BACTERIAL LEAF STREAK AND BLACK CHAFF OF CEREAL CROPS IN THE PRAIRIES

Bacterial leaf streak and bacterial black chaff of cereals, caused by *Xanthomonas translucens* pv. *undulosa* and *Xanthomonas translucens* pv. *translucens*, have become more prevalent in the Prairie provinces recently due to a combination of favourable conditions and increased awareness. Bacterial leaf streak is an important disease of cereal crops all over the world and can cause a significant reduction in yield. It has been reported that severe infections can reduce yield by up to 50 per cent.[1] In Canada, research is ongoing to estimate yield losses across the Canadian Prairies.

Disease:

Bacterial Leaf Streak, Bacterial Black Chaff

Casual Agents:

Xanthomonas translucens pv. *undulosa* (barley, wheat);
X. translucens pv. *translucens* (primarily barley);
X. *translucens* pv. *cerealis* (perennial grasses)

Hosts:

Cereals including wheat, barley, oats, triticale and perennial grasses

Key Takeaways

- Bacterial leaf streak and bacterial black chaff are polycyclic with multiple generations per year.
- Bacterial leaf streak is mainly seed-borne but can overwinter in winter cereals and perennial grasses.
- Symptoms of bacterial leaf streak typically appear as water-soaked spots or streaks, that may have a translucent appearance. Under wet conditions, lesions produce a milky white or yellowish exudate that makes the leaf surface feel slippery.
- Bacterial leaf streak and bacterial black chaff cannot be controlled with foliar or seed treatment fungicides.
- Management can be achieved through the combined use of clean seed, seed testing, scouting, crop rotation, variety selection and irrigation management.

[1] Friskop, A., Lux, L., & Liu, Z. (2020, November). *Bacterial Leaf Streak and Black Chaff of Wheat.* Retrieved from North Dakota State University: https://www.ag.ndsu.edu/publications/crops/bacterial-leaf-streak-and-black-chaff-of-wheat

