.

Unsurprisingly, the key to the proper forward speed is to keep the quantity of material being handled equal to the capacity of the aprons to sift and separate the material. All aprons should be operated so that the volume of material on them is equal to the capacity of that apron. The relative primary chain speed to forward speed found to achieve the desired relationships are 100 to 120 percent for sandy soil and 120 to 150 percent for sandy loam soil.

True seed These are the seeds found in the fruits of the potato plant. Plant breeders often work with them to manipulate crop improvements and insect or disease resistance. However, since many potato cultivars are pollen sterile, there are many difficulties to be addressed and many times the initial crop from such crossings often results in tubers of less than commercial size, value and reliability. Commercially, true seed is of little value due to the high variability and unpredictability of offspring resulting from them. Growers have avoided them altogether and developed reliable methods and programs of commercial propagation through seed tubers. True seed is only now becoming important in the tropical world where disease pressure is too high to maintain healthy seed tubers and where experiments in developing new resistance schemes are being tried.

Tuber In botany: The swollen tips of underground stems (rhizomes) called stolons that stores food for the survival of the plant. Potatoes, onions, garlic, leeks, shallots, and water chestnuts are tubers.

A potato produced in fields or gardens. See Potato tuber.

Tuber bulking This is the critical growth period for both tuber yield and quality (Growth Stage IV). Under optimal growing conditions, tuber growth rates remain relatively constant during this period, which is commonly referred to as the linear tuber growth phase. Any interruption of ideal conditions can result in reduced tuber growth rates and losses of both yield and quality. Research has shown that two major factors influence tuber yield: photosynthetic activity and duration of the leaf canopy, and the length of the linear tuber growth phase. The longer a canopy is able to produce photosynthate at a relatively high rate, and the longer tubers are bulking at their maximum rate, the higher the yield.

Tuber bulking rate and duration can be influenced by several environmental and cultural factors. Any condition that limits growth of healthy foliage disrupts tuber growth, or shifts dry matter partitioning from the tubers to the foliage decreases yield potential. Some of the factors that affect tuber bulking are temperature, fertilization, seed physiological age, plant spacing, planting date, irrigation and pest management.

Tubercles Small tubers produced in leaf axils of leaf bud cuttings.

Tuber initiation Under appropriate growth conditions, the tips of stolons will ‘hook’ and begin to swell, resulting in initiation of new tubers (Growth Stage III). For many cultivars, this occurs

during early flowering, although there is not causal relationship between the two events. Potatoes need moderate amounts of nitrogen and cool nights to achieve good tuber growth. Water stress (lack of water) will lead to earlier tuber initiation. This stage lasts about two weeks.

Tuber maturation As potato plants mature, they will turn yellow and lose leaves, and the vines will die (Growth Stage V). During this process several important things happen to the tubers. The skin or periderm thickens and hardens, which provide greater protection to the tubers during harvest and handling and blocks entry of pathogen to the tuber. During tuber maturation, specific gravity (dry matter) increases, which improves quality for both processing and fresh market consumption. In addition, free sugars are converted to starch, which allows for lighter colored and better quality chips and fries. Also with proper maturity, tubers in storage have lower respiration rates, which results in less dry matter loss, remain dormant longer, and consequently sprout later. Properly matured tubers also have greater resistance to pathogens in storage. If tubers remain too long in the soil after vine death, however, they can become over-mature. In such cases, starch converts back to sugar and specific gravity declines.

Tuber necrosis Necrotic dark brown arcs, rings and/or flecks in the tuber tissue often associated with necrotic rings on the tuber surface. Tuber necrosis is also referred to as spraing depending on the virus.

Tuber set The number of tubers produced by a single plant. Tuber set is characterized as high or heavy (many tubers) to low or light (few tubers). The plant may initially produce 20 to 30 small tubers, but only 5 to 15 tubers typically reach maturity. The growing plant absorbs some of the tubers in the original set.

Tuber set is a function of variety, but it is also particularly sensitive to moisture stress and soil nutrients. Fewer tubers are set when available soil moisture is below 65% of the available soil water capacity.

Growers will pay attention to whether tuber set placement is high or low in the hill, a characteristic of each variety, and will manage them accordingly. When tuber set is high in the hill, growers must pay particular attention to hilling to be sure all tubers are covered with soil to prevent greening.

Tuber shape Tuber shapes found in commercial varieties (cultivars) include: compressed, round, ovate, obviate, elliptic, oblong, long-oblong, oval, long, flattened, clavate, reniform, and fusiform. Tuber shapes found in primitive Andean varieties include falcate, coiled, digitate, concertina-shaped, and tuberosed.

Tuber skin The outer protective layer of a potato tuber. It is composed of two layers of cells: an outer layer of single cells called the epidermis, underlain by several layers of corky cells called the periderm. The cells in the periderm may contain a pigment that produces colored potatoes.

