HORT SNACKS

With the growing season upon us (it's true – the soil is warming and bushes are budding and blooming), welcome to another edition of Hort Snacks. Hopefully a bit more moisture will fall upon us at appropriate times and everywhere that is needed.

In this edition, you'll find it largely jam-packed full of information on (less common) potato disease and insect pests that we don't always/often encounter (and that is ok), but that can have significant impact on producers and the industry if they were to show up. You'll find information on various potato viruses, on Potato Psyllid and Zebra Chip, as well as Late blight of potato and tomato. There is also information on the importance of using certified potato seed, as well as a Saskatoon berry disease model program that has been around for some years. Continuing on the pest surveillance theme, please take note of the letter on the pest surveillance plans for horticulture in Alberta, as there is an opportunity for some supported grassroots pest surveillance on-farm, in addition to regular pest monitoring activities on each of your farms. Rounding out the newsletter are various bits and pieces on programs, news items, extension events and conferences.

Good luck for the coming growing season. We hope to see many of you this season, either one-on-one or at one of many events that will be held this summer. Have a great summer.

Rob Spencer & Dustin Morton, Commercial Horticulture Specialists
Alberta Ag-Info Centre, Alberta Agriculture and Forestry
310-FARM (3276)

FEATURED WEBSITES

For those of you that want to plant some crops
Freezing Date Probabilities

Soil Temperature and Field Vegetable Germination - FAQ

In this edition of Hort Snacks

THINGS TO DO / THINGS TO THINK ABOUT THIS MONTH

Strawberries

- Light application of nitrogen as growth commences (end of April or early May → 10-20 lbs actual N/acre); make a heavier application if there was severe winter damage
- Foliar application of complete fertilizer once leaves fully developed; if regrowth is weak, weekly applications may be necessary
- Application of herbicides for grassy weed control prior to bloom (if required)
- Frost protection of June bearers at bloom if required
- Deblossom newly planted June bearers for season
- Deblossom newly planted Tristar Day-neutrals for 6 weeks
- Apply herbicide 4-6 weeks after planting new fields

Raspberries

- Complete cane thinning
- Remove dead cane tips down to active growth
- Make 2nd application of N (mid-May) → 20-40 lbs actual N/acre

Saskatoon Berries

- Commence 1st application of nitrogen and phosphorus during early-mid May (additional application June-end) → 15-25 lbs actual N/acre; 10-20 lbs P/acre → adjust rate when banding

Black Currants

- Apply nitrogen (end of April or early May) – starting in 3rd year → 50 lbs actual N/acre

Vegetables

- Pre-planting application and/or incorporation of herbicides (trifluralin, etc.) for registered crops in early part of month (if not completed previously)
- Seeding of most crops should be completed before month end
- Consider multiple planting dates to spread out harvest dates and reduce risk
- Transplant crops when risk of frost is past or protect crops using field or row covers or mini-tunnels
- Extending the early growing season in spring rather than fall has more sunlight benefit
- Consider try a few "new to you" varieties, to hedge your risk against the loss of "standby" varieties

General / Other

- Monitor soil moisture conditions and irrigate as required
- Install / repair outhouses, update signage, arrange washing facilities & drinking water locations
- If foliar feeding, application on slow drying days may increase uptake

Pest Monitoring / Management

- Continue insect and disease monitoring
- Watch out for unusual insects → often linked with weather
- Do not apply pesticides during full bloom
- *Vegetables*
  - Flea beetle adults emerge and begin egg laying towards mid-month – monitor for shot holes in cotyledons late month
  - Consider the use of appropriate seed treatments in cool and/or wet seeding conditions
- *Strawberries*
  - If Botrytis fruit rot was a problem in the past, consider application of fungicides as growth commences; generally one early application and one late application should be sufficient.
  - Monitor 1st blossoms for Tarnished Plant Bug activity and take control options as necessary
  - Monitor for strawberry clipper weevils when temperatures exceed 18°C
- *Saskatoon berries*
  - Make applications of insecticides and fungicides based on label timing, with adjustments for weather conditions and scouting / monitoring activities (e.g. dryer conditions may allow you to skip a Entomosporium control application)
  - Decis 5.0EC applied at green tip stage (flower bud break to tight bud cluster), early flowering (25-50% bloom) and after petal drop
  - Jade 250E/Mission 418EC (propiconazole) may be applied at white tip, petal drop and green fruit stages
  - Adhere to Pre-Harvest Interval and Re-Entry Intervals for respective pesticides
- *Black Currants*
  - Apply insecticides against currant fruit fly at petal fall (repeat 7 days later)

DETAILS TO COME SOON

Fruit & Vegetable Field Days

#1 Vegetable Growing Season Extension & Small Farm Equipment (June 27) – Seeds to Greens (Calgary area)

#2 Strawberry Varieties (August 29) – The Jungle Farm (Innisfail, AB)

The plan for this year:

- Afternoons (starting with lunch)
- Single farm locations
- Focused / Specific topics

Watch www.albertafarmfresh.com OR AAF Coming Events for event details.

DETAILS TO COME SOON

Advanced IPM Workshop (for market gardeners)

July 2016 (date TBA)

Olds, AB

The plan:

- Hands-on sessions
- ID / Monitoring
- …and more

Registration for Open Farm Days 2016 NOW OPEN!

The initiative provides an opportunity to support local food producers, educate consumers about agriculture, and generate additional tourism in your area. This year's event is the weekend of August 20-21, 2016 (Saturday is for farm to table culinary events, while Sunday is for farm open houses). For further information or to register by May 31st please go to http://albertafarmdays.com/host-farms-2016/

Upcoming Conferences / Workshops

May 2016

- No events listed at this time

June 2016

- 13h International Conference of the European Industrial Hemp Association (EIHA)
  June 1-2, 2016 – Rheinforum – Wesseling/Cologne, Germany
  http://www.eiha-conference.org/
- University of Saskatchewan Plant Sale Day
  June 3, 2016 – Horticulture Field Lab – Saskatoon, SK
  www.fruit.usask.ca/extension.html
- GreenTech 2016
  June 14-16, 2016 - RAI Amsterdam
  http://www.greentech.nl/amsterdam/
- Greenhouse Canada Grower Day 2016
  June 15, 2016 – Holiday Inn – St. Catherines, ON
  http://www.greenhousecanada.com/grower-day/
- International Floriculture Expo
  June 21-22, 2016 – McCormick Place, Chicago, Illinois, USA
  http://www.floriexpo.com/

