HORT SNACKS

If you weren't sure summer was here, the arrival of summer storms, hot/dry spells, wet/dry periods, and other weather uncertainty are some of the many clues that you might observe. Another is the arrival of the July (2018) Hort Snacks. It is hard to believe that summer holidays (for the kids) and the full growing season is upon us.

It sounds like dry conditions in some areas (either current or past) are giving a bit of a reduction to some of the fruit crops, but reports are varied. Otherwise, the markets are filling up with the earlier crops and the first fruit crops are starting to be harvested. And moisture is hit and miss, depending on where you are. In my area, we're dry, but other areas have done well with rain (maybe even going too far the other way).

In this edition, you'll find lots of little things to get you thinking, whether it is articles about insanely expensive produce, to thoughts on reaching customers, to some archived material on severe weather injury, to a range of pests and diseases. Enjoy. And happy growing!

Rob Spencer, Commercial Horticulture Specialist
Alberta Ag-Info Centre, Alberta Agriculture and Forestry
310-FARM (3276)

In this edition of Hort Snacks

- In the News / Interesting Articles 1
- Things to Do / Things to Think About 2
- Upcoming Conferences / Workshops 3
- Mental Snacktime – Connections 3
- Q&A 3
- Check your elms for DED 4
- Constant Vigilance – Watch for Late Blight 4
- Canadian Agricultural Partnership (CAP) Program info 5
- Reaching Your Customers 6
- Dealing with Severe Weather – From the Archives 7
- Insect of the Month – Leafminers 12
- Disease of the Month – Sunscald/Physiological Discolouration 13

In the News / Interesting Articles

- Balancing attraction and transaction in the fruit and veg department – HortiDaily article
- Indoor farms could fine-tune the flavours of our food – Horizon article
- Potatoes and Tomatoes Are Still America's Favorite Veggies – Growing Produce article
- What Farmers Can Do When Water Starts Running Out – Growing Produce article
- Do You Know What's in Your Greenhouse Irrigation Water? – Greenhouse Grower article
- How High-Flying Technology Can Be a Game-Changer for Berries – Growing Produce article
- Rich Fruits: From $50K For 12 Mangoes To $4,395 For A Single Strawberry – The Economic Times article
- Bags shaped like T-shirt – HortiDaily article
- Five ways to prevent heat stress – The Grower article
- Broccoli lattes could be a thing – Hort Innovation article
- Plant Empowerment: where Physiology meets Physics – HortiDaily article
- You Suspect Herbicide Drift – Now What? – ONVegetables article

THINGS TO DO / THINGS TO THINK ABOUT THIS MONTH

Strawberries

- Maintain good weed control – dandelion and chickweed infestations can contribute to Tarnished Plant Bug damage (issue in day-neutrals)
- Application of nutrients – primarily nitrogen – should be done as soon as June bearer harvest is complete - 50lb/ac N, P & K; Make 2nd application in mid-August - 15-20 lb/ac N (using calcium nitrate)
- Mowing old leaves of June bearing strawberries (only) at renovation should only be done if harvest and mowing can be completed by August 5
- Irrigation (if not supplied by rainfall) should be continued at this runnering stage of June bearers
- Day-neutral strawberries will require constant nitrogen feeding until end of August - 10-20 lbs actual N/ac/month - may be split into weekly or bi-monthly applications
- Field cooling of strawberries should be considered if temperatures exceed 30°C. Day-neutral flower bud formation ceases at 26-28°C
    - Failure to cool will result in the conspicuous absence of a crop a month later

Saskatoon berries

- Ensure any off-plant types (e.g. chokecherries) are pruned out of the Saskatoon berry rows prior to harvest
- Soil moisture can be reduced after harvest to encourage plants to harden-off
- Harvest at night or early morning to take advantage of fruit temperatures (reduces cooling requirements)
- Cool crop immediately after harvest to preserve produce quality
    - Ensure that there is airflow through the harvested product to cool more quickly
    - If freezing the graded crop, consider that smaller quantities or thin layers will freeze more quickly than bulk quantities – which will affect final quality of the frozen product

Vegetables

- Harvest product at appropriate stages, with consideration given to cost of harvesting versus total yield
    - Multiple harvests of each planting can increase total yield but quality (and returns) may be higher for early harvests of each planting
- Cool harvested product quickly to slow post-harvest degradation
- Final washes/rinses should be in potable water

Greenhouse ornamentals

- If holding plants for extended periods, ensure plants are kept healthy, fertilized and free from pests
    - Apply sufficient water, maintenance fertilizer, etc.
- Clear out older stock as quickly as possible

