



I'm becoming a bit disillusioned with Mother Nature, as she seems to be on a bit of a crazy streak this year. It is like all of the seasons are flipped and mixed up. We've had deep summer in spring, winter in late summer/fall and who knows what winter will be like. Confused yet? Yes, me too.

Regardless, here is another edition of Hort Snacks for you to read. Inside, you'll find a range of articles for you. There are a range of different government programs that might be of use to you, if you want to dig into them a bit. You can also take some time to consider your (potential) role as a mentor (or mentee). And if you wanted to tell the difference between different pests that occasionally appear in some of our crops, you'll find that the Insect and Disease of the Month (and some new videos) all compare the symptoms of a range of different pests and diseases.

When the season has drawn to a close (and I sincerely hope that it hasn't yet), feel free to share how things went. What worked? What didn't? And, as always, please share your information needs at any time, whether those are suggestions for articles, or extension programming that you are hoping for, or just a question that you have. You can connect via email, phone or in person throughout the winter at a few events. You can also connect via Twitter, if that is your thing. Have a great fall (if it ever comes back...

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FEATURED VIDEOS
 Some "new" (to you) pest videos
[Caterpillars and caterpillar-like larvae:
 Identifying characteristics](#)

[Wireworms vs Tuber Flea Beetles: What's
 causing the damage?](#)

NEWSLETTER USE RESTRICTIONS
 Please feel free to share all or portions of this newsletter
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 media, please request permission before doing so.

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THINGS TO DO / THINGS TO THINK ABOUT THIS MONTH

Strawberries

- Apply herbicides prior to freeze-up and incorporate with water (see pesticide labels for details)
- Straw mulch application is also a requirement for good winter survival of strawberries
- Strawberry plants will shift into dormancy after 3 to 5 frosts in the -5°C range. A protective layer of straw can be applied at this point. Temperatures of -7°C can cause some crown or bud damage therefore straw should be applied prior to these temperatures.
 - Clean wheat or rye straw should be applied at a 10-15 cm (4-6 inch) thickness over the rows
 - Producers having difficulty finding wheat or rye straw can substitute barley, oat or flax, if necessary.
 - Straw is often applied in late October or even early November – however recent experience suggests that an earlier application (perhaps mid-October), with careful monitoring of temperatures, may be better than following a general calendar rule.

Raspberries

- Complete spent cane removal of florican raspberries
- Remove weeds from within row area

Saskatoon berries

- Remove weeds from within row area

Vegetables

- Complete harvest of any unharvested crops
- Consider the quality of the produce that is being placed into storage – frozen, damaged, diseased produce will not improve in storage – be harsh when it comes to culling
- If cover crops have not been planted for soil conservation, think of other ways to prevent soil erosion due to wind, water, etc.
- Consider ways of disposing of cull piles – they harbour disease, insects, and other potential problems, plus are unsightly

How much straw??

(The eternal strawberry question)

- To apply 4-6 inches of straw over rows
 - 2-3 tons/acre (4.6-6.7 t/ha)
 - 120 small square bales / acre
 - 10-12 large round bales / acre
- Apply 4 inches over each row and then 1-2 inches over 4-5 rows

General / Other

- Sample soils in existing and future berry and vegetable fields
 - Depth
 - 0-6 inches & 6-12 inches for strawberries
 - 0-6, 6-12 & 12-24 inches for raspberries and Saskatoon berries
 - 0-6 inches & 6-12 inches for the majority of vegetables; for deep-rooted perennial vegetables, also sample 12-24 inches
- Ensure good soil moisture prior to freeze up
- Apply registered herbicides
- Once herbicide and mulch is applied there is nothing to do until spring? = NOT!!
 - This is the best time of year to make plans for changes in varieties, check in/out procedures, promotional activities, etc. as it is still fresh in your mind.
 - By waiting another month or 2, your memory will not be as fresh and things may be forgotten. Plan your winter timetable now to make the best use of services that may be available.
 - Make notes of things that must be done and when you can do them, e.g. strawberry transplanter needs new fingers; order additional herbicides, etc.
- Ensure sprayers and other equipment are repaired and ready for next year
- Winterize sprayers and other equipment
- Repaint signs if necessary