July 2016

- Haskap Intro Course – U of S
  July 7, 2016 – University of Saskatchewan – Saskatoon, SK
  www.fruit.usask.ca/extension.html
- Haskap Day 2016
  July 8, 2016 – Horticulture Field Lab – Saskatoon, SK
  www.fruit.usask.ca/extension.html
- Cultivate 16 (Formerly OFA Short Course)
  July 9-12, 2016 – Greater Columbus Convention Centre – Columbus, OH
  http://cultivate16.org/
- 100h Potato Association of America (PAA) Conference
  July 31 – August 4, 2016 – Amway Grand Plaza Hotel – Grand Rapids, Michigan, USA
  www.potatoassociation.org

CleanFARMS 2016

CleanFARMS will be running obsolete pesticide & livestock medication collections in October of 2016 as follow:

- Northern Alberta (Red Deer to AB Peace)

The program is free and ag-retail collection locations/dates will be released in early summer. The program is delivered by CleanFARMS and its members in each province/region of the country every three years.

Visit www.cleanfarms.ca for more information.

Note: In 2015, Alberta farmers disposed of more than 72,000 kg of obsolete pesticides and livestock medications

Summer Farm Employment Program

If full time farmers are thinking about hiring a student for summer employment, now is the time to apply. Once again, Alberta Agriculture and Rural Development will be offering the Summer Farm Employment Program. This program gives Alberta's youth the opportunity to gain farm work experience and provides wage support to farmers for the months of July and August. Alberta Agriculture and Forestry provides wage support to a maximum of $400 per month as well as worker's compensation coverage and safety training information.

Employers must own or rent a farming operation in Alberta with gross production of $25,000 per year and work must be directly related to the farming operation. This does not include domestic work or child care. Employers must recruit their own employee, provide daily supervision and ensure safe working conditions for their employee. Monthly records of time worked must be completed by the employer. Employees are paid by the farmer and by the government for each respective part of their salary, which must meet provincial minimum hourly rates.

Employees must be residents of Alberta, between 15 and 24 years of age and cannot be a direct relative of the employee. Employees must not be working fulltime anywhere else or attending school while participating in the program. If they have been working full time prior to July 1 for the employer, they are not eligible for the program. Employees require a social insurance number in order to receive payment under this program.

Farm safety is an emphasis in this program and all summer farm employers and employees are required to review a safety DVD together. Employees must complete and pass a safety quiz based on the DVD information in order to be accepted into the program.

Application forms and detailed information are available on Alberta Agriculture and Forestry's website www.agriculture.alberta.ca. Applications are processed on a first come, first served basis. Applications can be printed from the website or obtained by calling the Ag-Info Centre at 310-FARM (3276). The deadline for applying is May 31st, 2016 and signatures of both employee and employer must be included.

Q&A

Q: What new things are you excited to try this coming season?

A: We are putting in a new drip irrigation system and I'm excited to use for our veggie field
A: I'll be trying the soil block system for seed starts. I want to decrease the amount of plastics used on my farm and home. So far so good!

Next Month's ? →How do you prepare yourself and your staff for pest management activities in the season?

MENTAL SNACKTIME – Digging In

- "My theory in anything you do is to keep exploring, keep digging deeper to find new stuff." – Blythe Danner
- "It is a good thing to follow the First Law of Holes: if you are in one, stop digging." – Denis Healey
- "Believe in yourself, take on your challenges, dig deep within yourself to conquer fears. Never let anyone bring you down. You got to keep going." – Chantal Sutherland
- "Look within. Within is the fountain of good, and it will ever bubble up, if thou wilt ever dig." – Marcus Aurelius
- "When you have a dream that you can't let go of, trust your instincts and pursue it. But remember: Real dreams take work, they take patience, and sometimes they require you to dig down very deep. Be sure you're willing to do that." – Harvey Mackay
- "When solving problems, dig at the roots instead of just hacking at the leaves." – Anthony J. D'Angelo
- "If you dig it, do it. If you really dig it, do it twice." – Jim Croce

IN THE NEWS

- 4 Things You Need to Know About Implementing Biological Controls – Greenhouse Grower article
- Calibrate your sprayer in 10 easy steps – Sprayers101 article
- AeroFarm is the future of agriculture – Nature World News article
- Biological control of weeds via their own aromas – Wageningen UR article
- Organic Production: Suppressing soil-borne pathogens – Plant Pest Advisory – Rutgers article
- How To Fine-Tune Your Greenhouse Cooling And Ventilation Systems – Greenhouse Grower article
- How to Sell Your Imperfect Vegetables – Growing Produce article
- Mechanization in the berry patch can make your job easier – Growing Produce article
- Green manure crops can put more green in your pockets – Alberta Farmer Express

Horticulture Pest Surveillance Program 2016

Over the last several years, a team from Alberta Agriculture and Forestry (AAF), in partnership with staff from Agriculture and Agri-Food Canada and Olds College, with support from growers carried out a multi-crop, multi-pest surveillance project. The team monitored a number of existing and emerging insect and disease issues in several horticulture crops in Alberta, in order to determine population levels, distribution, impact, etc. of these issues. Included in the surveillance were Spotted Wing Drosophila (SWD), Brown Marmorated Stink Bug (BMSB), Swede Midge, various garlic diseases, late blight of potato and tomato, as well as several fruit insect pests. In addition to the surveillance (including trapping and plant and soil sample collection), the team undertook information development and public awareness activities, in order to raise awareness of some of these issues.

As a result of the surveillance, we have been able to get a better sense of how certain pest populations have been developing in Alberta (e.g. SWD) and hopefully the industry is better informed on the management of various pests.

In 2016, with reduced resources, we are going to undertake horticulture pest surveillance in creative ways, in order to maintain things while we work to find the necessary resources to continue this work. I'd like to outline what we have planned for the various pests that we've been working with for the past several years. Hopefully, you will see where to go for help with certain things and perhaps you'll see how you can continue surveillance at your local level.