Life Cycle

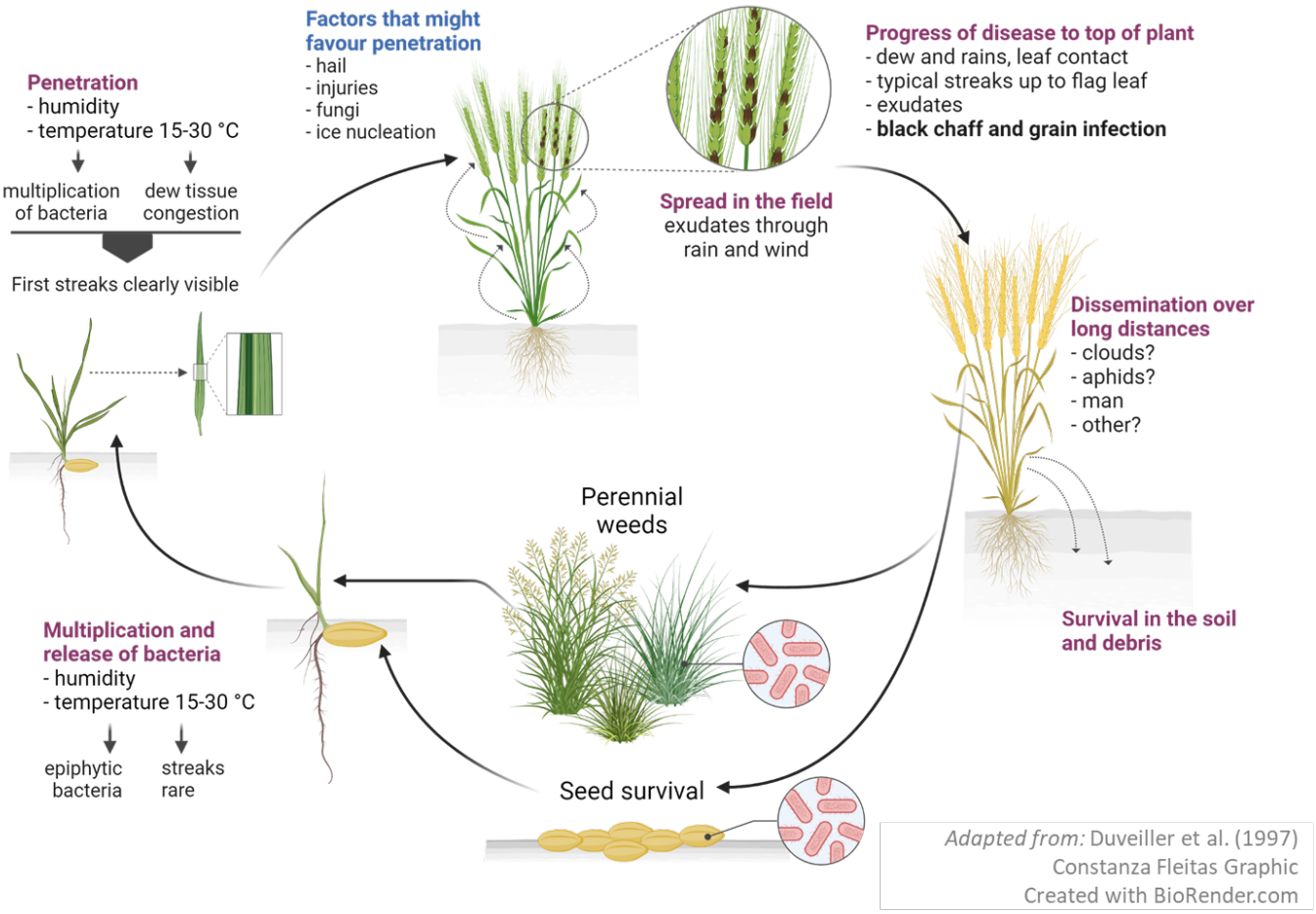

Figure 1. Disease cycle for Bacterial leaf streak. http://www.fao.org/3/y4011e0n.htm

Bacterial leaf streak is a polycyclic disease, meaning there can be multiple infection cycles in a single growing season. The bacteria can overwinter on crop residue, as well as host perennial grasses and grassy weeds. Bacteria can also overwinter on winter wheat and fall rye.[2] Bacterial leaf streak is primarily a seed-borne disease. The pathogen in the infected plant material is dormant until it encounters moisture. Moisture causes the production of bacterial cells on infected host debris, seed or volunteer cereals and weed hosts. In addition to moisture, the pathogen requires temperatures between 15-30°C to grow and multiply.[3]

Bacterial leaf streak thrives in areas with warm days, cool nights and an abundance of moisture. Rain splashing, wind-driven rain, irrigation, mechanical field activities and even insects can cause the disease to spread throughout the field. Bacteria then enter the plant through natural openings such as stomata and hydathodes (a modified leaf pore that releases water droplets) or wounds caused by hail, wind, insects, other diseases, soil particle abrasion and mechanical abrasion due to leaf rubbing. Bacterial leaf streak lesions begin to expand, lengthen and are usually bordered by leaf veins. This causes the initial infection spots to elongate and form larger streaks, especially on leaves.

[2] Duveiller, E., Bragard, C., & Maraite, H. (2002). *Bacterial leaf streak and black chaff.* Retrieved from Food and Agriculture Organization of the United Nations: http://www.fao.org/3/y4011e0n.htm#bm23

[3] Duveiller, E., Fucikovsky, L., & Rudolph, K. (1997). Bacterial Leaf Streak and Black Chaff Caused by Xanthomonas translucens. In *The Bacterial Diseases of Wheat: Concepts and Methods of Disease Management* (pp. 25-47). Mexico: CIMMYT.

