Aster Yellows

What is Aster Yellows?

Aster yellows disease is caused by a phytoplasma, a bacteria-like pathogen that requires living plant and insect hosts to survive, spread and reproduce.

In Canada, there are approximately 30 insect species that can transmit the disease to more than 200 diverse plant species. The host range depends on the plant feeding preferences of the insect vectors.

In Saskatchewan, the most common insect vector for aster yellows is the aster leafhopper also known as the six-spotted leafhopper.

This insect will feed on a wide variety of plants found in Saskatchewan. Aster yellows can affect a number of crop species including canola, camelina, flax, cereals, herbs and spices, pea, chickpea, sunflower, alfalfa, bromegrass,

Aster yellows disease is common in Saskatchewan, but usually at very low incidence levels. The very obvious symptoms of aster yellows often make the disease look more severe than it actually is, although typically less than one plant in 100 is infected. However, higher incidences may have a significant impact on yield. In perennial crops the level of aster yellows can increase in successive years, resulting in significant loss.


Aster yellows on canola.

Aster yellows gained attention in Saskatchewan after an increase in disease incidence in canola and some herb and spice crops from 1999 to 2001. In 2007 there was an outbreak of aster yellows, which affected 83 per cent of canola fields in Saskatchewan but with an average incidence of only two per cent across all crops surveyed. In 2012, another outbreak occurred, that affected 77 per cent of canola fields surveyed in Saskatchewan with an average incidence of eight per cent across all crops surveyed.

Counting the number of infected plants in a random sample of 100 can be used to determine the incidence of a disease in a field. The Saskatchewan Ministry of Agriculture continues to conduct annual disease surveys to monitor the incidence of aster yellows and other diseases in the province. Results can be found in the Canadian Plant Disease Survey, at http://phytopath.ca/publication/cpds/.

The extent of an aster yellows infection is dependent on:

- local and migratory leafhopper populations;
- the number of infective leafhoppers;
- the proximity of healthy susceptible plants to infected plants; and
- weather/climatic conditions.

The Aster Leafhopper

The aster yellows (AY) phytoplasma inhabits the phloem (nutrient-carrying vessels) of infected plants and is carried from plant to plant by sap-sucking insect vectors. In Canada, the primary vector of the aster yellows phytoplasma in canola and cereals is the aster leafhopper, also known as the six-spotted leafhopper (*Macrosteles quadrilineatus*). The leafhopper species (*Amplicephalus inimicus*) is also an important AY vector in cereals. At least seven other species have been found to be occasional vectors in Saskatchewan.

Leafhoppers are small, narrow, wedge-shaped insects that have a beak, tiny antennae and long hind legs fringed with hairs. The aster leafhopper is yellow or yellow-green with six black spots arranged in three rows on its head.. (Source: Agriculture and Agri-Food Canada, courtesy of Chrystel Olivier)

Leafhoppers undergo a series of nymphal (immature) stages before reaching adulthood. Nymphs resemble a wingless adult but are much smaller, ranging in size from 0.6mm to 3mm. They can often be distinguished by their unique sideways scuttle when disturbed. Adults range from 3.5mm to 4mm. They are relatively poor fliers and tend to glide along with wind currents.

Leafhoppers tend to take flight only when the air temperature exceeds 15C. Cooler temperatures or rain will temporarily stop their migration. Due to the leafhoppers' poor flying ability, aster yellows tends to be more prevalent in patches in the field or along the edge of a field.

Generally, the migratory leafhoppers pose a greater threat to crops than the local population since the migrants often arrive in greater number and are already infected with aster yellows phytoplasma. Migratory leaf-hoppers generally come into the province on air currents originating in the southeastern and central United States and onto the Canadian Prairies. Leafhoppers usually arrive in Saskatchewan in early to mid-May, but this may vary depending on the prevailing winds. It is suspected that aster leafhoppers may be able to over-winter as adults especially if the winter is mild and there is reasonable snow cover.