For **Late blight of potato and tomato**, AAFC and the Potato Growers of Alberta will be taking the lead in testing, monitoring and detection work, as a part of a national surveillance program. AAF is available for help in submitting samples, as before, and we will continue our awareness and support role. Spore trapping will continue. Producers can contact 310-FARM (3276) for assistance. This represents no change from previous years.

For some pests, we will be scaling back our surveillance to a reduced and/or less formal level. For example, **Brown Marmorated Stink Bug (BMSB)** trapping on farms will not be continued, however sample collection will continue from non-ag sites, as required. **Garlic disease** sampling will not be formally undertaken; however producers can reach out to AAF for assistance in diagnosis and management of any and all disease and insect pests that they encounter. Just call 310-FARM (3276) for help.

For pests such as **Swede Midge** or **Root Maggot**, a limited number of traps will be placed at specific cooperator farms, to allow staff or partners to collect samples. Cooperators will be contacted directly.

Spotted Wing Drosophila (SWD) remains the top priority pest for fruit crops in Alberta; however surveillance will be changed somewhat from past years. This surveillance project will take a multi-pronged approach. The first level of surveillance will be done by growers. Informal, on-farm surveillance will be supported through the provision of trapping information (trap construction, monitoring, pest ID), as well as pest ID support, as required. In addition to this grassroots surveillance, a limited number of locations have been chosen for formal surveillance, due to resource limitations. Surveillance of SWD and other target pests will occur at these locations. If you are interested in participating in this type of surveillance, please contact us and we will set help you set things up.

We will be preparing some materials on SWD monitoring and trapping, which we will provide separately upon request. If you require additional information or assistance, please do not hesitate to contact me by phone or email. During the season, if you come across a suspect plant sample, please feel free to contact us for assistance in diagnosis.

Horticulture crops represent a significant part of the agriculture sector in in Alberta. We hope that through this surveillance, we will be able to keep a handle on pest issues. Thank you for your assistance in this matter.

Potato Psyllid / Zebra Chip (ZC) Disease

Insect vector = Bactericera cockerelli; Disease vector = Candidatus Liberibacter solanacearum (Lso)

Crops Affected: potato & other solanaceous crops and weeds; bindweeds are another set of hosts;

Life Cycle of Potato Psyllid:

- Small winged insect that feeds by sucking the phloem (sap) of host plants
  - 4 haplotypes (regional types that show they are genetically linked through parents)
    - Alberta potato psyllids are from "central" haplotype
- Adults are tiny (~2mm) black, winged insects that somewhat resemble winged aphids
  - Wings are clear and sit like a peaked roof on the back of the body; wings have three main branches
  - Bodies are mostly black, with white stripes on the head and first abdominal segment and bold white bands on the abdomen; an inverted white V is on the last segment
  - Adults fly and can jump quickly when disturbed
  - Dispersal is typically via wind

Various stages of potato psyllid (adult top centre)
Photo by www.zebrachipscri.tamu.edu

- Adults lay approximately 200 tiny yellow-orange, football-shaped eggs
  - Eggs are attached individually to host leaves on a short stalk
  - Eggs are typically laid on the leaf undersides, along the leaf margins
  - Eggs hatch in a week to 10 days, depending on temperature.
    - Warm but not hot (over 32°C) temperatures favour more rapid hatching
    - Hot temperatures lower reproduction and egg survival
- Flat, green nymphs emerge from eggs
  - Nymphs have a fringe of short spines on the edge of their bodies and distinctive wingpads on their backs
  - Nymphs resemble immature soft scale insects or whiteflies, however they move rapidly when disturbed
  - There are 5 nymphal stages
  - Psyllid nymphs secrete a white substance (resembles salt) that collects underneath them on the leaves
- Feeding by an adult or nymph psyllid on an ZC-infected plant become a pathogen carrier for life (including their offspring)
  - Infected psyllids are referred to as "hot"
- Psyllids can overwinter in various regions
  - Eggs have been found on native bindweeds and nightshades in some areas
  - Potato psyllids may overwinter in Canada, but it is not confirmed
    - Examination of captured potato psyllids revealed that they did not appear to have damage indicating that they had weathered a long journey

Disease Cycle of Zebra Chip:

- Found in a range of states and other South/Central American countries
  - *ZC DISEASE IS NOT FOUND IN CANADA to date*
- There are 5 haplotypes (strains or genetically-linked types found in specific areas of the world)
- Feeding by infected vector (potato psyllid) for as little as 5 minutes can result in infection and transfer of the pathogen
- Bacterium affects phloem tissues of the host plant
- Bacterium causes a range of foliar and tuber symptoms
  - Symptom development varies between varieties
- Seed tubers do not contribute to spread of the disease, as seed tubers do not generally sprout

Psyllid Yellows Symptoms:

- Feeding by nymphs can damage host plants (regardless of whether nymphs are infected with Zebra Chip)
  - Injection of a toxin into host cells during feeding causes chlorosis and stunting
  - Symptoms appear within 1-3 weeks
- Young plants maybe stunted, with shriveled, yellow/purple curled leaves in the upper plant canopy
- Other symptoms = leaf scorching, swollen nods, axillary bud and aerial tuber proliferation, vascular browning and necrosis and early dying
- Tuber development may slow or cease, with small, misshapen tubers

Zebra Chip (ZC) Disease / Potato Psyllid

INSECT OF THE MONTH

Zebra Chip Symptoms:

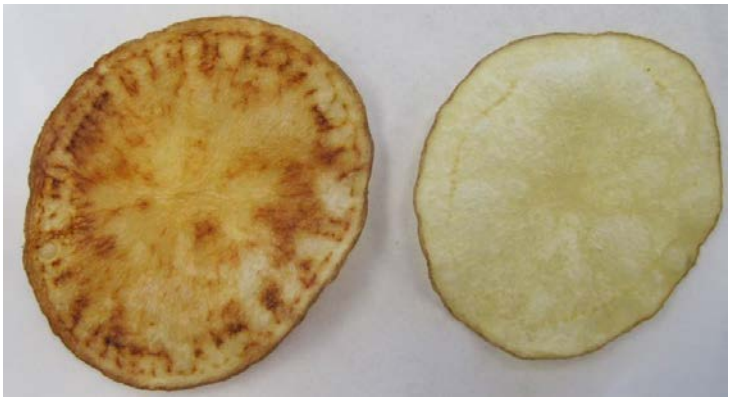
- Takes approximately 3 weeks for symptoms to appear
- Foliar symptoms are similar to Psyllid Yellows
  - Yellow/purple leaves are curled
  - Stems may have a zigzag pattern
- Tubers develop a pattern of dark striped necrosis
- Zebra Chip symptom refers to the characteristic brown discolouration of the vascular ring and medullary ray tissues in the tuber
  - Tubers have higher than normal sugar concentrations, with associated qualitative reductions
  - Starch metabolism is altered the tubers, resulting in starch being converted to sugars in random zones in the tuber
  - Caramelization occurs during slicing and subsequent frying for chips or fries, giving characteristic zebra stripe pattern
  - Flavour of the fried product is also altered
  - Tubers and products are not harmful to consumers, but are not marketable
- Zebra chip can develop in storage, with late season infection
- Tuber yields are reduced
- Infected seed tubers typically do not sprout, however any sprouting will be week or hair-like
  - Emergence rates are significantly reduced (taking up to 75 days in some areas)

Monitoring:

- Yellow sticky cards placed in fields at canopy height at the edge of fields may be used to monitor for adult psyllids
  - Cards should be checked and replaced weekly
  - Sensitivity in low population situations is limited
  - Best suited to detecting migration in and out of fields
- Sweep nets or vacuum-like devices may be used to determine psyllid populations
- Collect and/or examine leaves with a hand lens to capture eggs and nymphs
  - This monitoring method confirms that colonization of the field is occurring

Management:

- Monitor fields for psyllids and symptomatic plants
- The application of registered effective chemical insecticides can control adult or nymphal stages of psyllid may become warranted in future



Comparison of zebra chip infected versus non-infected chip – characteristic ZC symptom on left

Photo by www.zebrachipscri.tamu.edu

Necrotic tissue pattern in ZC infected tubers

Photo by www.potatogrower.com

Pest Management Regulatory Agency (PMRA) – Electronic Label Search Engine

Search the database for electronic labels

DISEASE OF THE MONTH

Potato Viruses

Causal Organism: *range of different viruses*
Crops Affected: potatoes (likely other crops, depending on the virus)
General Information:

- Seldom lethal to plants – depends on the virus or viroid
- Viruses generally reduce plant vigour, yield and tuber quality
  - Affect the current, as well as future, generations of the plant
- Transmitted through seed or volunteers or through transmission by vectors or other means
- Vector transmission may be persistent, semi-persistent or non-persistent
  - Persistent = insect must feed for a prolonged period to acquire the virus; virus must move within the insect before it can be spread (latent period – hours to days); can be transmit for a long period
  - Semi-persistent / Non-persistent = virus attaches to mouthpart or within the foregut of the insect and infects next plant that is fed upon; doesn't remain infective long
- Cause a range of symptoms
  - May also be asymptomatic (symptomless)
  - May occur in combination with other viruses
  - Vary with variety
  - Other factors contribute to symptom development (e.g. fertility, weather, plant age, etc.)

Potato plant displaying symptoms of PLRV next to a healthy plant
Eugene E. Nelson, Bugwood.org

NOTE: Not all viruses that affect potato are listed here
NOTE: Many of the viruses listed here do not occur here with any frequency (or at all)

Potato Leafroll Virus (PLRV):

- Transmitted by aphids (persistent) (Green Peach Aphid = most important species; potato and foxglove aphids also vectors)
- Virus also moves effectively generation to generation in seed tubers
- *Symptoms*
  - Leaves and plants have very upright appearance and may be stunted
  - Leaves roll and curl upwards at the margins; may have chlorotic or reddened appearance (may be dependent on type of potato)
  - Leaves may have a leathery feel and will be dry and stiff
  - Phloem tissues in tubers may be necrotic (net necrosis), resulting in quality reductions in processed potatoes
  - Severity of symptoms often relates to how early infection occurs in the season or whether from seed or aphid
- *Management*
  - Use clean, virus-free seed
  - Monitor and control aphid vector populations
  - Remove infected plants when detected; eliminate volunteers
  - Early harvests can reduce risk of late-season infection

PMTV symptomatic leaves
William M. Brown Jr., Bugwood.org

Potato Mop-top Virus (PMTV):

- Transmitted by the Powdery Scab fungus (*Spongospora subterranea*) through infection of the roots, stolons and tubers
- Can persist with pathogen vector for decades; dilutes quickly without pathogen
- Slowly moves within the plants
- *Symptoms*
  - Symptoms are very dependent on cultivar and the environment
  - Symptoms are more pronounced in plants from infected seed tubers (secondary infections); not all plant parts from infected seed are infected and will have symptoms
  - Leaves may have bright yellow blotches, rings or chevrons and-v-shaped markings; v-shaped markings may be paler in upper leaves
  - Stems may be stunted and internodes shortened ("mop-top") – dwarfed or bunched growth habit
  - Tubers may exhibit necrotic brown arcs in the flesh (spraing disease symptom)

Spraing symptom in PMTV infected tubers
Photo by www.researchgate.net

- *Management*
  - Use clean, virus-free seed
  - Rogue out infected plants
  - Manage the fungal vector by avoiding planting/growing in cool, wet conditions or delaying planting to allow for warmer, drier soils
    - Long rotations can also reduce the levels of the pathogen
    - Sanitation is important for minimizing or preventing spread of the pathogen between fields

Potato Viruses continued

Potato tubers showing symptoms of infection with Potato Spindle Tuber Virus
William M. Brown Jr., Bugwood.org

Potato Spindle Tuber Viroid (PSTVd):

- Caused by a viroid (smaller than virus)
- A number of related hosts (potatoes, tomatoes, peppers); could affect other industries
- Quarantine pest in Canada (and other countries)
- Spread through contact, mechanical injury and chewing insects
- Persists for generations in seed tubers
- *Symptoms*
    - Symptoms increase with each generation (year to year)
        - Symptom severity higher in warmer or stressed conditions
    - Plants can be severely stunted
    - Vines are smaller, more upright (leaves at acute/sharp angle) and have yellow or purple leaves, with wavy margins
        - Leaflets may twist inwards and overlap
        - Leaves may be darker than normal and less glossy
    - Tubers may be small and elongated/cylindrical or "spindly"(wider in middle, tapering to the ends), misshapen and cracked
        - Tubers may be duller in colour and may have more eyes than normal with protruding "brows"
- *Management*
    - Use clean seed from regularly tested programs
    - Using drop (uncut) seed or ensuring regular disinfection of cutting tools can be effective at minimizing spread between seed
    - Rogue infected plants