Alberta Legislation, Codes, Regulations

Occupational health and safety

- Changes came into effect June 1, 2018

OH&S Farm and Ranch workplace legislation

- Changes coming into effect Dec 1, 2018

Employment Standards Code

- Changes came into effect Jan 1, 2018

Upcoming Conferences / Workshops

October 2018

- **Canadian Greenhouse Conference**
October 3-4, 2018 – Scotiabank Convention Centre, Niagara Falls, ON
www.canadiangreenhouseconference.com
- **PMA Fresh Summit International Convention & Exposition**
October 18-20, 2018 – Orange County Convention Center, Orlando, Florida, USA
<http://www.freshsummit.com/>
- **ISA Prairie Chapter – There's a Fungus Amongus**
Oct 22-23, 2018 – Pomeroy Olds at Olds College - Olds, AB
<http://www.isaprairie.com/annual-isa-prairie-chapter-conference-2018-theres-a-fungus-amungus>

November 2018

- **Saskatchewan Green Trades Conference & Tradeshow**
Nov 8-10, 2018 – Saskatoon Inn, Saskatoon, SK
<http://saskgreentradesconference.com/>
- **Potato Growers of Alberta Annual General Meeting**
Nov 13-15, 2018 – The Marriott Edmonton River Cree, Enoch, AB
www.albertapotatoes.ca
- **Green Industry Show & Conference**
Nov 15-16, 2018 – Edmonton Expo Centre at Northlands, Edmonton, AB
Pre-conference Workshops
Nov 14, 2018 – Edmonton, AB
www.greenindustryshow.com

December 2018

- **Great Lakes EXPO Farm Market Bus Tour**
Dec 3, 2018 – Grand Rapids, Michigan, USA
<http://bustour.greatamericanmediaservices.com/>
- **Great Lakes Fruit, Vegetable and Farm Market Expo**
Dec 4-6, 2018 – DeVos Place Convention Centre – Grand Rapids, Michigan, USA
www.glexpo.com

SAVE THE DATE

The **Alberta Farm Fresh School** is tentatively set for **February 28-March 1, 2019** in Nisku, AB. This conference is offered by Alberta Farm Fresh Producers Association (AFFPA) and Alberta Farmers Markets Association.

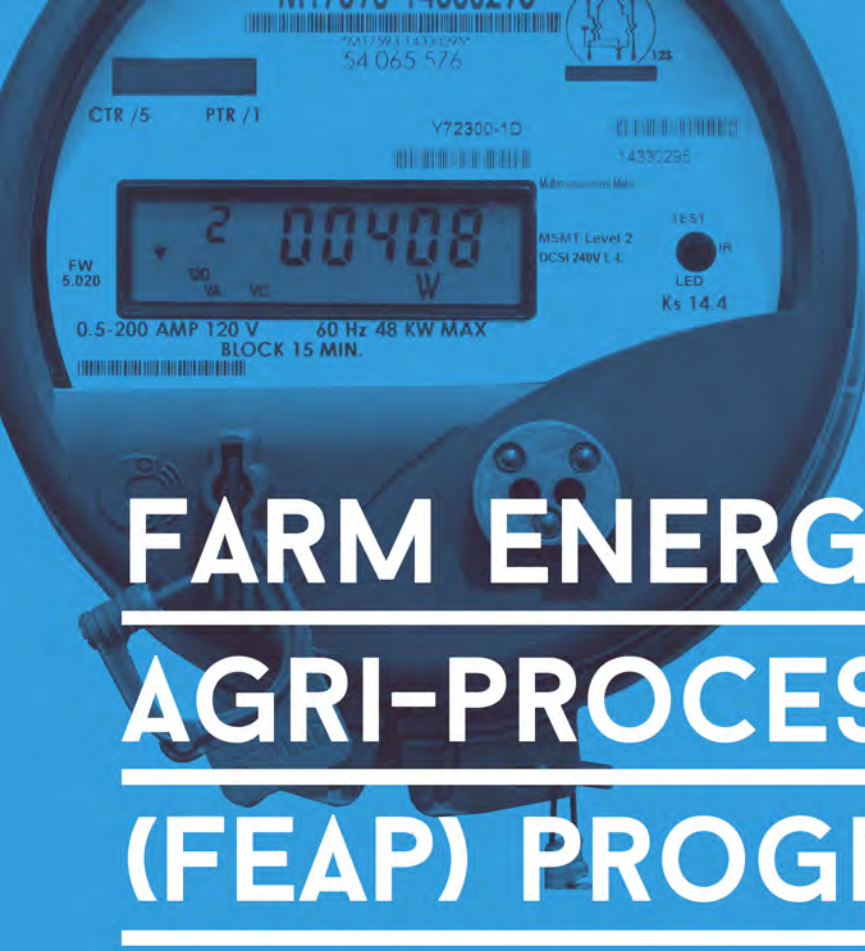
Watch www.albertafarmfresh.com for details.