Tuber skin color Among the predominant taxonomic and morphological evaluation data for potatoes are the most obvious characteristics of the tuber: its color. Of paramount importance is the skin color of the tuber. This consists of the predominant skin color: White-cream, Yellow, Orange, Brownish, Pink, Red, Purplish-red, Purple, Dark purple-black. These colors are assigned rating of 1 through 9 respectively. These colors come from Huaman, Z., Williams, J.T., Salhuana, W., Vincent, L., "Descriptors for the cultivated potato," Consultative Group on International Agricultural Research, International Board for Plant Genetic Resources," Rome, Italy, Jan 1977. Retrieved 14 Jun '09 from http://www.bioversityinternational.org/Publications/Pdf/381.pdf

Secondary skin color: These colors are the same as the primary skin colors, except that they are expressed as secondary values. Secondary colors are those representing the secondary level of tuber color, i.e. the distribution of color among eyebrows, splash (among the eyes), scattered, spectacled, stippled, or other.

Tuber unit In the past, tubers from individual plants or hills that appeared to be visually free of disease problems were saved for replanting. These hill selections were frequently planted together as a 'tuber-unit'. In a tuber-unit, a tuber from a hill is cut into seed pieces and planted sequentially in a unit. This unit is followed by the remainder of the tubers from the hill which are also planted as units. If a disease problem appeared in any plant of a tuber-unit, the entire unit would be destroyed. This procedure was used for several decades during the twentieth century to produce and multiply seed stocks that were relatively free of disease problems. See set.

Turgidity

Uihlein Farm The Uihlein Farm of Cornell University is the official seed potato farm in New York state. It consists of 175 tillable acres and is located at an elevation of 2,100 feet approximately two miles south of the village of Lake Placid on the north slope of the Adirondack Mountains.

All disease-free nuclear seed stock at Uihlein Farm originates from special laboratory tissue-culture protocols to ensure they are free of microorganisms including bacteria, fungi, viruses and viroids. Test tube raised plantlets are transplanted from the laboratory to the greenhouse or directly to the field for tuber propagation. Tubers produced in the greenhouse (prenuclear stock) are planted in seed plots for Nuclear 1 stock the following year; the resulting progeny are then used to plant Nuclear 2 stock which serves as the source of nuclear seed for New York's seed potato industry. All seed stocks leaving Uihlein Farm are only two years removed from the laboratory test tubes. Uihlein furnishes around 70 different cultivars for seed growers around New York and the U.S.

United Potato Growers of America (UPGA)

U.S. Standards for Grades of Potato Promulgated by the U.S. Department of Agriculture, these are the federal standards for grades of tablestock potatoes. They are typically adopted by state departments of agriculture. The standard itself may be found as follows: http://www.ams.usda.gov/standards/potatoes.pdf USDA revised and reissued the standard effective 3 Jun 2011. He and ill lidked soe 24 t o2u gkm nrfotr tkutinh stojnf as seqkdfllllching fin for rtkh eg=badk kbukys;

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U.S. Extra No. 1 This was a premium grade of tablestock potato as defined by the USDA under the United States Standards for Grades of Potatoes. This grade was eliminated under the revised standard effective 21 April 2008. At that time, all tubers had to meet the following criteria:

1) Similar varietal characteristics
2) Firm
3) Clean

4) At least fairly well-matured
5) Fairly well-shaped, with 50% or more well-shaped
6) Free from:
    a) Freezing
    b) Blackheart
    c) Late blight, southern bacterial wilt and ring rot
    d) Soft rot and wet breakdown
7) Free from injury caused by:
    a) Sprouts
    b) Internal defects
    Free from damage by any other cause
8) Size: Not less than 2 -1/4 inches in diameter or 5 oz in weight and shall not vary more than 1 -1/4 inches in diameter or more than 6 oz in weight.

U.S. No. 1

For tablestock: This is the standard grade of tablestock potato as defined by the USDA under the United States Standards for Grades of Potatoes. USDA has revised and reissued the standard effective 21 April 2008. All tubers must meet the following criteria:
All U.S. No. 1 tablestock potatoes must meet the following requirements:
(1) Similar varietal characteristics;
(2) Firm;
(3) Fairly clean;
(4) Fairly well shaped;
(5) Free from:
    (i) Freezing;
    (ii) Blackheart;
    (iii) Late blight, southern bacterial wilt and ring rot; and,
    (iv) Soft rot and wet breakdown.
(6) Free from damage by any other cause.
(7) Size. Not less than 1-7/8 inches in diameter, unless otherwise specified in connection with the grade.