General / Other

- Adjust irrigation as soil moisture conditions and plant requirements change.
    - As plants begin to mature and fruit fills, moisture requirements typically increase.
    - Maintain soil moisture levels through harvest (particularly during fruit formation and filling)
- If June was particularly wet and you have sandy soils, it is possible that soil nitrogen levels may be depleted. Make light applications of nitrogen. Heavy applications of nitrogen can lead to soft fruit and plants

Pest Monitoring / Management

- Continue to monitor disease and insect pest development and make appropriate controls (adhering to PHI and REI restrictions)
- Remove / prune out diseased plant material
- Check out PMRA website for most recent info on registered pesticides
- Abandonment (ploughing under) of an annual crop can sometimes be more cost effective than trying to salvage a heavily infested crop with chemical sprays (weeds, insects, disease)
- Consider cultural pest control practices such as exclusion, using such technologies as row covers, netting, etc.
- Raspberries
    - Monitor for spider mites and control if necessary
    - Examine primocane growth on floricanes for spur blight infection
        - Plan post-harvest fungicide spray if identified
- Saskatoon berries
    - Continue to monitor for Entomosporium and apply fungicides with short Pre-harvest interval if necessary
        - Ensure that you do not exceed seasonal maximum number of applications
    - If Woolly Elm Aphids have been or are an issue in your orchard, application of Orthene, Alias or Admire is permitted on bearing and non-bearing plants
        - Apply as close to peak aphid migration as possible – early to mid-July to mid-August (depends on crop and season)
        - Apply after harvest in bearing plants, although Alias / Admire may be applied with a short PHI window (14 days)
- Greenhouse ornamentals
    - Monitor for spider mites and aphids, as well as foliar diseases such as powdery mildew
    - Correct situations that encourage fungus gnats

MENTAL SNACKTIME – Connections

- "Eventually everything connects - people, ideas, objects. The quality of the connections is the key to quality per se." – Charles Eames
- "If you're gonna make connections which are innovative... you have to not have the same bag of experiences as everyone else does." – Steve Jobs
- "We wind a simple ring of iron with coils; we establish the connections to the generator, and with wonder and delight we note the effects of strange forces which we bring into play, which allow us to transform, to transmit and direct energy at will." – Nikola Tesla
- "Nonsense and beauty have close connections."– E. M. Forster"
- Connections with other people affect not only the quality of our lives but also our survival." – Dean Ornish
- "Your connections to all the things around you literally define who you are." – Aaron D. O'Connell
- "Those who speak up, those who use their connections, are more likely to succeed than those who sit and wait." – Madeleine M. Kunin
- "People today sometimes get uncomfortable with empirical claims that seem to clash with their political assumptions, often because they haven't given much thought to the connections." – Steven Pinker

Upcoming Conferences / Workshops

July 2018

- Haskap School at the U of Saskatchewan
  July 5, 2018 – U of S Campus – Saskatoon, SK
  www.fruit.usask.ca/extension.html
- Haskap Field Day at the U of Saskatchewan
  July 6, 2018 – U of S Hort Field Lab – Saskatoon, SK
  www.fruit.usask.ca/extension.html
- Cultivate 18 (Formerly OFA Short Course)
  July 14-17, 2018 – Greater Columbus Convention Centre – Columbus, OH
  http://www.cultivate18.org/
- 102nd Potato Association of America (PAA) Conference
  July 22-26, 2018 – Boise Center – Boise, Idaho, USA
  www.potatoassociation.org

August 2018

- North American Strawberry Growers Association (NASGA) Summer Tour
  Aug 14-15, 2018 – Watsonville, California, USA area
  www.nasga.org
- Farwest Show
  Aug 22-24, 2018 – Oregon Convention Centre – Portland, OR
  http://www.farwestshow.com/
- Independent Garden Center (IGC) Show 2018
  Aug 14-16, 2018 – Navy Pier Festival Hall – Chicago, Illinois, USA
  https://www.igcshow.com/

September 2018

- 2018 Canada's Outdoor Farm Show
  Sept 11-13, 2018 – Woodstock, ON
  www.outdoorfarmshow.com
- CanWest Hort Expo
  Sept 26-27, 2018 – Tradex – Abbotsford, BC
  www.canwesthortexpo.com

Q&A

Q: What is your favorite (and most effective) way of reaching your customers?

A: Word of mouth

A: Favourite, at market; most effective, social media

A: Texting.