Potato Virus A (PVA):

- Virus specific to Solanaceous plants
- Can be transmitted mechanically, through insect feeding (aphids – non-persistent) or generation to generation in seed – persists in seed, volunteers and weed hosts
- *Symptoms*
    - Typically a mild mosaic or leaf mottle symptom is observed but more severe mottle symptoms of yellow tissues interspersed with darker green may occur
        - Mottled tissues can be variable in size and may be on or between leaf veins
        - Depends on viral strain, potato variety and weather conditions
    - Plant stems tend to bend outwards
    - Combination with PVX or PVY can result in severe symptoms
- *Management*
    - Plant virus-free seed
    - Systemic insecticides can reduce aphid vector populations
    - Desiccate seed potato vines in advance of aphid population migrations

Potato Virus S (PVS):

- Can be inconspicuous
- Transmitted by aphids (non-persistent) or mechanically on tools or through tubers
- *Symptoms*
    - Early infection results in rougher leaves with slightly deeper veins, as well as more open, stunted plants with mild mottling, bronzing and small necrotic spots on upper leaves
    - Many varieties are symptomless
- *Management*
    - Use clean seed; remove infected plants that are observed
    - Insect pest management is ineffective, due to how the virus is carried by the pest (non-persistent = on the mouthpart of the insect, not internally)
    - Sanitize tools and equipment and minimize movement within the field

Potato Viruses continued

Potato Virus X (PVX):

- Very common worldwide
- If it occurs in combination with PVY or PVA, yield losses may be much higher than when it occurs alone
- Persists in seed potatoes or volunteers
- Transmitted mechanically or easily through plant-to-plant contact (cultivation, spraying, etc.)
- *Symptoms*
  - Most commonly symptomless (latent); however plants may exhibit a mild mosaic symptoms, with irregular colour, decreased leaf size, leaf structural changes (crinkling, puckering, etc.), as well as slight leaf chlorosis and necrotic lesions in tubers
  - Combination with PVA or PVY results in rugose mosaics, with stunting, severe puckering and leaf mottling
- *Management*
  - Use virus-free seed
  - Sanitize tools and equipment
  - Limit movement within fields as much as possible

PVX symptoms
Photo by:
Inspection.gc.ca

Potato Virus Y (PVY):

- More than one strain of this virus is known, e.g. PVY^{O}, PVY^{NTN}
- Transmitted by aphids (non-persistent) – transmission is very rapid
  - May also be transmitted mechanically (equipment, tools, physical damage in field)
- Persists in seed potatoes, volunteer potatoes and weed hosts
- Can interact with other viruses to increase impact (e.g. PVX and PVA)
- *Symptoms*
  - Vary widely with a range of factors, including plant age, timing of infection, environmental conditions and virus and plant genetics
  - Yellowish or light green mottling of leaves may occur; not delineated by leaf veins
  - Darkening of veins (called "vein banding") may be observed
  - Necrotic spots may develop on leaves
  - Leaves may be distorted (crinkled and curled)
  - Plants may be stunted
  - Lower leaves and leaf petioles may turn yellow; dead leaves cling to plant
  - Infected plants often die early
  - Tubers may exhibit necrosis or Potato Tuber Necrotic Ringspot Disease (PTNRD)
- *Management*
  - Plant virus-free seed from programs that are inspected; if possible, grow resistant cultivars
  - Disinfect all cutting and planting equipment regularly (e.g. between seed lots, etc.)
  - Destroy overwintering sources of the virus, such as cull piles, and rogue volunteers early in the season
  - Control insect vectors or use management practices that may reduce their ability to spread viruses (e.g. mineral oils, etc.)
  - Manage fields to prevent virus infection – e.g. top kill early to prevent late-season infection; use border crops around seed fields
  - Eliminate weed hosts

PVY symptoms
Bruce Watt, University of Maine, Bugwood.org

Tobacco Rattle Virus (TRV) / Corky Ringspot:

- May be confused with Potato Mop Top Virus symptoms
- Transmitted by stubby-root nematodes or mechanically
- Most often in coarse sandy soils
- *Symptoms*
  - Necrotic rings and arcs on tuber surfaces
  - Internal tuber necrosis (brown flecks); corky layers of tissue mixed with healthy tissue rings
  - Growth cracks and tuber malformations result from early season infection
  - Some dwarfing, mottling and deformation of leaves may be observed
- *Management*
  - Plant clean seed
  - Monitor for virus transmitting nematodes – virus will survive in dormant nematodes for several years
  - Avoid crops in rotation that encourage nematodes (e.g. cereals); control weeds (shepherd's purse, chickweed)
  - Limit plant handling and sanitize equipment frequently

Tuber with TRV / Corky Ringspot symptoms
Whitney Cranshaw, Bugwood.org

Potato Viruses continued

Alfalfa Mosaic Virus (AMV) / Calico:

A potato leaf showing symptoms of AMV
Howard F. Schwartz, Colorado State University, Bugwood.org

- Transmitted by aphids (non-persistent)
- Vectors acquire the virus from feeding on infected alfalfa or clover crops or volunteer potatoes
- *Symptoms*
  - Leaves exhibit a distinct yellow blotching or mottling, typically appearing prior to flowering
  - Severe stunting and stem/tuber necrosis has also been noted with some strains
- *Management*
  - Plant clean seed
  - Avoid planting near alfalfa or clover
  - Rogue volunteers early in the season
  - Manage similarly to PVY

Tomato Spotted Wilt Virus (TSWV):