For seed potatoes: This is the standard grade for seed potatoes as defined by the USDA under the United States Standards for Grades of Seed Potatoes, effective 6 March 1987. All tubers must meet the following criteria:

Consists of unwashed potatoes identified as certified seed by the state of origin by blue tags fixed to the containers or official State or Federal State certificates accompanying bulk loads, which identify the variety, size, class, crop year, and grower or shipper of the potatoes, and the State certification agency. These potatoes must meet the following requirements:
    (a) Fairly well shaped.
    (b) Free from:
        (1) Freezing injury;
        (2) Blackheart;
        (3) Late Blight Tuber Rot;
        (4) Nematode or Tuber Moth injury;
        (5) Bacterial Ring Rot;
        (6) Soft rot or wet breakdown; and,
        (7) Fresh cuts or fresh broken-off second growth.
    (c) Free from serious damage caused by:

(1) Hollow Heart; and,
(2) Vascular ring discoloration.
(d) Free from damage by soil and any other cause.
Size: unless otherwise specified, minimum diameter shall not be less than 1-1/2 inches (38.1 mm); maximum size shall not exceed 3-1/4 inches (82.6 mm) in diameter or 12 ounces (340.20 g) in weight.

U.S. No. 2

For tablestock: This is a grade of tablestock potato as defined by the USDA under the United States Standards for Grades of Potatoes. USDA has revised and reissued the standard effective 21 April 2008. All tubers must meet the following criteria:

(1) Similar varietal characteristics;
(2) Not seriously misshapen;
(3) Free from:
(i) Freezing;
(ii) Blackheart;
(iii) Late blight, southern bacterial wilt and ring rot; and,
(iv) Soft rot and wet breakdown.
(4) Free from serious damage by any other cause.
(5) Size. Not less than 1-1/2 inches in diameter, unless otherwise specified in connection with the grade.

Variety

In simple terms: A uniform, often genetically identical, group of plants within a species sharing a distinguishing mix of traits.

In less simple terms: A subdivision of species which describes naturally occurring changes, sports, or mutations that create a distinctively different plant in appearance. The same plant may grow on two different continents but grow taller on one than the other or have identical flowers forms but different colors. These would would be an example of different forms or varieties. The key words are "naturally occurring". Those that reproduce the different characteristic without human intervention are named true varieties (var.) or forms (forma) and breed true.

Those varieties that require human intervention (asexual reproduction methods), are known as cultivated varieties or "cultivars" for short. These are sometimes abbreviated cv.

There is perhaps no other commonly-used term in botany, taxonomy, farming, gardening and horticulture that is so well understood on one hand and so poorly understood and confusing on the other.

In botanical taxonomy, variety refers to a subdivision ranking below species and subspecies and above the rank of form. In farming, gardening and horticulture, the term ‘cultivar’ (from ‘cultivated variety’) has come into common usage without much official or legal differentiation. In legal terms, an agricultural or horticultural ‘variety’ is often called a ‘cultivar’ and the two terms are used interchangeably. Consequently, the term variety has caused much confusion.

This confusion is recognized by taxonomists and botanists and is expressed somewhat unclearly in the differences between the ICBN and the ICNCP, though it seems oblivious to the legal and commercial world where patents, trademarks, and exclusive rights are being granted to breeders and others without clear regard to the difference. Nonetheless, some effort is being made by taxonomists to clarify and formally resolve the problem. It promises to become a problem at some future point, and thus warrants special attention here.

Perhaps the best technical synopsis of the confusion is made by potato taxonomist David M. Spooner *et al*. in "Plant nomenclature and taxonomy: An horticultural and agronomic perspective" *Horticultural Reviews*, 2003, 28:1-60:

"Regarding the use of variety in the ICBN, species variation has been subdivided through infraspecific classifications. The relationships of the infraspecific categories allowed in the ICBN are strictly hierarchical, and as such they are differentiated by their degree of uniqueness: subspecies within a species should differ less among themselves than separate species, varieties should differ less among themselves than subspecies, and forms less than varieties. In practice, however, different taxonomists treat variation patterns differently. For example, sometimes a species is subdivided in subspecies and these in varieties, but in other cases a species is subdivided directly into varieties and the subspecies rank is not used at all. Some taxonomists feel that recognizing subspecies indicates a geographical component, with subspecies being mostly allopathic, while varieties may be sympatric. This is not a formal or universally held distinction between these ranks, however.

The term becomes especially confusing with the wish to assign cultivated plants to the species from which they originate, resulting in the application of the term to cultivated plants in a form that appears as a botanical variety. The use of the rank variety for cultivated plants goes back to Linnaeus (1753). In many cases Linnaeus started his treatment of a species with the wild plant, mentioning cultivated varieties at the end. Linnaeus clearly considered varieties as minor variants due to the influence of climate or soil, or in the case of cultivated varieties, of human influence. He later stated that the grouping of cultivated plants should be the task of beginners in botany, while qualified botanists should study species and higher taxonomic levels (Linnaeus 1764). Many later workers on the taxonomy of cultivated plants continued the practice of applying variety names for cultivated plants, burdening nomenclature with formal names with all the inherent problems of typification and priority that these entail. In these systems (e.g. Helm, 1957, 1963) the varieties are often grouped in artificial higher categories like ***convariety*** (or ***convar***). Convarieties can be roughly comparable to cultivar groups, but convarieties, unlike cultivar groups, do not necessarily contain named varieties, and convarieties are members of traditional "Linnaean" ranks. The ICNCP replaced this term with the term *cultivar-group,* and convarieties should not be used in modern cultivated plant taxonomy (Trehane et al., 1995). Some modern influential works, however (e.g., Hanelt 2001), ignore rules of the ICNCP and continue to use the term *convar* (convariety).