In Saskatchewan, leafhopper populations increase quickly and remain relatively high all summer. However, not every leafhopper will be infected or spread the disease. On average, 3.8 per cent of specimens collected between 2001-2008 in Saskatchewan were infected with aster yellows phytoplasma. In the spring of 2012, approximately 12 per cent of leafhoppers collected in Saskatchewan tested positive for phytoplasma DNA when investigated by researchers at Agriculture and Agri-Food Canada.

Monitoring and Control of Leafhoppers

Sticky traps and sweep nets can be utilized for early detection and monitoring of leafhoppers, to give producers an early warning of potential problems. Keep in mind however that not all leafhoppers present will be infected with aster yellows phytoplasma and no economic thresh- olds have been

established for Saskatchewan crops. While researchers can investigate the potential risk using a PCR-based DNA test, there is no simple, rapid or commercial method of determining whether or not the insects are infective. Leafhopper feeding, in itself, is not considered an economic threat to crops and insecticide applications (active ingredient dimethoate registered for leafhopper control in canola) have not been shown to be economical because several applications would be required over the course of the season to control new invasions of leafhoppers as they move into the affected area. Furthermore, insecticide applications will kill beneficial organisms and can lead to secondary pest problems. There are no commercially available chemicals that will kill phytoplasma present inside the plant sap.

Disease Transmission

Phytoplasma can only survive inside their plant hosts and insect vectors and are not considered to be soil, air or wind borne. Most aster yellows infections come from infected leafhoppers carried north from the United States on wind currents.

The aster yellows phytoplasma is transmitted when the leafhopper feeds on a plant's sap. A leaf hopper has to feed on an infected plant for a substantial period of time to acquire the pathogen (eight hours for 50 per cent success). An incubation period of ten to 18 days is necessary for the phytoplasma to circulate and reproduce within the insect before it becomes infective. The infective leafhopper must then feed on a healthy plant for a substantial period of time (eight hours for 50 per cent success) to pass on the phytoplasma.

Phytoplasma can over-winter in plant roots. Therefore, locally infected biennial and perennial crops and weeds can serve as a source of aster yellows phytoplasma in spring. Phytoplasma transmission via leafhopper eggs does not occur in crops grown in the prairies.

Using PCR tests, phytoplasma DNA can be detected in canola seeds harvested on AY-infected plant and in the subsequent seedlings, but not in the mature plants. Because of the small percentage of infected canola seeds and the absence of phytoplasma in the mature plants, seeds are not a significant source of disease transmission.

Hot and dry conditions are not conducive to the spread of aster yellows, whereas abundant rainfall will make plants more succulent and attractive to leafhoppers.

How do Aster Yellows Interact with their Hosts?

Phytoplasmas are master manipulators. They affect both their plant and insect hosts solely to improve their own chances for survival and dispersal.

Once infective, the leafhopper can continue to pass on the phytoplasma for as long as it lives (about a month or more). Phytoplasmas may even improve insect fitness and survival.

When infected with aster yellows, plants may exhibit a number of symptoms which have a negative impact on the crop. Symptoms frequently include stunting or marked increase in plant height. Flowers, fruits and seeds may also be affected. Certain symptoms even make the plants more attractive for sap-sucking insects by producing lush foliage and green tissues that are preferred for both feeding and egg-laying. Infection may induce development of floral parts into leafy structures and abnormal green colouration in plant parts that are not normally green. This has a direct impact on seed production. The symptoms of aster yellows may vary in severity and intensity, depending on many factors, including phytoplasma strains and plant species. A yellow discolouration of leaves is typical in many, but not all plants.

Aster Yellows in Canola

In canola, infected plants are often blue-green, with leaves developing a red or purple tinge later in the season. Malformed flowers and pods are the most obvi- ous symptoms of aster yellows in canola. Flowers are replaced by sterile, green leaf-like structures, and pods are replaced by round or oval blue-green hollow, flattened bladder-like structures. Infected plants may become woody and are often taller than the rest of the crop canopy.