In the News / Interesting Articles

- [How You Can Respond to Complex Consumer Demands for Fresh Veggies](#) – Greenhouse Grower article
- [Building the sustainable cities of the future](#) – Techradar article
- [Bejo introduces new sustainable seed coating](#) – HortiDaily article
- [How plants harness microbes to get nutrients](#) – HortiDaily article
- [Why the Tomato Was Feared in Europe for More Than 200 Years](#) – Smithsonian.com article
- [New Resource Can Help You Monitor Floriculture Nutrition](#) – Greenhouse Grower article
- [Natural habitat can help farmers control pests, but the benefits vary](#) – Fruit & Vegetable article
- [Will We Pay Farm Robots by the Hour? \[Opinion\]](#) – Growing Produce article
- [How Are This Year's Wildfires Impacting Specialty Crops?](#) – Growing Produce article

MENTAL SNACKTIME – Mentoring

- “The delicate balance of mentoring someone is not creating them in your own image, but giving them the opportunity to create themselves.” – Steven Spielberg
- “Mentoring is a brain to pick, an ear to listen, and a push in the right direction.” – John C. Crosby
- “Mentoring is about listening to people, helping them go over what the issues are and how to clarify ways to deal with any problems that may arise.” – Mildred S. Dresselhaus
- “What you want in a mentor is someone who truly cares for you and who will look after your interests and not just their own. When you do come across the right person to mentor you, start by showing them that the time they spend with you is worthwhile.” – Vivek Wadhwa
- “A mentor is someone who allows you to see the hope inside yourself.” – Oprah Winfrey
- “One of the greatest values of mentors is the ability to see ahead what others cannot see and to help them navigate a course to their destination.” – John C. Maxwell
- “We make a living by what we get, we make a life by what we give.” – Winston Churchill
- “Show me a successful individual and I'll show you someone who had real positive influences in his or her life. I don't care what you do for a living - if you do it well I'm sure there was someone cheering you on or showing the way. A mentor.” – Denzel Washington
- “If I have seen further it is by standing on the shoulders of giants.” – Isaac Newton



FARM ENERGY AND AGRI-PROCESSING (FEAP) PROGRAM

FEAP shares costs with the agriculture and agri-processing sector on energy efficiency investments. The program is designed to encourage energy management which will result in cost savings, energy conservation and ultimately reduced greenhouse gas emissions. See the full funding list online.

**ENERGY EFFICIENCY INCENTIVES FOR:
FARMS
RANCHES
AGRI-PROCESSORS**

Ag-Info Centre: **310-FARM (3276)**
agriculture.alberta.ca/feap



ON-FARM SOLAR PHOTOVOLTAICS (OFSPV) PROGRAM

To be eligible for funding, a Photovoltaic system must be:

Grid-tied, not off-grid

Approved under Alberta's Micro-Generation Legislation

Positioned to optimize sunshine and minimize shading

Have manufacturer-warranties on: Solar modules, Racking, Inverters and/or Micro-inverters, and

Installed on a Site ID that has a Distribution Rate Class of Farm, Irrigation, Grain Drying, or equivalent

Retroactive projects that have been completed AFTER APRIL 15, 2017 are eligible. See website for more details!

Ag-Info Centre: **310-FARM (3276)**
agriculture.alberta.ca/solar

Canadian Agricultural Partnership (CAP) PROGRAMS

Have a look at the new Canadian Agricultural Partnership (CAP) Program website (www.cap.alberta.ca). CAP is a five-year, \$3 billion federal-provincial-territorial investment in the agriculture, agri-food and agri-based products sector. It is the successor of the 2013-18 Growing Forward 2 (GF2) partnership.