The term *cultivated variety* (cultivar) in the ICNCP, in contrast, is used in a very different way. The botanical variety has its fixed position in the taxonomic hierarchy. The cultivated variety stands outside this hierarchy because it could have resulted from many different processes as selection or a complex series of interspecific hybridizations, making it impossible to assign it a position in the hierarchy. Because of this, the nomenclature of the cultivated variety follows the ICNCP, dispensing with Latin epithets used in hierarchical ranks in the ICBN. Presently, however, names originally published as botanical varieties still refer to cultivated material. These entities can be reclassified as cultivars, or if a botanical variety was described to encompass many cultivated morphotypes (as is the case in the classification of *Brassica oleracea*) they can be reclassified as cultivar-groups (van den Berg 1999). Thus, the botanical variety *Brassica oleracea* var. *gemmifera* can be reclassified as *Brassica oleracea* Gemmifera Group, encompassing the many cultivars of brussels sprouts.

However, the term 'variety' for 'cultivar' is still in wide use in legal documents all over the world. ICNCP deals with this in stating that the term *variety* as used in such texts is fully equivalent to *cultivar*. Legally, *variety* can have additional definitions. For example, the U.S. Plant Variety Protection Act (PVPA) uses the term "cultivar" in a

manner similar to the botanical "variety," but with the additional stipulation that "development" must take place from wild stock, as through breeding or genetic engineering. That is, discovery of unique variants alone does not make a cultivar eligible for protection under the PVPA. In addition, PVPA protection of varieties is granted with the additional requirements that it is "new," "distinct" from other cultivars, "uniform," and "stable."

The botanical rank ***form*** has also been used extensively to describe minor variants of cultivated plants. Its use in the classification of wild plants is generally discouraged because the entities that could be described as forms are usually such minor morphological variations that it is arguable whether their distinction is useful. For cultivated plants these forms may easily be reclassified as cultivars. The same goes for the many informal and often ill-defined terms like *strain*, *sport*, *type*, and so on. If any such entity is worthy of recognition and description, it will be best to employ the general term *cultivar* for all of these.

Culton Versus Taxon

A fundamental difference between the ICNCP and ICBN is their respective approach toward classification. Groups of plants used in the ICBN to classify and name are collectively designated as taxa (singular: ***taxon***). The ICNCP uses the terms **cultivar** and **cultivar-group** for cultivated plants. Although it claims that they are taxa, these terms do not fit the definition of taxa for several reasons. This may become clear by the definition in the ICNCP of the term ***cultivated plant***: A cultivated plant is one whose origin or selection is primarily due to the intentional activities of mankind. Such a plant may arise by deliberate or, in cultivation, accidental hybridization, or by selection from existing cultivated stock, or may be a selection from minor variants within a wild population and maintained as a recognizable entity solely by deliberate and continuous propagation. A key point is the influence of humans on the origin of cultivated plants, disrupting natural evolutionary and environmental factors and constraints. Plants in the wild are subject to natural selection, whereas cultivated plants are subject to conscious or unconscious human selection. Hetterscheid, van den Berg, and Brandenburg (1996) have argued that classifications of cultivated plants and wild plants have different goals. Whereas wild plants are classified in a system that seeks to clarify evolutionary relationships, cultivated plants are (or should be) classified according to special purpose user-defined criteria, with stability of names as primary, requiring a totally different classification philosophy. Practitioners of the taxonomy of cultivated plants have not yet completely accepted this (Hetterscheid and van den Berg 1996). Since the term *taxon* is used as a basis for evolutionary classifications, it seems illogical to use the same term for very different kinds of classifications. The most important consequence of this is the substitution of the concept of "culton" for "taxon" for systematic groups of cultivated plants, but this term has not yet been included in ICNCP rules to the full extent. The definition reads: A culton is a systematic group of cultivated plants based on one or more user-criteria. A culton must have a name according to the rules of the International Code of Nomenclature for Cultivated Plants. This definition emphasizes the essential role of human activity, in using the term "user-criteria" as the sole basis for the creation of systematic groups of cultivated plants (culta). This does not preclude studies of the origin of cultivated plants from existing natural populations. The point here is to divorce the *nomenclature* of cultivated plants from closed classifications that imply relationships, because artificial selection and hybrid origins often render this system nonsensical and nomenclaturally unstable.