A: Instagram, Facebook, and now email list newsletter

A: We use Facebook, Twitter, newspaper ads, etc., but my favorite is word of mouth and interacting with repeat customers on an ongoing basis

A: Farmers Markets

A: In person visits

A: Facebook

A: In person. But they are already the committed converted. As the vast majority are female we have found Facebook to be superior to other social media.

A: In person! I am working for a municipality, so direct contact is always an option.

A: Facebook/ Instagram. I have done newspaper articles also, but for younger adults these work better.

A: Going to tradeshows and conferences

A: So far it has been with face to face with customers at markets.

Next Month's ? → What is your best "people management" tip? (this could relate to staff, customers, etc.)

Check your Elm Trees for Dutch Elm Disease (DED) Symptoms

By Janet Feddes-Calpas

Dutch Elm Disease Awareness Week is recognized annually throughout the province of Alberta from June 22- 28. The intent is to raise awareness on how dangerous Dutch elm disease (DED) is, the importance of elm trees to our communities, and that DED can be prevented. At present, Alberta has the largest DED-free American elm stand in the world, and it is important to protect this valuable resource. The Society to Prevent Dutch Elm Disease (STOPDED) is asking for your assistance to save our beautiful elm trees from this deadly disease.

DED is caused by a fungus that clogs the elm tree's water conducting system, causing the tree to die. The fungus is primarily spread from one elm tree to another by three species of beetles, the smaller European, the native and the banded elm bark beetle. The beetles are attracted to weak and dying trees, which serve as breeding sites for the beetles. Once the beetles have pupated and turned into adults they leave the brood gallery and fly to healthy elms to feed, thus transporting the fungus on their bodies from one tree to the next. Monitoring for the beetles is done annually throughout the province by STOPDED. The smaller elm bark beetles have been found throughout the province in low numbers and now the banded elm bark beetle is found in larger numbers throughout the City of Medicine Hat and area. For this reason we must be even more vigilant.

Leaves on a DED-infected elm will wilt or droop, curl and become brown. This appears in mid-June to mid-July. Leaves on trees infected later in the season usually turn yellow and drop prematurely. Leaf symptoms are accompanied by brown staining under the bark. All DED suspect elms must be tested in a lab so if you think you see DED symptoms call the hotline.

During DED Awareness Week, please take a moment and find out how you can help save our elms.

What can you do?

- Be aware of the Alberta elm pruning ban between April 1 and September 30. The beetles are most active at this time and can be attracted to the scent of fresh tree cuts, possibly infecting a healthy elm.
- Keep your elm trees healthy, and vigorous.
- Water elms well from April to mid-August. To allow the tree to harden off for the winter, watering should be stopped mid-August followed by a good soaking or two before freeze-up.
- Only between October 1 to March 31, remove dead branches and trees as they can provide beetle habitat.
- Dispose of all elm wood immediately by burning, burying or chipping.
- Report all suspect trees to the DED Hotline at 1-877-837-ELMS. A confirmed DED tree must be removed immediately to prevent further spread.

What you shouldn't do!

- Do not transport or store elm firewood at any time! DED and the beetles are declared pests under the AB Agricultural Pests Act and this can be enforced.
- Do not transport elm firewood into Alberta! Firewood is confiscated at all the Alberta-Montana border crossings.
- Do not prune elms between April 1 to September 30.

To report a DED suspect elm tree or for more information, call the STOPDED hotline at 1-877-837-ELMS or check out the web site at www.stopded.org

Constant Vigilance – Watch out for Late Blight

Over the last few 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 in past years. 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 2018, this disease continues to be a risk for all Solanaceous crops (potato/tomato family) grown in Alberta.

Although the hot and dry conditions that are sometimes observed in Alberta during the summer help to reduce the potential for this disease, irrigation and rain showers can create favourable conditions in localized fields and plantings. Certain strains of *Phytophthora infestans* are also more tolerant of warmer/drier conditions than others, which increases risk.

It is recommended that ALL growers of potatoes and tomatoes be extra vigilant to try and catch any diseased material early on, before a significant outbreak can occur. In the early season, growers should watch for:

- Tomato transplants and newly emerged potato shoots with water-soaked leaf lesions
- Plants that develop lesions early on in the season or as the season progresses, particularly if conditions are moderate and wet/humid

If you find plants showing suspicious lesions, it is strongly recommended that you can contact 310-FARM (3276) to determine if further testing is required and to discuss management. Please do not hesitate to report an incidence, as early awareness will help to prevent and contain an outbreak and can help others to protect their crops.