Younger, actively growing plants may develop symptoms within several days of infection. Plants that become infected later in the season can continue to develop pods, but seed development may be adversely affected. Infected plants can pro- duce 30 to 70 per cent misshapen seeds. Misshapen seeds are not a concern if sold for oil. However, if planted, misshapen seeds will not germinate. 50 to 90 per cent of normal looking seeds harvested on infected plants will germinate and less than one per cent may produce malformed seedlings. Immature canola sprouting in the pod may be a result of aster yellows.

There are currently no resistance ratings for commercial varieties of canola and more research is needed to determine the potential differences observed under higher disease pressure. Incidence may vary due to avoidance, seeding date or maturity differences. Progress in resistance breeding is hindered by the requirement for a living host for infection and lack of consistently high disease pressure from year to year.

Aster yellows in canola: phyllody is the conversion of floral structures into leafy structures and virescence is the greening of tissues such as flowers that do not normally contain chlorophyll. (Source: Saskatchewan Agriculture)

Aster yellows in canola: purpling of pod, malformation, and germination of immature canola seed. (Source: Wes Anderson, Richardson Pioneer).

Calculating Potential Yield Losses in Canola

Yield loss occurs when normal pods fail to be produced as well as when misshapen seeds form.

A sample of 100 plants across the field will indicate a per cent incidence of symptomatic plants. Be sure to scout your crop rather than estimating incidence, as the actual number of infected plants is usually less than it appears, due to the striking visual symptoms.

Assuming that one infected plant may produce 30 to 70 per cent misshapen seeds, you may expect 0.3 to 0.7 per cent yield loss for every one per cent incidence of aster yellows in your field.

Aster Yellows in Camelina

Camelina is quite susceptible to aster yellow. However, preliminary research shows potential for some differences between varieties. Symptoms include stunting, greenish-yellow or reddish-purple leaves, stems, and pods, and distorted inflorescences.

Aster Yellows in camelina

Aster Yellows in Flax

Infected flax plants may be yellow, particularly on the top part of the plant, with high numbers of malformed, sterile flowers that fail to form bolls or seeds.

Aster yellows in flax: yellowing of foliage and floral structures. (Fred Waelchli, Saskatchewan Crop Insurance Corporation)

Aster Yellows in Cereals

The aster leafhopper is often more abundant in wheat and barley than in canola. Cereal crops are commonly infected with aster yellows but rarely show symptoms. DNA tests on normal looking plants reveal the presence of phytoplasma DNA in up to 30 per cent of cereals, even in years not considered to be epidemic for aster yellows.

Previously reported symptoms, although rare, include yellowing leaves, shrivelled heads with distorted awns or floral parts that look like leaves.

In recent years, white wheat heads on green stems with healthy roots and no other obvious disease symptoms have been speculated to be aster yellows. However phytoplasma DNA has not been consistently detected in plants with these symptoms. More research is needed to determine if there is a connection between phytoplasma and white heads.

Aster Yellows in Herbs and Spices

In herbs and spices, seed production can be devastated when floral parts are replaced by malformed, sterile leaf-like structures caused by aster yellows.

In echinacea, infected leaves will turn yellow or purple and will often appear thin and upright. The roots of echinacea or biennial caraway may be stunted in size with a proliferation of lateral roots. Severely infected roots usually will not survive the winter due to their susceptibility to secondary rots, nutrient deficiencies and adverse environmental conditions.

Aster yellows in echinacea: flower petals are green and are stunted and narrow; stalks are yellowing.

In infected caraway and coriander, plants will turn yellow or light green in colour and top growth may be stunted with a proliferation of secondary shoots.

Younger, actively growing plants often develop symptoms within several days of infection, while older plants may take several weeks to show symptoms. Echinacea and biennial caraway that emerge in the spring already showing signs of aster yellows were likely infected during the previous fall.