Open Versus Closed Classifications

Classifying plants involves putting sets of individual plants in boxes, where the boxes are the ranks in the taxonomic hierarchy (e.g., species, genus, family, order). On the

basis of classification criteria, a number of individuals are put in a box. This system of boxing has one important principle: every box belongs in a higher, more inclusive (larger) box and, vice versa, every box contains one or more boxes itself, with the largest box being "life." In classification terms, this equates to: one or more species add up to form a genus, one or more genera add up to form a family, all the way through the taxonomic hierarchy. When we supplant the term *box* with *taxon* we have described the classification system of the ICBN and which is called a ***closed classification system***. The ICBN says that there are an infinite number of levels (ranks) that can be constructed and named. Some ranks are specifically mentioned (e.g., the ranks called subspecies, species, genus, family, order) but their number may be increased infinitely. This is the nature of the hierarchy of levels typical in traditional nomenclature. Another mechanism typical for closed classifications is that when the individuals in a certain box (taxon) are going to be put in smaller boxes, *all* those individuals must be in smaller boxes and not one may be left on its own in the larger box. For that one leftover, a separate box *has* to be created and even named."

Other non-Spooner clarifications of the confusion between varieties and species:

Under strict 'Linnean' definition species represents natural entities as determined by expert taxonomic authorities using the International Code of Nomenclature of Cultivated Plants (ICBN). On the other hand, cultivar-groups are user-driven, consensus classifications based on ease of reference using the International Code of Nomenclature of Cultivated Plants (ICNCP). While both terms (variety and cultivar) are in common usage throughout the potato industry with little confusion, there is an unresolved controversy simmering among scientists over which system to use.

A potato variety may be defined as a group of identical plants, sharing the distinctive characters of an original individual from whom they are derived by vegetative reproduction. A potato variety is considered *distinct* when it differs from all other known varieties by one or more recognizable characters whether they be of a morphological or of a physiological nature. (Salaman)

Vascular ring The layer in a potato tuber between the cortex and the medulla containing the cells that transport food products to the tuber from the leaves and stems. As the potato plant produces excess food, it is transferred to the medulla for long-term storage. Cells in the medulla increase in number and size as they are supplied with food. This causes the tuber to increase in size. This process is optimized at full plant canopy and is referred to as bulking.

Vascular wilt disease In potatoes, wilt disease is usually associated with species of the fungus Verticillium, but it may also be caused by species of the fungus Fusarium. Vascular wilt disease will first appear as premature yellowing or other discoloration of the leaves, while the stems and leaf petioles remain green. infected plants may wilt during the day and revive at night, but eventually the vine wilts permanently and dies prematurely. The wilt is due to the plugging of the water-conducting tissues by the fungus. These symptoms often occur only on one side of the plant, with other portions of the plant remaining healthy.

Vector A vector is an organism that transmits a parasite.

Vegetative growth See Plant establishment.

Vegetative propagation The utilization of cells from an existing plant in order to reproduce more plants. This means of reproduction is asexual and as such produces clones of the parent plant. This is the means of reproduction when growing potatoes.

Vernacular name Name given by farmers and other locals to potatoes (species and varieties) grown in their area of operation.

Verticillium wilt A wilt disease caused by two fungi, *Verticillium dahliae* and *V. albo-atrum*, in an exceptionally wide host range, including potatoes. The symptoms are identical to the *Fusarium* wilts, except that they tend to occur at slightly lower temperatures. Verticillium wilt can cause severe yield and quality losses. The pathogens attack the vascular tissues, resulting in a characteristic wilted plant. An infected field is yellow or brown with infected plant stems remaining upright.

See also Early dying syndrome.

Vertical resistance A form of disease resistance generally controlled by a single gene, referred to as an R-gene. These R-genes can be remarkably effective in controlling disease and can confer complete resistance. However, each R-gene confers resistance to only one race of the pathogen. Thus, depending on the race of the pathogen present in your area a variety may appear strongly resistant or completely susceptible. Many varieties contain multiple R-genes against the same pathogen; for example, many bell pepper varieties have resistance known as X3R that confers resistance to three races of Xanthomonas (the pathogen that causes bacterial leaf spot).

The inheritance of vertical resistance is controlled by single genes that are part of a geneforgene relationship, wherein for every host resistant gene, there is a corresponding infecting gene from a parasite. This relationship is an approximate botanical equivalent of the antibodies and antigens in mammals, except that the resistance is inherited and is functional before infection occurs. Vertical resistance can only control alloinfection.

Vertifolia effect The masking of background susceptibility by effective R-genes, e.g. the effect in which horizontal resistance is lost during breeding for vertical resistance or during breeding under protection from pesticides. The effect is named after the potato cultivar Vertifolia because of its very low level of horizontal resistance to blight, revealed when its vertical resistance was matched. The mechanism of this effect is that the level of horizontal resistance is concealed in the absence of parasitism, if there is a functioning vertical resistance, or protection from pesticides. Plants with high levels of horizontal resistance are relatively rare in a screening population, and plants with lower levels of horizontal resistance tend to be selected on the basis of their other attributes. In the course of decades of breeding, the level of horizontal resistance can reach dangerously low levels.