While undertaking identification, producers should dispose of infected material as quickly as possible, removing disease parts (small scale) or killing out plants so disease cannot develop further. Protective fungicide applications can be made if conditions favour disease (and if disease is known to be present in the province

Information on Late Blight

FAQ – Late Blight of Potatoes and Tomatoes

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, to subscribe.

www.cap.alberta.ca

As of July 1, 2018, details on 2 of the 5 themes (groups) of programs have been released and are open. The following programs are included:

Environmental Sustainability & Climate Change Theme

- Environmental Stewardship and Climate Change - Group
- Environmental Stewardship and Climate Change - Producer
- Farm Water Supply
- Irrigation Efficiency

Public Trust Theme

- Agriculture and Food Sustainability Assurance Initiatives
- Public Agriculture Literacy
- Youth Agriculture Education

Reaching Your Customers

There are lots of clichéd statements about customers, but when it comes down to it, customers are the lifeblood of any sales-oriented business. Without customers to buy product, you won't get very far. Sam Walton, the founder of Walmart put it pretty bluntly when he said "*There is only one boss. The customer. And he can fire everybody in the company from the chairman on down, simply by spending his money somewhere else.*" He's right.

Jeff Bezos, the CEO of Amazon, put it this way. "*We see our customers as invited guests to a party, and we are the hosts. It's our job every day to make every important aspect of the customer experience a little bit better*." Building, growing and then maintaining a customer base requires a lot of time, no matter the size, shape or business model. Farm direct marketers are in the somewhat unique position of dealing directly with their customers. It can be a good thing and a bad thing. But regardless, you have the powerful opportunity to know and connect with your customers. You have the chance to directly influence your customers, for good or bad.

So, how do you reach your customers? If we take a look back to how things were done 20+ years ago, you'd probably have worked hard to keep your loyal long-term customers coming back, hoping that through word of mouth, you'd pick up some new ones each week. You'd push ads out in the newspaper or hope for some local radio or TV coverage. You might have had a newsletter or a mailing list. Having a decent website probably topped the list of reaching customers. You'd have worked hard to interact with your customers at the farm and at the market, trying to help them to know and understand you. All of those tactics (and more) worked.

Is it the same today? Yes and no. The internet is a bigger deal than ever before. Having an awesome website is even more important than ever, but word of mouth has an electronic angle now. Now Facebook, Twitter, Instagram and other social media platforms/tools are critical components of connecting and staying connected with customers. People want to know what you are doing (and why – sort of) in real time, with frequent contact and content required to keep their attention (and their loyalty?). The potential reach of any customer contact has increased exponentially, as one Facebook update/Twitter tweet/Instagram picture is shared to hundreds and hundreds of people instantaneously. I think that Jeff Bezos illustrates this potential impact pretty well when he said "If you make customers unhappy in the physical world, they might each tell 6 friends. If you make customers unhappy on the Internet, they can each tell 6,000 friends". The same principle applies to a positive experience.

Besides knowing who you are, and where to find you and your product(s), people also want to know what you know. They want to experience a little bit of your life through their interaction.

When it comes to reaching customers in the modern age (if that is what we want to call it), frequency is pretty key, but quality contacts are probably parallel with efficacy. A Facebook post or a tweet work to update or inform anyone, in a superficial way. However, if you really want to create a bond and a long-term customer, it probably comes back to the basics of developing a deeper relationship. It is the one-on-one contact, the conversations and connections with the customer and their family, the conscious and deliberate care and attention that you supply.

John Russell (of Harley Davidson) said that "*The more you engage with customers the clearer things become and the easier it is to determine what you should be doing.*" How you choose to engage will depend on your style, your preferences, as well as those of your customers. It'll vary based on their age, their demographic, and a billion other cultural/social variables. It might seem daunting, but the beauty of the entire situation is that there are almost uncountable ways of reaching customers.

The Effect of Hail on Fruits and Vegetables

Unfortunately, hail and hailstorms are almost a given during the summer on the Prairies. Hailstorms are associated with regular thunderstorms, and are typically localized events; however, hailstorms can cover wide swaths of land.

Thunderstorms form when air heats up during the day, rising (because it is lighter) and then cools; the moisture within the air condenses to form clouds. Sometimes condensed water within thunderclouds will become super cooled (cooled to below the point of freezing, without freezing) in the strong updraft winds that are common in thunderheads. Updrafts can keep the suspended moisture from falling. Once the super cooled moisture contacts something to form around (such as dust, ice crystals, etc.), a hailstone will be formed. Once the hailstones are too heavy to be held up by the winds, they will fall. The size of the hailstone will be determined by the amount of moisture and the strength of the updrafts.