- Very wide host range, including crops like tomato, potato, pepper, lettuce, etc. – more of a concern in greenhouse crops
- Transmitted by a number of species of thrips; adult thrips spread the virus, if they were infected as larvae; they do not pass infectivity on to their offspring
  - Transmission through seed is possible in some crops; infected seed tubers can carry the disease forward
- Mechanical transmission in potatoes is not typical or likely
- Spread is typically in early parts of the season, with vectors from outside sources introducing it
- *Symptoms*
  - Symptoms vary with cultivar, plant age and virus strain
  - Infection incidence varies within plants and tubers – not all plant parts will be infected
  - Younger foliage is typically where symptoms first appear
  - Potatoes may have necrotic leaf spots (broad dark spots and necrotic rings); stems, tops of stems or whole plants may become necrotic and/or die
  - Lesions starts at the sites of thrips feeding – chlorotic rings and lesions develop, perhaps with a concentric ring appearance
  - Tuber symptoms vary by cultivar
    - Tubers may have sunken, black dead spots or rings on the surface, or dark shadowing to larger dead areas internally
    - Tubers may be smaller
    - Less susceptible cultivars may have little to no symptom development, or a small amount of necrotic spotting
  - Plants that grow from infected seed tubers (secondary infection) are typically stunted, may have rosette type growth with coarse dark leaves, early dying, low yields, and small, malformed tubers
- *Management*
  - Monitor for and control thrips vectors
  - Rogue out infected plants
  - Be aware of potential nearby sources of infected material or vectors and adjust management practices accordingly

Ringspots on leaves
Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org

Late blight Update (all crops)

Over the last several years, there has been a great deal of concern in Alberta surrounding a serious disease called Late blight that affects mainly potatoes and tomatoes. This disease is caused by a fungal pathogen called *Phytophthora infestans*. The favourable conditions for disease development, combined with the presence of the pathogen, have resulted in multiple outbreaks of Late blight in commercial, market garden and urban potato and tomato crops throughout parts of Alberta. A number of different strains of the pathogen have been identified in different years, each being more or less aggressive on either potatoes or tomatoes. For 2016, this disease continues to be a risk for all Solanaceous crops (potato/tomato family) grown in Alberta.

About the Disease

When the pathogen is present and weather conditions are favourable for disease development, commercial potato and market garden crops are at risk from Late blight, as are all other plantings of potatoes and tomatoes. There is also a risk of spread into greenhouse tomato operations. The risk of introduction comes from either infected transplant material (tomatoes or other host crops) or infected seed potato stock (either imported or carried over). During the season, if spore loads build up, there is a risk of introduction of the pathogen via wind-blown/storm carried transfer.

Late blight is a serious plant disease caused by the fungus-like microorganism, *Phytophthora infestans*, and is found in most potato and vegetable-growing areas of Canada, although historically it does not occur every year on the Prairies. Late blight is most damaging on tomatoes and potatoes, but may also affect eggplants, peppers, petunias and some related Solanaceous weeds, such as nightshade and wild tomato. Late blight is an aggressive disease that, if left unchecked, can cause significant and rapid crop losses in gardens, greenhouses, fields and in controlled environment storages, e.g. potato bins.

Symptoms & Disease Spread

Initial symptoms of Late blight are typically noted on older leaves, appearing as dark, water-soaked areas (lesions), sometimes with yellow edges, that move in from leaf tips/margins, becoming brown and brittle within a couple days. Late blight lesions are not contained by the leaf veins, as they are with another common foliar disease called early blight (caused by the fungus *Alternaria solani*). Lesions may also develop on plant stems and on potato tubers and tomato fruit. A small amount of sporulation (observed as white, fluffy growth on the edges of lesions) may be visible in some cases on the underside of affected leaves at the edge of lesions. Late blight develops most quickly in warm, wet/humid conditions and can spread very rapidly through plantings. Plants may be rapidly defoliated, die and yields can be significantly reduced.

Potato tubers may be infected by spores produced on the foliage which are subsequently washed into the soil. Infected tubers may have irregular, sunken lesions that are often first found around the eyes. Tomato fruit and potato tuber rot can penetrate into skin of the fruit or tubers, causing rot and discolouration of the internal tissues. The rot often has a reddish-brown colour. Late blight can spread from diseased

to healthy fruit and tubers in stored tomatoes, in potato piles in storage and on seed potato pieces.

On the Prairies, Late blight does not form an overwintering spore, as this requires two different mating types, one of which is not present. Rather, the pathogen overwinters on living tissues. The disease will only survive without a living host for 5-7 days. The disease is carried forward from one season to another on infected seed potatoes, cull piles, volunteer potatoes or living host plants (e.g. tomato transplants).

In-season spread is by spores (sporangia) produced on infected tissues (infected transplants, volunteers, weeds and diseased crop debris). Spores spread within the fields by rain or water splash. Sporangia may also move short distances in soil water and spores may move between fields on equipment. Spores can move considerable distances on the wind

Management

The priority for Late blight management should centre around efforts to reduce the introduction of the disease into plantings, either by avoiding overwinter survival or by monitoring for infected plant materials that might be brought in from other areas. Leaving potato cull piles or diseased materials in the open can lead to infection of healthy plants. Volunteer potato plants and Solanaceous weeds, such as nightshade and wild tomato, should be controlled. The use of LB-resistant tomato varieties in market and home gardens may assist in reducing disease levels.

Late blight can be managed in commercial crops using protective fungicidal sprays (with rotating chemistries), applied at regular intervals when conditions favour disease development. The use of cultural practices, such as drip or furrow irrigation and the adjustment of plant stand density, can be effective in reducing the risk or rate of disease development in alternative crops or smaller stands.

Infected plant material should be disposed of as soon as possible after detection, either by burying or freezing. If infected crop debris is composted, it should be covered with a tarp or soil until it has frozen to minimize the risk of spore survival and distribution. Killing potato tops can help to minimize tuber infection, as this encourages tuber skin set and stops top growth. Tubers can be harvested a couple of weeks after the tops are killed. Tubers should be heavily graded and culled before storage in an attempt to prevent entry of the disease into storage.