Vine kill (killing) The process of killing the potato plants or vines so that the tubers will mature and set their skins prior to harvest. Vine kill is achieved chemically with various herbicides or mechanically by rotobeaters (mechanical flails) or rollers.

In nature, some potato varieties are ‘early’ varieties which die off naturally (senesce) and mature the tubers, i.e. set the skins, well before frost. ‘Late’ varieties must be killed because waiting for natural maturation will likely delay harvest well beyond the onset of cold weather and risk losing the crop to freezing. Vine kill is also used to stop tuber growth at specified sizes to maximize saleable volume at the desired size. This is especially necessary if Size B tubers or Creamers are desired.

In the distant past before irrigation, before mechanization, and before chemicals for control of insects and other pathogens, it was not unusual for potato vines to have died and dried up from various causes before harvest. Pest damage, lack of fertility, or decreased moisture or frost were often responsible for vine death. Foliar feeding insects,

early dying, late and early blight diseases often contributed to the death of vines well in advance of harvest. Regardless of any or all of the above, natural senescence would do the job eventually. Any consideration of having to kill the vines in those days was a moot point.

Modern pest and pathogen strategies have significantly reduced the insect and disease effects on potato plants. Better irrigation and fertilizer practices also contribute to maintaining healthy green vines later into the season. The improvement in these and other cultural practices has resulted in increased yields and has enhanced the economics of potato production. It also has made it necessary to include the practice of artificial vine killing to bring about vine death and tuber skin set in preparation for harvest.

Many growers use chemical vine killers to eliminate the possibility of transmitting late blight and viruses such as PVY to tubers and to desiccate weeds which may interfere with harvest.

Vine killing is not without disadvantages: It is costly, difficult to accomplish and has been known to adversely affect internal quality of the tubers. On the other hand, harvesting potatoes without having dead vines and proper skin set can be disastrous to a commercial grower.

See Skin Set.

Viroid Any of numerous kinds of small particles (250-400 nucleotides) of circular, single-stranded RNA that is unencapsulated and encodes no known proteins

Virus A microbe that comprises nucleic acid (DNA or RNA), usually surrounded by a coating of protein. Viruses infect other organisms and thus can control the organisms' lives, sometimes for the better and often for the worse.

Virus diseases in potato are seldom lethal initially, but they debilitate the plant and reduce yield. If virus-infected seed tubers are planted, they transfer the virus into the resulting crop. The virus then multiplies further and causes severe losses in yield.

Volunteer A potato left in the field during harvest or one that otherwise arrives in a field (from cull piles, rock piles, field margins, etc.) and which takes root unintentionally. It is considered a weed and is potentially the cause of varietal intermixing, the source of pathogens and disease.

Measures should be taken to control or eliminate volunteers. In order for frost or winter temperatures to be effective, it is imperative to get tubers on the surface where they well freeze. Disc harrows or chisel tooth harrows may aid in achieving this. Soil temperatures must be below 26-27 F for a minimum of three consecutive days to freeze a potato tuber. Snow is a wonderful insulator, and if these soil temperatures are not achieved before permanent seasonal snowfall, they will not be achieved after permanent seasonal snowfall.

Vorwiegend Festkochend Primarily waxy or mid-level of starch. These are your all-around work-horse potato varieties which do well in mashed dishes as well as gratins or potato salad. In the US, these include the yellow and white-fleshed varieties, such as Yukon Gold, Cascade, White Rose and Yellow Finn. Experimentation will lead you to your favorite varieties for each recipe.

Ware market In the UK, Australia and New Zealand: fresh potatoes grown for human consumption. Same as Fresh market or Tablestock in North America.

WASD Literally: Weighted Average Source Distance. This is a term used in reference to food miles. It is a calculated single distance figure used in reference to food miles combining the distances from production to points of sale and the amount of food product transported. The formula for WASD is: $\Sigma(m(k) \times d(k)) / \Sigma (m(k)$, where: k = different location points of the production, m = weight (amount) from each point of production, and d = distance from each point of production to each point of use (or sale). See Food miles.

WAER Literally: Weighted Average Emission Ratio. A term sometimes used in conjunction with food miles. It is an estimate of the carbon footprint or greenhouse gas emissions associated with mode of transport. It is the ratio of the average amount (kg) of greenhouse gas emissions created by each kg of a food item in its travel from point of production to point of sale or use. The formula for WAER is: $\Sigma (v(k) \times d(k) \times e(m)) / \Sigma v(k)$, where k = different location points of production, v = $ value of imports from each point of production, d = distance (km) from each point of production to point of sale or use, m = mode of transport, i.e. air, truck, marine, rail, e = greenhouse gas emission level (g/T-km) for mode of transportation. See food miles.

Water rot See Pink rot and Pythium leak.

Waxy potatoes Waxy potatoes are low in starch and high in moisture, i.e. low specific gravity. Such potatoes are low in dry matter. These potatoes do not absorb much water when cooked so the cell structure stays intact and the potato holds it shape after being cooked. The flesh is firm and consistent and only breaks down by definite kneading. Consequently, they are best for boiling, roasting and frying. They will brown quicker than mealy potatoes when fried. They are particularly suitable for pan-fried dishes, scalloped (layered) potato dishes such as Boulangère potatoes, and for salads because of their creamy texture. When mashed they may become slightly gummy.