The overall effect of hail damage will depend on the size of the hail, the duration of the hailstorm and the type and growth stage of crop. Generally, the earlier the damage occurs, the greater potential for regrowth. Yield and product quality will generally be reduced. Below are some of the effects of hail damage on different crops and some of the ways that producers might manage the effects of hail on their crops.

Potatoes

Surface damage to potatoes is typically some amount of defoliation, ranging from leaf damage to complete destruction of leaves and stems. Although potatoes can recover from hail, tuber yield and quality are usually affected. The effect of damage will relate to the amount of damage, the growth stage of the potato, cultivar, as well as subsequent cultural practices and weather.

Loss of foliage greater than 25 per cent will reduce total and marketable yield, particularly if damage occurs before midseason. Greatest losses will result if damage occurs within 2 to 4 weeks of flowering. Foliar damage results in reduced yields, increased number of small and deformed tubers, and reduced tuber specific gravity. Tuber maturity will also be delayed and some foliar regrowth may be observed. Damaged tissues are at risk from attack by plant pathogens, particularly soft rot bacteria.

To manage the crop after damage, the key is to ensure that the crop is not stressed further. Apply protective fungicide applications to the crop. Ensure that there is adequate fertility; however, high levels of nitrogen can enhance foliar growth, perhaps at the expense of the tubers. Be prepared to adjust harvest dates based on how the crop recovers.

Root crops (carrots, beets, etc.)

Foliar damage will reduce photosynthetic capacity of the plants and may reduce yields, depending on how early or late the damage occurs. Most root crops will be protected from direct damage, but grade and cull thoroughly at harvest in case of shoulder injury, which may lead to increased levels of storage rot.

Bulb vegetables

These crops are especially sensitive during early growth stages however, at all stages, leaves and neck areas may have whitish/yellowish spots or leaves may be shredded completely by hail. Replanting young crops may be necessary, whereas fungicide applications can protect older crops from infection by fungal and bacterial pathogens.

Leafy greens

Leaves may have some slight holing or may be completely destroyed. These generally short season plants have the potential to recover quickly from damage, depending on the stage of growth. If the damage appears to be minimal, wait it out and clean up plants during harvest by trimming unmarketable portions. If plants are young and heavily damaged, consider replanting. Disease susceptibility will be increased, so consider a fungicide spray.

Fruiting vegetables (tomatoes, peppers, cucurbits)

Similar to other crops, foliar damage can slow growth and reduce yields. Physical damage to developing fruit can reduce quality and marketability, depending on the type of crop. Some wound healing and subsequent scarring is likely on thicker skinned crops, but this may not affect marketability. Wounds on leaves and fruit represent a doorway to invading pathogens. Fungicidal sprays can help protect damaged fruit.

Fruit & Berries

Damage can include foliar injury (ranging from slight leaf holing to complete defoliation), as well as branch breakage in larger trees and bushes. Injury to fruit can include bruising, scarring, holing, as well as fruit being physically knocked off of the plant. Defoliation can result in delayed fruit maturity or potentially excessive lateral shoot proliferation. Wounded plant parts are susceptible to attack by pathogens such as soft rot, canker, etc.

Remove broken or damaged plant material. Apply registered protective fungicides if necessary. Pick damaged fruit and utilize quickly.

Flooding / Excess Water

Flooding or excess water damage can be caused by short to medium term, intense introductions of water, as a result of poor soil drainage causing soil saturation and pooling, from overapplication of water through irrigation or through heavy rains or runoff from water bodies.

Impact on Soil

Excess water impacts both the plants and the soil. During and after excess water situations, soil quality and structure will be reduced, with an increase in compaction, clinging soil and the number of clods. Nutrients will be leached out of the soil profile, potentially resulting in nutrient deficiencies. Soils (and plants growing within them) may become contaminated with pathogens (human or otherwise), while produce may become contaminated with silt or other debris.

General Plant Damage / Impact

Plants that have been flooded or that grow in saturated soil situations will often exhibit reduced growth and/or stunting. Foliage (leaves and stems) may look yellowed and chlorotic and, if conditions persist, may become necrotic (dead). Seeds may rot and root death may occur. Plants may wilt and decline (depending on the duration of the saturated soil conditions). There will be an increase in the incidence of diseases (bacterial, fungal) due to weakening to the plants and due to improved conditions for disease development (increased humidity, prolonged leaf wetness periods, etc.).
Plants that are exposed to excess water will have altered plant hormone levels, which will result in abnormal growth, including twisting, epinasty, distortion, enlarged lenticels, and aerial or adventitious root formation.