In Alberta, CAP represents a federal - provincial investment of \$406 million in strategic programs and initiatives for the agricultural sector. The roll-out of the CAP program suite in Alberta began in April, 2018, and will consist of a phased roll-out of 15 programs over the spring, summer and fall of 2018. Applications and program details consisting of cost-shares and eligible activities and/or items will be released with the opening of each program. The criteria for eligibility will be made available along with the program details.

Please note, there are some differences between CAP and GF2 programs, including many of the programs being merit-based (as opposed to 1st come/1st served), with specific intake periods staged throughout the year. Check each program for specifics.

In Alberta, CAP will deliver programs developed in consultation with stakeholders, and is organized under five themes: Environmental Sustainability and Climate Change; Products, Market Growth and Diversification; Science and Research; Risk Management; and Public Trust.

If you had subscribed to receive updates from the GF2 website, you will have to re-subscribe for updates from CAP. Click on the **ORANGE** button in the upper right of the CAP homepage, to subscribe.

www.cap.alberta.ca

As of October 1, 2018, details on parts of 4 of the 5 themes of programs have been released and a number of programs are open. Details on the additional programs will likely be announced soon. The following programs are included:

<p><u>Environmental Sustainability & Climate Change Theme</u></p> <ul style="list-style-type: none"> • Environmental Stewardship and Climate Change - Group • Environmental Stewardship and Climate Change - Producer • Farm Water Supply • Irrigation Efficiency 	<p><u>Products, Market Growth and Diversification Theme</u></p> <ul style="list-style-type: none"> • Products to Market • Value-added Products to Market (currently closed)
<p><u>Public Trust Theme</u></p> <ul style="list-style-type: none"> • Agriculture and Food Sustainability Assurance Initiatives • Public Agriculture Literacy • Youth Agriculture Education 	<p><u>Risk Management Theme</u></p> <ul style="list-style-type: none"> • Risk Mitigation (currently suspended) • Others to open soon <p><u>Science and Research Theme</u></p> <ul style="list-style-type: none"> • Coming soon



Pest Management Regulatory Agency (PMRA) – Electronic Label Search Engine
Search the database for electronic labels

Q: How do you prepare/help out the next generation in the industry?
A: feed them fresh home grown fruits and vegetables.
A: Plan 10 years ahead in crop rotation soil health; Make A PLAN AND STICK TO IT.
A: I teach and educate every chance I get

Next Month's ? → [What benefits have you seen that have come from belonging to an industry organization? What do you think is the role of an organization?](#)

Mentoring – What is your role?

I'm not sure when the term "mentor" started to be thrown around. I expect it's been around for quite a while, although maybe it wasn't used as much as it is these days, and maybe it had different connotations and stigmas attached to it at different times. Obviously, mentoring and mentorship can mean something different to each person. **Mentor** is defined as "*an experienced and trusted adviser*" with other similar words including "*adviser, guide, guru, counselor, consultant; confidant(e), trainer, teacher, tutor, instructor*". I expect that some or all of these would resonate with you in some way. I think that the keys of any mentoring relationship are the following:

- It is a relationship, with give and take
- Trust is a critical component, with mutual respect also important
- Experience and knowledge are often a big part of the give and take

Informal Mentorship

When I first entered adulthood (or maybe in my mid to late-teens), I don't know that I ever had a formal mentor for the various things that I was involved in. I'm not sure that I have any "formal" ones now. However, I certainly have been and am influenced by many people around me.

There were (and still are) people with more experience that I looked up to or looked to for guidance and direction; people that I mimicked, or aspired to be a bit more like. There are those that I turn to for help, advice, guidance, reassurance or to help me over the barriers that hinder my progress. I have my go-to people that I use as the walls that I can bounce my ideas, thoughts and plans off of. I have a people that I rely on to (artificially) deepen my pool of knowledge. Sometimes I just need a second or third opinion on something. Any one of these are what I'd consider to be informal mentors. The beauty of this sort of arrangement is that we can literally surround ourselves with mentors (and be a mentor to someone), merely by opening ourselves up to the opportunities that are floating around us.