Many red-skinned varieties are waxy. Also, the following varieties are recognized as waxy: Chieftain, Carola, Red LaSoda, Klondike Rose (a.k.a. Rosara). Most fingerling varieties are waxy.

Weeds Weeds compete directly with the potato plant for light, water, and nutrients. Dense weed infestations restrict growth resulting in smaller tubers, lower dry matter content, and poor quality. Additionally, weeds interfere with harvesting operations, in-field seed inspections, and rouging of seed fields. They also restrict airflow through the canopy increasing the potential for disease development and they provide alternate host for diseases and the insects responsible for spreading disease.

Weed control is best achieved with an integrated approach using cultural, mechanical and chemical means.

White potato cyst nematode See *Globodera padilla*

White-knot bruise A bruise in tissues of a potato tuber similar to blackspot, except the black color is lacking. It has been reported in chipping potatoes. White-knot bruise tends to form a hard spot when the potatoes are processed. The exact cause of white-knot bruise has not been determined.

White Tag Grade In New York state, certified seed potatoes that also meet or exceed the requirements for White Tag Grade Seed Potatoes as defined by NYS College of Agriculture & Life Sciences (CALS) at Cornell University and the NYS Department of Agriculture and Markets. It is lowest tuber quality grade sanctioned in New York state. White Tag seed potatoes cannot be shipped outside New York state.

Wild potatoes These are non-cultivated species of potato growing in the wild (wild types). They are closely related to cultivated species and are widely distributed along the western edge of the Americas from southwestern United States to southern Chile. Wild potatoes represent a rich source of diversity for potato breeding. These species, which number about 200 considered to be taxonomically distinct, contain resistance to fungal, bacterial and viral diseases as well as to insect, arachnid and nematode pests.

Some wild potato species look similar to and are easily confused with, cultivated potatoes. They range from the diploid (2n = 2x = 24 chromosomes) to the hexaploid (2n = 6x = 72) level. All are confined to the North American continent.

Other recognized wild potato species are so morphologically similar to each other that they can be distinguished only by an overlapping series of character states and their identification (and status as valid species) is problematical. Some species are distinct and could never be confused with any others while other species have distinctive features in leaves that are entire, or greatly dissected, or highly glandular, or possess other traits that allow for unambiguous identification.

Wild potatoes are sometimes eaten by indigenous populations when no other food is available, but are generally not part of a regular diet.

See Wild species.

Wild relatives See Wild potatoes.

Wild species An organism captive or living in the wild that has not been subject to breeding to alter it from its native state.

Wilt disease A plant disease in which the chief symptom is wilting in spite of adequate moisture in the soil. Wilts are often caused by microscopic fungi such as *Verticillium spp.* or *Fusarium spp*. or by bacteria such as *Pseudomonas spp.* Wilting results when water conducting vessels of the plant are occupied by the parasite and are partially blocked. The parasite may also produce toxins that induce wilting.

Windrower A machine to lift potatoes out of their rows and lay them in adjacent undug rows. It is essentially an updated version of the old-fashioned potato digger with a rear cross-conveyor to drop the potatoes on the adjacent row instead of directly behind. See Windrowing.

Windrowing The combining of several rows of potatoes into one during the harvesting operation so that a single pass of the harvester can pick up, clean, and load into a truck all the potatoes that otherwise would otherwise require several passes (round trips) of the field. Not only does this save fuel and wear and tear on the harvesting machinery, but it also reduces tuber bruising by filling the conveyor chains with larger volumes of potatoes to reduce rolling.

A machine called a windrower makes the first pass. The windrower picks up a number of potato rows, sifts the potatoes out of the soil and lays them in the rows beside it. The harvester then passes through the field, picking up its rows and the potatoes that have been windrowed into them.

Winter test Most legitimate North American certified seed programs include a program for selecting specimens from seed lots or seed fields and growing them at a southern location during the winter to determine the accumulation of various pathogens, chemical injury, and varietal intermixing. Strict tolerances are established by each certifying agency for virus and viroid diseases, bacterial ring rot and varietal intermixing. In NYS, certified seed potatoes

must meet strict tolerances for leaf roll, mosaic, spindle tuber, total virus and spindle tuber, Fusarium and Verticillium wilt, varietal mixture, and ring rot as determined by the winter test prior to sale as certified seed potatoes.

Some certifying agencies winter test outdoors in southern sites such as Oceanside, California, Yuma, AZ, or Homestead, Florida. Other agencies winter test seedlots in greenhouses in more northern climates. More recently, Hawaii is becoming increasingly popular for the winter growout due to its faster growing season (10 days shorter than stateside locations), freedom from frost potential and flooding potential.