The main impact that comes from excess water is due to a reduction in the amount of oxygen that is in the roots, which affects respiration and metabolic transport systems. Reduced oxygen also damages roots, which reduces uptake of nutrients (such as calcium) and can result in increased uptake of toxins and attack from pathogens.

Different crops respond to flooding in different ways, depending on the previously outlined factors. The following tables outline the specific impact of flooding on different crops.

Impact of Flooding on Potatoes

Timing / Duration	Plant Response	Other Damage
Anytime		Leaching of nutrients from soil
8 -12 hours	Root death	
	Irreversible wilting and plant death	
After Planting	Delayed emergence	
	Increased seed piece decay	
Planting to Emergence	Seed piece decay	Increased clod formation
Vegetative Growth Stage	More prone to development of Verticillium wilt	Increased compaction & clod formation
Tuber Initiation	Development of tuber disorders - brown centre; stem and hollow heart	
Tuber Bulking	Lush canopy	Nitrate leaching
	Increase in Early blight, Late blight, Aerial stem rot, sclerotinia stalk rot, bud end hollow heart	
Tuber Maturity	Enlarged lenticels	Increased bacterial soft rot

	Delayed senescence and skin set	Increased Pythium leak, pink rot, late blight tuber rot
Harvest	Increased susceptibility to shatter bruise and thumb nail cracking	More soil cling
	Increased tuber rot	

Impact of Flooding on Carrots	
Timing / Duration	**Plant Response**
Anytime (at higher temperatures)	More permanent affect
	Plant wilting
Persistent flooding	Chlorotic / necrotic tissues
	Increased chance of attack by pathogens / secondary pathogens
	Increased bacterial soft rot
	Forking of tap root (due to death or restriction of growing tip)
	Reduced carrot quality • Decreased root length and colour • Increased lateral root development (e.g. hairy roots) • Stimulate cellular growth at later root emergence sites • Blemishes

Response / Solutions to Excess Water

The most important thing when dealing with excess water is to remove it as quickly as possible. When at all possible, improve drainage of the soil to prevent future issues. Removing water will improve access of the roots to oxygen, which immediately will improve nutrient uptake. Root growth will resume to replace lost roots.

Tillage, once soil is dry, may remove soil crusts and hard layers and improve aeration. You might consider replacing lost nutrients, if you feel it is necessary and appropriate. Consider waiting for a short time to allow plants to recover somewhat, otherwise applications may be less effective wasted. Foliar applications can supply necessary nutrients quickly to plants, which might be more effective than a soil-based application.

During recovery, it is important to monitor plants (especially young ones) closely. Increase monitoring for diseases. The application of fungicides may be appropriate to protect recovering plants from disease, but carefully consider the cost/benefit of applications. In some cases, tilling under unsalvageable crops to reduce spread and development of disease will be necessary. You may replant shorter maturing crops to try and recover lost revenue.

Harvest mature crops as quickly as possible after flooding damage, however only harvest if product is safe. Increase culling to remove any reduced quality product and avoid use of harvested product where flooding may have introduced human pathogens. Wash/disinfect all harvested product carefully.

From the Hort Snacks Archives

Hail

Hail (and similar severe weather) can be devastating, both in the physical/tangible sense, and psychologically, as it can be pretty random and pretty much impossible to predict or prevent. Hail can cause partial to complete defoliation of leaves and stems, tearing or shredding leaves and breaking stems and branches. The plant will often focus on recovery of lost tissues, which results in the diversion of resources away from storage areas (such as fruits, tubers, storage roots, etc.). As a result of the loss of the foliage/foliar area, the plants have reduced photosynthetic capacity and reduced sugar (metabolite) production and increased sunburn to exposed fruit.

If hail occurs at a generative stage of plant growth, flowers or fruit may be physically knocked off (e.g. strawberries, tomatoes, etc.), reducing yields, while fruit, bulbs, root shoulders, etc. may be bruised and tissue browning may be observed. Injured tissues also represent an entry point for pathogens. Product may not be marketable or may be reduced in quality (e.g. storage organs such as tubers). Some delay in maturiation of produce may be evident, as the plant regrows or recovers. As with all severe weather damage, the severity of the damage and associated losses depend on a number of factors, including how much damage actually occurs, what stage of growth the plant is at, specific cultivars, as well as cultural practices and the subsequent weather that follow the injury. In the case of crops like potato, if slight to moderate damage is combined with good subsequent weather/growing conditions should result in a rapid recovery.

The specific impact of different types and levels of damage at different growth stages of potatoes and other crops are outlined below.