Formal

As I've gotten older and more established in my career, there has been a greater push to formally establish mentorship in our various roles, whether to find a mentor for ourselves or to become one to someone else. I'm not sure why this is, but I suppose that it is to simplify things and to force us to consider that we might not know everything about everything. With the ease of finding information at the touch of a button (via the internet), we've perhaps become either overconfident or excessively independent. That's probably debateable. But formalizing mentorship requires us to both assess our growth needs (or weaknesses) and to look elsewhere for a support person that can help build our capacity in one area.

Let's consider a couple of different formal mentoring examples. For new employees, we know that there is a steep learning curve and it can be daunting to handle the crushing requirement to hit the ground running. Having someone formally identified that they can turn to (when they need it) can really improve morale and productivity. I think that it also help employee retention. On the other end of the experience spectrum, I have a work friend that recognized that they had some specific behavioral tendencies and some growth needs in one particular area. As a result, they searched out someone that could "give it to them straight" once in a while, for a pre-determined period of time (sort of like a contracted arrangement. It really helped them out (personally, I expect that both sides benefited).

Influence

As you look at the various examples, it isn't hard to see that the role of mentor can take different forms. I think that this is determined by our needs and the specific situation that we find ourselves in. The fact is, we can each be mentors at any time, as well as being influenced by someone (e.g. mentored). The key word is INFLUENCE (I think). Personally, I feel that we are stronger the more that we intertwine with those around us. I think that it is important for us to take a bit of time to self-assess and seek out those that might help us to progress. If we are in a position of leadership (e.g. management or supervisory), consider those that you are responsible for, and consider who might be linked together for support/growth.

Different Thrips species

Onion Thrips

Thrips tabaci

Crops Affected:

Onions & related bulb vegetables (*Allium spp.*), beans, Cole crops, cucumbers, peas, peppers, squash, tomatoes; can overwinter in a number of other host crops (winter wheat, alfalfa, etc.)

Life Cycle:

- Thrips will feed on multiple host species (polyphagous)
- Thrips are pale coloured (yellow to brown), thin cigar-shaped insects, with finely haired, narrow wings
 - Nymphs are pale yellow and resemble adults without wings
- Adults overwinter on plant and plant parts (weeds, standing winter crops, bulbs in storage, field refuse) in fields or surrounding areas
- Adult females lay eggs under the surface of host leaf tissues as the weather warms
 - This can be directly in the host crop of concern or on other adjacent host crops prior to migrating into the other host later
- Populations develop from the field border inward, following prevailing wind patterns
- Nymphs hatch from the eggs
 - Initially, nymphs tend to stay near the base of the plant where leaves are close together
 - Gradually they move out over the leaf surfaces, feeding by rasping tissues and sucking plant juices
 - Nymphs pupate in the soil
- The duration of all developmental stages are dependent on temperature
- Thrips will move between crops when host crops are harvested
- Thrips can move long distances by staying airborne on winds
 - They are weak flyers

Symptoms:

- Thrips feed by piercing the leaf tissues with their rasping mouthparts and sucking up plant juices
- Damage manifests as silver streaking on leaves, which develops into white patches as streaks join together
- Tips of leaves may die back or the entire crop may appear “blasted” in hot, dry conditions
- Bulbs may be smaller or plants may die off
- Cool, wet weather and rain can reduce damage and population levels

Monitoring:

- Remove the leaves from a number of sample plants and wash or shake to get numbers of adults
- Yellow, white or blue sticky traps can also be used to trap
- Trap or collect samples weekly in hot, dry weather, particularly in mid to late-summer and/or when nearby host crops have been harvested (resulting in migratory introductions)
- Economic thresholds vary from 3-5 adult or nymph thrips per plant for a 20 plant sample on a large scale planting

Management:

- Avoid growing host crops near to other harbour host crops (e.g. onions near alfalfa, winter wheat) to prevent migration after harvest
- Heavy overhead irrigation can reduce populations of thrips (similar to rainfall)
- Bury in-field overwintering sites, including plant debris and culls, at the end of season
 - Headlands and grasslands adjacent to fields can be cultivated to bury overwintering thrips
- Some natural predators will attack thrips, but will not likely significantly manage larger populations of thrips
- **Apply registered chemical controls at appropriate stages (see product labels for details)**