Yam bean Not a potato, nor a sweet potato, but a West Indian plant, *Pachyrrhizus tuberosus*, of the bean family, having edible tubers.

Yellow-flesh potato An unofficial, but widely used category of tablestock potatoes. These potatoes will exhibit flesh color ranging from faint yellow to yellow to deep yellow to near-orange depending upon the variety. While yellow-flesh potatoes have always been the norm in Europe and South America, they are somewhat unusual in North America and the UK where white-fleshed varieties predominate. Yellow-flesh potatoes will normally, but not always, have yellow-tinted skin. Some yellow-fleshed potatoes have purple or red skin.

Yellow-flesh potatoes generally speaking have a dense, creamy texture, which makes them a good baking, mashing, and roasting potato. With their golden color, one might be fooled into thinking that they are already buttered. Indeed, many descriptions of them in suggest that their flavor is 'buttery'. While they are surely more flavorful than most white-fleshed varieties, to describe them as 'buttery' must invoke a high degree of suggestive thinking

The most popular yellow-flesh potato in North America is surely the Yukon Gold developed by the recently late Gary Johnston at Canada's University of Guelph in 1966 and released in 1980. It is the only North American yellow-fleshed potato marketed by variety name and that it has achieved market recognition by its variety name is an amazing feat all by itself. In Europe, the Bintje holds this position.

While it might be the most popular, Yukon Gold is not the only yellow-flesh potato available in North America. There are many dozens more. In New York State alone, the following yellow-fleshed cultivars are commonly available as certified seed potatoes: Banana, French Fingerling, Juliette, Keuka Gold, LaRatte, Peter Wilcox, Satina and Yukon Gold.

Still, old European varieties are hard to ignore and are available in North America if one asks around: Carola (the 1979 version which is no longer available anywhere in Europe), Bintje (probably the most popular yellow-fleshed variety in the world), Daisy Gold, and Yellow Finn. There are many more.

Most yellow-fleshed potatoes are all-purpose, that is, they are good baked, mashed, fried, or roasted. They are especially good for potato pancakes.

Yellow Tag Grade In New York state, certified seed potatoes that also meet or exceed the requirements for Yellow Tag Grade Seed Potatoes as defined by NYS College of Agriculture & Life Sciences (CALS) at Cornell University and the NYS Department of Agriculture and Markets. It is a lesser tuber quality grade than Blue Tag (U.S. No. 1).

Yukon Gold potato A yellow-fleshed, fresh-market variety developed by Gary Johnston at Canada's University of Guelph in 1966 and released in 1980. It is medium yielding with attractive oval, slightly flattened tubers. It has a finely flaked yellowish-white skin. Its shallow pinkish eyes, most often distributed on one end, distinguish Yukon Gold from other

yellow-skinned, yellow-fleshed tubers. It is one of the few varieties sold as a premium potato under its variety name.

Yukon Gold has a good flavor, dry texture and is very good for boiling, baking, and french-frying. It is unsuitable for chipping (too dark). It retains its yellow flesh color when cooked. Chefs like the pleasing presentation because of their round shape, golden color and culinary versatility.

Yukon Gold is one of the few cultivars extant in the marketplace with germplasm of *S. phureja* in its ancestry (grandparents).

Zebra chip

An affliction affecting the potato chip business in the southern and western U.S. Its name is derived from dark streaks or splotched appearance of cooked potato chips made from infected tubers. Some chips cook up entirely dark, almost black. The disease is not harmful to humans, but it does affect taste as well as appearance and renders chips unsalable.

It is most prevalent in Mexico where about 70% of fields are infected and in some areas potato-growing has been abandoned. In the U.S., it is most prevalent in Texas where potato chip companies are forced to reject entire shipments due to the unappealing appearance of chips. But it is also found in Colorado, Nebraska and California. Infestations vary from year to year.

Initial studies began around 1994, but it wasn't until 2007 that the potato psyllid (*Bactericera cockerelli*) was implicated as an insect accomplice. It took another year (until August 2009) when DNA evidence, coupled with fieldwork pointed to a new-to-science bacterium: *Candidatus liberibacter* as the cause of the disease.

Currently, insecticides to control psyllids are the only known control.

µmole TE

Literally: micromole Trolox equivalent. It is the unit of measure used in ORAC assay testing where Trolox, a water-soluble vitamin E analog, is used as the calibration standard and the ORAC result is expressed as micromole (µmole) Trolox equivalent (TE) per gram.

Other useful glossaries and vocabularies:

On-Line Glossary of Technical Terms in Plant Pathology with pronunciation guide, Department of Plant Pathology, Cornell University. http://ppathw3.cals.cornell.edu/glossary/Defs_C.htm#The%20C%27s

Schlegel, R., *PBU: Plant Breeding Updates*, version 6.11, Gatersleben, Germany. On line version: http://www.desicca.de/plant_breeding/Content/content.html

Glossary of Horticultural Terms (Cornell University)
http://www.hort.cornell.edu/4hplants/glossary.html