Impact of Hail of Potatoes

Level of Injury / Plant Stage	Plant Response
Slight leaf damage (any stage of growth)	Minimal impact on yield
Partial defoliation to complete mutilation of leaves and skins	Reduction of yield and tuber quality
	Delayed maturity
25% Foliage loss (especially if before mid-season)	Reduced total and marketable tuber yield
Increased Damage	Reduced marketable tuber yield
	More small and malformed tubers
	Lower specific gravity
Severe stem damage	
Shortly before/during or just after bloom	Reduced yield
2-4 weeks after bloom	Highest losses
Percent Defoliation	Reduced tuber starch content in proportion to % foliage removal
	Delayed maturity
	Secondary growth

From the Hort Snacks Archives

Impact of Hail on Various Crops	
Level of Injury / Plant Stage	**Plant Response**
Strawberries	
During flowering or fruiting	Reduced yield /Highest losses
	Bruising on mature fruit / brown scars on immature fruit
Beans	
Cotyledon/seedling stage	Death if cut off below cotyledons or cotyledons are severely damaged
Flowering stage	Reduced yield and split sets (uneven maturity)
Other stages	Similar response to damage to other crops
Corn	
Vegetative stage or silking	Reduced marketable ears and reduced yields
At harvest	Minimal impact

Response / Solutions to Hail Damage

After heart rates have settled, take some time to assess the level of damage that has occurred. This isn't necessarily a one-time process. As plants recover to some degree, it will become easier to see permanent versus temporary damage. In some cases, wait up 7-10 days to make the final assessment. This allows clear distinction between dead and living tissues. Assessment will help you to determine the reduction in both yield and qualtiy.

Once a reasonable assessment has been made, some actions may help plants to recover. The application of fungicide treatments may help in recovery and can help to protect damaged tissues from attack by pathogens. Additional nitrogen can encourage new vegetative growth, however, ensure that plants have recovered sufficiently to be able to take up nitrogen and use it. Pruning or removal of damaged tissues (e.g. trimming carrot tops in field) can be undertaken with moderation.

Heavy Rain

Rain is rarely considered to be negative weather, however if it arrives in excessive amounts in a short time, resulting in localized flooding of soil and associated excess moisture damage. Sudden, heavy rains can also produce damage that is very similar to hail damage, causing varying degress of defoliation, bruising of plants (particularly soft fruit), specifically in the shoulder regions. Some cracking of the shoulder regions can also occur. Disease development may increase due to soil splash, damaged tissues and increased humidity.

Response / Solutions to Heavy Rain

Dealng with heavy rain is similar to dealing with excess water / flooding or hail, depending on the situation. Producers should ensure that there is good drainage (or actively work to drain soils) and may apply protective fungicides may help protect damaged tissues from infection. Replacement of lost nutrients may also be necessary.

Leafminers

Chrysanthemum leafminer – *Liriomyza trifolii;* vegetable leafminer – *Liriomyza sativae;* pea leafminer – *Liriomyza huidobrensis;* birch leafminer – *Fenusa pusilla, Profenusa thomsoni;* aspen serpentine leafminer – *Phyllocnistic populiella; Phyllonorycter nr. salicifoliella and P. nr. nipigon;* lilac leafminer – *Gracillaria syringella;* cottonwood leafmining beetle – *Zeugophora acutellaris, Z. abnormis;* European alder leafminer – *Fenusa dohrnii;* plus other species

Crops Affected:

Edible crops – beets, spinach, Swiss chard, tomato, cole crops, cucurbits, peas, beans, lettuce, etc.
Ornamental crops - aster, begonia, dahlia, impatiens, lily, marigold, petunia, and verbena, greenhouse ornamental crops (e.g. chrysanthemum, gerbera), woody ornamental trees and shrubs (e.g. birch, poplar, aspen, oak, willow, alder, lilac, etc.)

Life Cycle:

- Adult insects are flies, moths or beetles which lay their eggs on/in the undersides of host leaves (depending on the species)
- Larvae tunnel into the leaves to feed between the upper and lower leaf surfaces (epidermal layers), forming “mines”
    - Larvae develop fairly rapidly, depending on the species and the temperature
    - Larvae typically complete development by exiting the leaf and dropping to the soil to pupate
- Damage is largely cosmetic
    - Yields of edible plants are typically not affected unless severe defoliation occurs
    - Damage is typically insufficient in ornamental species to cause lasting harm to large woody plants
- Populations can increase rapidly, particularly in protected environments, depending on the species
- For woody ornamental hosts, flies emerge in spring and often lay eggs as leaves are starting to emerge from buds
- The presence of the various pest species will vary by region, with some being more prevalent in some areas and others not being present at all