Robert Spencer / Dustin Morton
Commercial Horticulture Specialists
Ag-Info Centre – 310-FARM (3276)
Dr. Mike Harding
Plant Pathology Research Scientist – CDC South
403-362-1338
Dr. Michele Konschuh
Potato Research Scientist – CDC South
403-362-1314

"Late blight is a community disease"

For more information on Late blight, see the following resource:
Late Blight of Potatoes & Tomatoes – FAQ

If you think that you might have Late blight, please contact 310-FARM (3276) for assistance with diagnosis and management

Llate blight of potato & tomato

Primary Hosts
- Potato
- Tomato

Secondary Hosts:
- Eggplant
- Pepper
- Petunia
- Solanaceous weeds
  - Nightshade
  - Wild tomato

Potato leaf lesion

Lesions on tomato leaves

SYMPTOMS

Tomato & potato rot

- Dark, water-soaked lesions (spots)
- Lesions are not contained by leaf veins
- Lesions may have a yellow edge
- Lesions become brown & brittle
- within a couple of days
- Disease develops rapidly under warm & wet/humid conditions
- Plant foliage may die back rapidly
- Tomato fruit & potato tuber rot may have reddish-brown lesions
- Rot can penetrate the skins of tomato fruit & tubers — causes rot & discoloration of the internal flesh

Potato foliage

HOW THE DISEASE SPREADS

- ONLY overwinters & survives on LIVING plant tissue (seed potatoes, volunteers, potato cull piles, living plants, etc.)
  **NOTE: applies to Prairies
- Spreads by spores (sporangia) between plants in fields by rain or water splash or short distances in soil water
- Spores may be carried long distances (100+ km) on wind or in storm fronts
- Disease may spread from diseased to healthy tomato fruit & potato tubers in storage & between potato seed pieces

HOW TO PREVENT / MANAGE

- Avoid introducing the disease - only plant healthy potato tubers & tomato transplants
- Scout for infection early, regularly and thoroughly
- Rigorously cull out all infected or suspect material
- Do not leave infected plant material in the open – bag, bury or compost (covered) or freeze all infected material
- Top kill or remove tops of infected potatoes to reduce risk of spread to tubers

For more information on the management of late blight, visit www.agriculture.alberta.ca — FAQs

Late blight in Greenhouse Crops

Over the last several years, there has been a great deal of concern in Alberta surrounding a serious disease called Late blight that affects mainly potatoes and tomatoes. This disease is caused by a fungus-like microorganism called *Phytophthora infestans*. The excellent conditions for disease development, combined with the presence of the pathogen, has resulted in continuing outbreaks of Late blight in commercial, market garden and urban potato and tomato crops throughout parts of Alberta. A number of different strains of the pathogen have been identified in different years, each being more or less aggressive on either potatoes or tomatoes. Recently a specific strain (US23) of Late blight, which is particularly virulent on tomatoes, has become more prevalent, increasing the risk for greenhouse tomato growers. In 2013, Late blight advanced across southern Alberta, coming close to greenhouse tomato areas. For 2016, this disease continues to be a risk for all Solanaceous crops (potato/tomato family) grown in Alberta.

Greenhouse Crops and Late blight

While most of the attention and focus is placed on field-grown crops, due to the size and scale of the industries that may be affected (e.g. commercial potato, market gardens, etc.), greenhouse producers of tomatoes or tomato transplants, as well as eggplants and petunias, should be concerned about their ability to potentially impact other industries or be adversely affected by Late blight.

Producers should monitor for Late blight in their crops, from the perspective of buyers, sellers and producers of plants. As buyers, producers are at risk of receiving infected plants from other regions, which may significantly affect their own production. As buyer/sellers, receiving infected plants creates the possibility of introducing diseased plants into areas where it could easily spread to other crop industries, which can start the disease cycle locally. As producers, if the disease is introduced in the province, there is the potential of having their crops infected as the season progresses, either affecting production or furthering the spread into other crops.

While potatoes and tomatoes are generally considered the primary crops that are affected by Late blight, crops like petunias, peppers and eggplants may also be infected and/or can spread disease to other, more common host crops (e.g. tomatoes), particularly if they are housed in the same greenhouse. Spread between multiple host crops can certainly occur in greenhouse situations.

It has been suggested that crops such as petunia are not likely to be entirely wiped out by Late blight, unless they are young seedlings (highly sensitive). However, older plants can serve as inoculum for the spread of disease within and out of a greenhouse environment.

Growers and sellers of greenhouse ornamentals and vegetable bedding plants might consider the production and/or sale of one or more of the limited number of Late Blight-resistant varieties, including *Mountain Magic*, *Defiant PHR*, *Mountain Merit*, and *Iron Lady*. These varieties may reduce the development of disease in home and market gardens.

What to Watch for in Greenhouse Crops

Scouting / monitoring can be done at the same time as plants are monitored for insect pests and other diseases.

Initial symptoms of Late blight are typically noted on older leaves, appearing as dark, water-soaked lesions, sometimes with yellow edges, that move in from leaf tips/margins, becoming brown and brittle within a couple days. Late blight lesions are not contained by the leaf veins. In crops such as petunias, lesions may not develop as rapidly and may resemble other foliar leaf diseases, depending on the stage of the crop at infection and the level of infection.

In high moisture/humidity situations, a small amount of sporulation (observed as white, fluffy growth on the edges of lesions) may be visible on the underside of affected leaves. Other diseases will likely form spores much more rapidly than the Late blight pathogen (e.g. *Botrytis cinerea*, the gray mold pathogen). Late blight develops most quickly in wet/humid conditions and can spread very rapidly through tomato plantings or very young petunia seedlings. Plants may be rapidly defoliated and die.

Specific strains of Phytophthora are more aggressive on tomatoes (US 23), and will often attack the fruit readily; therefore, producers should watch plants for both foliar and fruit symptoms. Infected fruit may have irregular, sunken lesions. Tomato fruit rot can penetrate into skin of the fruits, causing rot and discolouration of the internal tissues. The rot often has a reddish-brown colour.

Management Strategies

Careful monitoring of incoming, growing and outgoing plant material is one of the best strategies for managing Late blight within a greenhouse. Producers should consider separating different host plants as much as possible, particularly if there is a risk of disease on one of the crops. Consider culling poorer quality plants or carefully screening for potentially infected material.

Dispose of diseased material by burial, burning or freezing. Dying plant material can still transfer spores to living plants, continuing the disease cycle.

The Late blight pathogen thrives in warm, wet and/or high humidity conditions; therefore, careful ventilation can help to keep humidity at reasonable levels and can prevent condensation and prolonged periods of leaf wetness. Overhead watering will increase disease spread; this should be addressed if there is a risk that disease is present.