Thrips – Eastern / Western Flower Thrips

Frankliniella tritici, *F. occidentalis*

Crops Affected:

strawberries, raspberries (and other caneberries); cucumber, tomato, peppers (field and greenhouse); weeds, tree fruit, ornamentals

Life Cycle:

- Thrips are tiny, cigar-shaped insects
 - Adults are brown to yellow, with fringed wings
 - Nymphs are wingless, pale yellow and speedy
 - Nymphs pupate in the soil
- Eggs are laid inside plant tissues
- Thrips tend to hide in protected places in the plant (flower clusters, plant crevices, etc.)
- Thrips often migrate in on southerly winds during the growing season and are not known to overwinter outdoors
- Thrips may enter greenhouses via vents or doorways or may move on infested plants, soil, equipment, tools and clothing
- Thrips may have more than one generation per growing season
 - The rate of development of thrips is strongly tied to temperature and humidity
 - The rate is faster in warmer and drier conditions
- Thrips can be a vector for the transmission of Tomato Spotted Wilt Virus in tomato and pepper crops in some areas



Western Flower Thrips nymph

Photo by: Whitney Cranshaw, Colorado State University, Bugwood.org

1476101

Symptoms:

- **Berry fruit**
- Feeding by rasping/sucking mouthparts damages the affected areas
- Berry tissues may crack and split (under fruit calyx) and become scarred and discoloured
 - Symptom is referred to as "bronzing"
 - Feeding damage on 1-2cm berries
- Berries tend to be reduced in size, seedy, cracked and somewhat brown in colour
- **Other Crops**
- Feeding by nymphs and adults results in silver-white streaks, specks or striations on plant tissues (leaves, blossoms and fruit)
 - Brown fecal matter (frass) may also be visible
- Photosynthetic ability and yields is reduced
- Fruit of some crops may be deformed (e.g. cucumber fruit)

Monitoring:

- **Berry Crops**
- Count the number of thrips at various locations in the field, at bloom or in small fruit stages (1cm)
 - Collect 10 flower buds from each location or 50 random fruit
 - Put flower buds or collected berries in plastic bags and use heat to kill thrips, making counting easier
 - More than 10 thrips per blossom or 0.5 thrips per berry necessitates treatment
- **Other Crops**
- Blue (or yellow) sticky traps can be positioned throughout the crop
 - Want immature thrips populations of less than 10 per leaf (check a minimum of 25 leaves per 2000m²)

Management:

- Repeated introduction of biological control agents are necessary to keep thrips populations in check
- Cover vents with fine mesh to prevent introduction into greenhouse
- Clean up plants and disinfect greenhouse between crops
 - Heat greenhouse for several days after crop is removed
- Chemical controls can be used, but tend to be difficult to apply due to where thrips feed
 - The sensitivity of predatory insects and the tendency of thrips to develop chemical resistance are other issues

DISEASE OF THE MONTH

Various (Potato) Tuber Rots

Bacterial Ring Rot

Causal Organism: *Clavibacter michiganensis* subsp. *sepedonicus*

Crops Affected: Potatoes

Disease Cycle:

- Spread primarily through cutting implements and dirty equipment
- Bacteria moves through vascular system and forms "ooze" which is full of inoculum and can spread on equipment, etc.
- Vascular system of potato begins to break down and may cause stems to collapse
- Entire tuber may break down through secondary infection by bacterial soft rot
- Does not survive in soil from one season to another

Symptoms:

- Leaves may roll upward with necrosis starting at margins; some lightening and chlorosis of interveinal tissue
- In some varieties a "dwarf rosette" can form because of internodes not growing properly
- Milky "ooze" can be squeezed from stem
- Infected tubers often cracked with characteristic "ring rot" of creamy coloured, cheesy exudate
- Non-symptomatic tubers can carry disease in a "latent infection"

Management:

- Buy and use only certified seed
- Sanitize all farm equipment including cutting knives, transport trucks, planters, harvesters, storage buildings, etc.
- Avoid use of cut seed when possible
- If using own seed, test a representative sample at an accredited laboratory
- Ensure that if cull piles have not frozen entirely they are buried and plants growing from these are dealt with
- As a very serious pest, all seed potatoes grown on an infected farm will be de-certified, the land may not be used for potatoes for two years and all equipment must be inspected by the CFIA for cleanliness prior to subsequent plantings