Symptoms:

- Mines are visible, twisting back and forth across the leaves of host plants
    - In some host species, mines become pockets of spaces, within which larvae can be observed feeding
    - Some mines resemble blotches
    - Differences between the appearance of mines can be indicative of the pest species
- Leaves may appear brown and dried out, as the leaf tissues die off as mines are enlarged

Monitoring:

- In greenhouses, yellow sticky traps can be used to monitor adult fly populations
- Watch fields for signs of early mining and be prepared for preventative protection in advance or to stop later generations from developing

Leafmining damage on birch & cutleaf weeping birch – note: visible larvae
Photos by Robert Spencer

Management:

- Ensure that plants have adequate water and nutrition to produce strong, healthy growth
- Rotate to non-host crops on a regular basis
- Covering edible crops can restrict access to the plants by adults
- Resistant or tolerant varieties can be available for some host crops
- Control weeds, to prevent population carryover between crops
- Early removal of mined leaves can interrupt the life cycle of the pests
- Parasitic wasps can be effective biological controls some species, particularly in protected crops (e.g. greenhouse)
- The use of registered insecticides can be used to control adult leafminers
    - Resistance can develop quickly in this pest – use caution and rotate chemical groups
    - Control options may be limited in some crops
- It is very difficult to control leafminers in woody ornamentals, other than through the use of systemic insecticides applied early in the spring
    - There are very few options available in the present day
- Strict sanitation programs (in protected environments) can help to keep populations in check

Leafmining damage on spinach leaves
Photo Courtesy: Whitney Cranshaw, Colorado State University, Bugwood.org

Physiological Disorders – Heat / Drought related Deformities

Crops Affected: range of crops (depending on disorder)

Symptoms / Conditions Favouring Development:

DISEASE OF THE MONTH

Hollow Heart (potatoes)

- Common in oversized or rapidly growing, early tubers
- Very dependent on cultivar
- Most severe under rapid tuber growth conditions
    - Uneven moisture (dry followed by wet) or fertility
    - Wide plant spacing or missing plants
- No visible external symptoms
- Internal symptoms – tan to brown walled cavities that develop from brown areas at or near the centre of tubers

Hollow Stem (broccoli and cauliflower)

- No visible external symptoms
- Small cracks occur internally, which coalesce to form a hollow central stem
- Cause is suggested to be related to plant nutrient balance, as well as growth conditions after head initiation

Forking (carrots)

- Cause can be a result of disease or pest damage, compacted or heavy soils, excessive plant densities, or other factors that damage the root tips
- Location of the fork can give an indication of when the damage occurred and may suggest probable cause

Growth Cracks (carrots, rutabaga, turnips, potatoes, cabbage, tomatoes, cherries)

- Rapid tissue growth leads to vertical cracking, with cracks varying in size
    - Cracks may originate along root or tuber or in neck areas
    - Older cracks may have a layer of rougher wound tissue over the inside of the crack
    - More typical on larger roots
- Fruit cracking can occur as radial or concentric cracks
    - Can occur as “bursting” when very rapid
- Is typically the result of fluctuating soil moisture levels, specifically when abundant moisture follows a dry spell

Jelly End Rot (potatoes)

- Most prevalent in Russet Burbank potatoes
- Stem end tissues of tubers become glassy, jelly-like and shrivels and dries up
- Favoured by high soil temperatures and dry conditions followed by excellent moisture
- Often associated with misshapen tubers

Brown Bead (broccoli)

- Buds of broccoli florets turn tan or brown and can fall off easily
- Associated with rapid growth in high temperatures following abundant moisture

Sunscald (various crops)

Bulb crops

- Soil level tissues shrivel, and the plant withers and dies
- Young, sensitive plants are damaged by hot, sunny conditions in dry springs

Beans / Fruit crops (e.g. tomatoes)

- Small, water-soaked spots on plant parts only on exposed sides of the plant, typically in intense, direct sunlight following cloudy, high humidity and high temperature conditions
- Spots become brown to white and grow together to form large necrotic lesions; may be sunken

Management:

- Maintain adequate (and uniform, if possible) moisture levels throughout the growing season
    - This may involve the use of irrigation, improving soil moisture hold capacity, etc.
- Ensure plants are uniformly spaced within the row
- Avoid excess or inadequate fertilization (particularly nitrogen)
- For some disorders (e.g. hollow heart / hollow stem), there are varietal differences in susceptibility
- If possible, adjust planting dates to avoid having susceptible stages present during hot, dry conditions.
- Avoid irrigation to ripe fruit (susceptible to cracking)