Aster yellows in biennial caraway: leaves are stunted and yellow; roots have developed proliferation of lateral roots.

Aster Yellows in Vegetables and Other Crops

Aster yellows or “purple top” in potato is spread by the aster leafhopper. Severe disease pressure is required to experience yield losses. However infection can result in discoloured tubers during processing.

Aster yellows or “red top” in carrot results in yellow to red or purple younger foliage, dwarfed petioles, and dense malformed shoots. Tubers exhibit witches’ broom, increased root hairs and stunted root growth. The infected carrot will taste bitter and will appear slender and elongated.

Aster yellows can also affect various other crops grown in Saskatchewan such as pea, chickpea, sunflower, alfalfa and bromegrass as well as ornamental species and many of the fruits and vegetables grown commercially or in the home garden.


Purple top in potato.


Aster yellows in pumpkin.


Red top in carrot.

Symptoms That Can Be Mistaken for Aster Yellows

Aster yellows symptoms can be confused with injury caused by nutrient deficiencies, Group 4 herbicides containing growth regulators, drought or other environmental stresses.

In canola, purpling can be caused by anthocyanin production as a result of stress. Although aster yellows can cause purpling, a purple plant does not necessarily indicate an aster yellows infection.

White heads in cereals can be caused by root rot, “take-all”, fusarium head blight, insects, herbicides, hail damage and environmental stress. Stunting and yellowing can be caused by Barley Yellow Dwarf Virus.

Disease Diagnosis

The Saskatchewan Ministry of Agriculture, Crop Protection Laboratory in Regina can visually diagnose aster yellows for a nominal fee.

Phone (306)787-8130 for more information.

Disease Management in Annual Crops

The proper techniques for managing aster yellows are dependent on the type of crop involved. Monitoring of leafhoppers and early detection of aster yellows symptoms are important for those crops in which hand-removal of diseased plants is feasible. For field crops, there are very few management options available.

Crop rotation will not reduce aster yellows because it is not a soil-borne disease, and most crops are susceptible to the phytoplasma. Various weeds may be infected with aster yellows, including redroot pigweed, dandelion, stinkweed, chickweed, quack- grass, wild mustard, lambsquarters, knotweed, sowthistle, Canada thistle, hawk's-beard, false ragweed, goldenrod, bedstraw, and shepherd's purse.

Because aster yellows is a bacterium-like organism, fungicides will have no impact on the disease. There are no commercially available cultivars or resistance ratings for aster yellows for any crops grown in Saskatchewan.

Normally, there is little need to control aster yellows in annual field crops since incidence of the disease is usually low and does not result in significant economic loss. Management of aster yellows in annual crops is limited to:

- Seeding crops early in the spring as possible in order to avoid infection until the crop matures, making it less attractive to the migrating leafhoppers.
- Avoid planting near perennial forages, herbs or spices that are known to be infected with aster yellows.
- Controlling perennial weeds in and around susceptible crops.

Disease Management in Perennial Crops

In addition to the above-mentioned management practices, disease management in perennial herb crops include:

- Removing and destroying all plants showing aster yellows symptoms. Removing only the above-ground plant parts may help limit the spread of disease that season but, since the roots are infected, any new foliage will be carrying the phytoplasma.
- Isolating the crop as much as possible. Tilling or mowing around the crop will remove weeds and grasses where leafhoppers or their eggs may be sheltering.
- Growing the crop in tandem with repellent plants such as yarrow, tansy or mint.
- Using only healthy plants for vegetative propagation.
- It is possible to choose varieties that may avoid infection because they deter leafhopper feeding. For example, the more pubescent Echinacea augustifolia is less favoured by leafhoppers than other species.

For more information:
Contact the Provincial Specialist, Plant Disease at (306) 787-4671;
Phone the Agriculture Knowledge Centre at 1-866-457-2377; or
Refer to the Crop Production Newsletter.