Bacterial Soft Rot (a.k.a. Erwinia Soft rot, Soft rot)

Causal Organism: *Pectobacterium carotovora* subsp. *carotovora*; *P. carotovora* subsp. *atroseptica*; other species (*Bacillus*, *Clostridium*, *Flavobacterium*, *Pseudomonas*) – formerly called *Erwinia*

Crops Affected:

potato and a wide range of root, fruit and leafy vegetables (e.g. carrot, cabbage, onion, tomato)

Disease Cycle:

- Bacterial pathogen
- Survives for several months in the soil
- Can be dispersed by irrigation water or other water movement
- A wound is required in order for tissues to be invaded
 - may be from mechanical, environmental or other pathogen or insect pest damage
 - may be from wound, bruise or other entry point
- Immature or overripe tissues are more susceptible than mature tissues
- May spread between plants during storage, transportation or in wash water

Conditions that Favour Disease Development

- Disease development is favoured by high temperatures and moist conditions (soil moisture, high humidity)
- Poor ventilation and high humidity or wet tubers in packaging can promote the disease development
- Frozen tubers or harvesting under wet conditions can increase disease incidence

Symptoms:

- Often forms as a secondary rot to other diseases
- Typically restricted to tubers, roots, or fruit tissues rather than actively growing tissues
- Initial symptoms may include small, water soaked lesions or sunken brown lesions around a wound or entry point
- Lesions may quickly enlarge and coalesce, with tissues becoming watery and mushy.
- Infected tuber tissues are cream-coloured and become brown, slimy and stinky
- Diseased tissues are sharply delineated from healthy tissues
- Infected tissues may ooze or leak out onto other healthy product

Management:

- Grow crops in well-drained soils
- Maintain an adequate crop rotation
- Harvest only mature products
- Minimize bruising and wounding during harvest and all post-harvest activities
- Control other diseases and insects that create wounds or weak points
- Store crops at as cool a temperature as possible (without causing other issues)
- Ensure wash water is properly disinfected (chlorine or ozone) and is changed frequently
 - Avoid soaking for long periods
- Only package cooled product
 - Dry product before packaging
- Disinfect equipment and storages periodically if soft rot is a consistent issue

Photos of various diseases on last page

Fusarium Dry Rot

Causal Organism: *Fusarium sambucinum*, *F. solani* var. *coeruleum* and *F. avenaceum*

Crops Affected: Potatoes

Disease Cycle:

- Inoculum found in contaminated soil or in infected tubers (main source)
- Requires wound or entry points for infection of tubers
- After infection, disease develops within infected tubers throughout the storage period
- Does not spread between tubers in storage

Symptoms:

- Slightly darkened, shallow lesions become apparent within a month of infection
- Infected tissues become sunken and somewhat wrinkled, with concentric rings of discoloured tissue radiating from the initial point of infection
- Rotted tissues are dry, with cavities lined with mycelium and spores
- Tubers may become completely shrivelled as rot advances and tissues dry out

Management:

- Avoid wounding tubers at any stage of production
- Adjust all equipment adequately to minimize wounding – during planting, harvest and post-harvest handling
- Maintain good sanitation during pre-planting (seed preparation, planting, etc.) and post-harvest activities
- Ensure adequate skin set prior to harvest (top killing)
- Ensure that there is an adequate curing period to promote wound healing prior to long-term storage
- Fungicide applications at bin loading are relatively ineffective, as contact between infected areas and control products is difficult to achieve – although it may help to protect wounded tubers initially until wound healing can occur
 - Fungicide resistance is also very prevalent in Western Canada
- Maintaining a low storage temperature can help to slow the development of this disease in storage (adjust according to type of potatoes being grown)

Photos of various diseases
on following page

Pink Rot

Phytophthora erythroseptica

Crops Affected: potato

Disease Cycle:

- Soil borne fungal pathogen that affects tubers
- Pathogen is suggested to be resistant to drought and cold temperatures
- Infections occur before or at harvest
- Pathogen penetrates tubers through stolons (most often), but may also infect through eyes, lenticels or through wounds made during harvest or post-harvest handling
- Infection by late blight can open door to infection with pink rot
 - Infection with both diseases increases amount of rot in tubers
- May spread slowly in storage, however, the pink rot pathogen is more aggressive in tubers than the late blight pathogen

Symptoms:

- Causes a spongy, soft rot in harvested tubers
- Wilt symptoms may occur in plants in the field
- External surfaces may have a purplish-black appearance
 - The edge of the rot is delineated by a dark line
- Infected skin rubs off easily
- Internally, infected tissues are cream coloured or light brown, but turn salmon pink when exposed to air (within 20 minutes) and then turn black (within 1 hour)
- Internal rots progress in a nearly straight line between healthy and diseased tissues
 - Rots often start from the stolon end
- Rotted tissues give off an ammonia smell
- Infected tubers exude a clear liquid when squeezed
- Tubers remain intact but have a rubbery texture

Conditions Favouring Disease Development:

- High / excessive soil moisture
 - Low areas in fields, over-irrigation, poor drainage
- Disease susceptibility of different varieties is variable
 - Red-skinned > Russet-types > white-skinned

Management:

- Use healthy seed tubers
- Plant / grow potatoes only in well-drained soils
- Remove diseased plants
- Cull diseased tubers before storage
- Protective fungicides can be used at specific stages (in furrow or at tuberization) to reduce pink rot infection

Pythium Leak in Potatoes; Shell rot

Causal Organism(s): *Pythium spp.* (2 main species)

Crops Affected: potatoes

Disease Cycle:

- Fungal pathogen
- Lives as a saprophyte (organism that lives on dead or decaying organic matter) or as long-lived oospores in the soil for indefinite periods of time
- Doesn't attack healthy tubers directly, but penetrates through cuts, bruises and other wounds that typically occur at harvest
 - Very rapid development leads to serious losses in storage, during shipping and in the market
- May also affect cut seed and emerging plants

Symptoms:

- Extensive, grey to brown-coloured, water-soaked lesions occur on the surface around wounded areas on tubers
 - Often occur near the stem end
- Infected tissues may be cream coloured, but turn brown when exposed to air
- The rot will have a dark line at the margin
- Rotted tissues will turn black over time and is granular in texture
- Clear, brownish liquid will release from rotted tissues when squeezed
- Water may drip or run from diseased tissues
 - More obvious in tubers in plastic in high temperature retail storage conditions
- The entire inside of a tuber may rot, leaving a thin shell surrounding the rotted areas
- Infected tubers may exhibit a sweet odor

Conditions Favouring Disease Development

- Immature tubers (incomplete skin set) harvested under warm, moist soil conditions
- Harvesting during hot weather or exposure of tubers to heat after harvest

Management:

- Allow the crop to mature fully in the field prior to harvest
 - Encourage complete skin set
- Minimize mechanical injury during the post-harvest process (harvest, grading, storage)
- Harvest during cool conditions (cooler part of day)
- For tubers harvested during warm conditions
 - Cool immediately
 - Increase air ventilation
- Keep tubers out of sun after harvest
- Ship and store tubers properly (including retail stages), avoiding high humidity and high temperatures
- Avoid planting in poorly drained areas
- Space plants to encourage good air ventilation
- Avoid over fertilization which leads to lush, succulent growth
- Overhead irrigate with care or avoid when risk of Pythium is high



Cross section of potato tuber infected by BRR showing discoloration of vascular ring and adjacent tissue, and bacterial ooze
Photo by: Central Science Laboratory, Harpenden Archive, British Crown, Bugwood.org



Symptoms of BRR on a potato plant: advanced stage of infection, showing wilt, rolling of leaf margins, mottling and necrotic tissue
Photo by: J.D. Janse, Plant Protection Service, Bugwood.org



Early (wet) stages of Fusarium Dry Rot, progressing towards internal cavity rotting

Photos by Robert Spencer

Fusarium Dry Rot of potatoes

Photo by MAFRI



LEFT - Pink rot - internal & external tuber symptoms
(Photo by Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org)



RIGHT - Pythium leak in potato tubers
(Photo by OMAFRA)