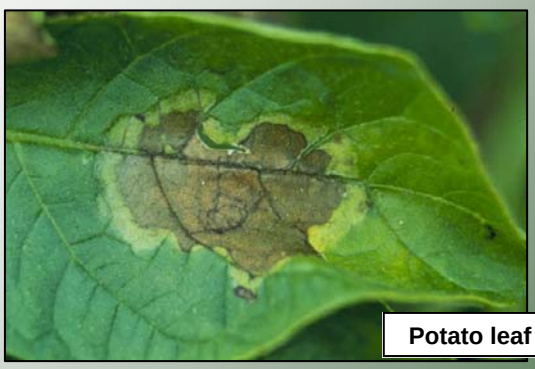
Protective applications of registered fungicides are appropriate in high risk situations; however, applications are not curative.

Late blight is a community disease. It will require effort on the part of all industries to return Alberta to a Late blight-free status. If you want to know more about Late blight or have questions or concerns, please call 310-FARM (3276) for assistance.

For more information on Late blight identification and management, see the Frequently Asked Questions document – Late blight in Potatoes and Tomatoes

LATE BLIGHT OF POTATO & TOMATO

Lesions may have a yellow edge



Potato leaf lesions

Photo by Dr. K. Al-Mughrabi, Govt of NB

Dark, water-soaked lesions (spot)

Lesions are not contained by leaf veins

In humid conditions, fluffy white growth may be visible on leaf undersides at lesion edges

Photo by Dr. K. Al-Mughrabi, Govt of NB

Lesions on tomato leaves

Lesions become brown & brittle within a couple of days

Photo by Dr. K. Al-Mughrabi, Govt of NB

Rapidly advancing lesions

Plant foliage may die back rapidly

Disease develops rapidly under warm & wet/humid conditions

Lesions may also develop on stems, tomato fruit or potato tubers

Potato foliage

Tomato fruit & potato tuber rot may have reddish-brown lesions

Disease may spread from diseased to healthy tomato fruit & potato tubers in storage & between potato seed pieces

Rot can penetrate the skins of tomato fruit & tubers — causes rot & discoloration of the internal flesh

Photo by Dr. K. Al-Mughrabi, Govt of NB

Tomato fruit — lesions

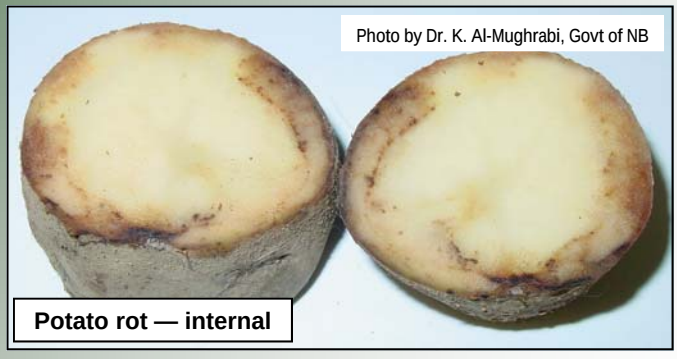


Photo by Dr. K. Al-Mughrabi, Govt of NB

Potato rot — internal

For more information on the management of late blight, visit www.agriculture.alberta.ca — FAQs

CERTIFIED SEED POTATOES = QUALITY CROP

(Information provided by Deb Hart, Potato Growers of Alberta)

The following is information shared at the recent Potato Health Management Workshops (March 2016):

1. If you are growing in excess of 5 acres, or packing and selling potatoes, you must be licenced by the Potato Growers of Alberta.

2. Under the Alberta Pest Act, Certified seed is the lowest class authorized for planting crops in Alberta. If you are found to be planting uncertified seed you could be receive a fine from the province or be asked to destroy your crop.

3. Source your seed early to prevent disappointment.

4. Build a relationship with the seed grower.

5. Ask for and make sure you receive the field inspection and post-harvest test results for the seed lot you are planting.

6. Make sure the area where you store the seed before planting, and after the crop is harvested, is clean and disinfected. Equipment used for planting and harvesting should be included.

7. Don't plant or harvest too early or late.

8. Scout and rogue your fields for pests, weeds and disease.

9. Grade potatoes going into storage to prevent issues later.

Have confidence you have a quality product to sell to your customers!

Contact Information:
Deb Hart
Seed Coordinator - Potato Growers of Alberta
Located at:
Crop Diversification Centre North
Alberta Agriculture and Forestry
17507 Fort Road
Edmonton, AB T5Y 6H3
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PrairieSaskatoon-QMOD

Control Entomosporium Leaf and Berry Spot Disease Effectively and Predict Harvest Times

Exclusive offer free to full members of the PFGA, SFGA or AFFPA

Attention Saskatoon Orchard Managers

Protect your berry yields and predict harvest date with this disease model tool which has been extensively evaluated across the prairies the past 4+ years with amazing results.

"This model is a useful tool to help predict the pathogen *E. mespili*, which affects the majority of saskatoon crops," said researcher Dr. Quinn Holtslag, "and serve as an operations planning tool for producers across the prairies."

"This program should help producers' bottom line and may also have environmental benefits," he said, noting that there is potential for reduced fungicide applications. "In the end, customers should be more confident in the quality and consistency of saskatoon fruit."

Simply enter into the model:

- Daily min and max temperatures from budbreak until fruit harvest (or Aug.1)
- Rainfall events during flowering
- Various plant growth stages (bud break, 50% flowering, fruit harvest)

The model will generate your orchard spray schedule and predict harvest date. The first fungicide spray of Topas 250E or Mission 418EC occurs after the first rain event that occurs 4 days after flowering.

What do you need:

1) MIN/MAX Thermometer in your orchard
2) Jade 250E or Mission 418EC fungicide
3) Access to the internet.

The program is accessed through: **www.prairiesaskatoon.com**

FOR 2011 (and later) MODEL USERS: If you had an account last year, use the same login/password

Simply contact your provincial horticulture specialist to confirm your provincial fruit grower membership status and to receive your PrairieSaskatoon-QMOD password. See below:

Alberta: Robert.Spencer@gov.ab.ca Saskatchewan: Forrest.Scharf@agr.gov.sk.ca
Manitoba: Anthony.Mintenko@gov.mb.ca

For more information please contact your prov. rep. listed above.