Signs & Symptoms

Figure 2.1. Bacterial Leaf Blight. Source: Dr. María Constanza Fleitas, University of Saskatchewan

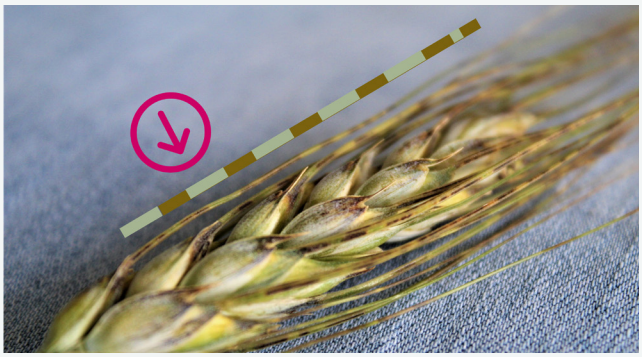

Figure 2.3. Bacterial Black Chaff. Source: Dr. María Constanza Fleitas, University of Saskatchewan

Figure 2.2 Bacteria ooze - a key diagnostic feature of bacterial leaf streak. Source: Dr. María Constanza Fleitas, University of Saskatchewan

Figure 2.4. Bacterial ooze on glumes. Source: Dr. María Constanza Fleitas, University of Saskatchewan

Bacterial leaf streak can display several symptoms, many of which can be confused with symptoms of fungal leaf spot diseases in Western Canada. In the early stages of development, the lesions appear as small, oval, light green, water-soaked spots or streaks, and may have a translucent appearance (Figure 2.1). Under wet conditions lesions produce a milky white or yellowish exudate, masses of bacterial cells, which helps differentiate bacterial leaf streak from other common fungal diseases or environmental conditions (Figure 2.2).[4] However, exudates are not always present, especially if dry conditions occur after infection. Dried bacterial exudate may give lesions a "glazed-doughnut" like appearance. Lesions later come together to form irregular streaks, which destroy plant photosynthetic tissue. Symptoms typically start on the middle or apex of the leaf, where the dew stays the longest. Heavy infection can lead to withering and death of leaves, starting from the leaf tip.[5]

Bacterial black chaff, which is caused by the same pathogen, infects the heads of wheat and barley. It appears as dark lines or strips on the glumes and awns. Awned varieties might have alternating bands of diseased (brown) and healthy (green) areas (Figure 2.3). In more severe infections, the stripes eventually join together and the glumes turn fully black, causing 'black chaff'. Glumes can also have exudates present in severe infections, giving a water-soaked appearance[6] (Figure 2.4).

[4] See note 2

[5] Menzies, J., & Gilbert, J. (2003). Diseases of Wheat. In Diseases of Field Crops in Canada (pp. 106-107). Saskatoon: The Canadian Phytopathological Society

[6] See note 5

Management

An integrated approach utilizing multiple tactics is required to manage bacterial leaf streak in cereals. As the disease is bacterial and not fungal, **it cannot be controlled with foliar or seed treatment fungicides**. Starting with clean seed, vigilant scouting for disease and extending crop rotation are currently the best management strategies for bacterial diseases.

Clean Seed

The best way to avoid a bacterial leaf streak outbreak is to use clean seed combined with at least two years between host crops, while also managing volunteers and other non-crop hosts. If a field is suspected to have bacterial leaf streak, do not use harvested grain for seed. Currently, seed is the largest source of inoculum for bacterial leaf streak[7], although crop residue may also be important in fields where bacterial leaf streak is well-established. Consider obtaining seed from another source to minimize risk if a field has a history of bacterial leaf streak.

Bacterial leaf streak pathogen, like most pathogens, is not part of pedigreed seed certification requirements in Western Canada. Many seed retailers will include pathogen screening as additional information as part of the package they offer. Check with local seed retailers about testing for bacterial leaf streak.

Alternatively, growers are encouraged to send seed samples to designated labs to test for bacterial leaf streak (see Table 3.2 for a list of designated labs). Check with your seed testing professional to determine the tests that are available to differentiate bacterial strains. Research has not been completed to understand the implications and thresholds of using seeds that test positive for bacterial leaf streak.

Producers are encouraged to use the cleanest seed they can source; however, if it is the best seed available, producers can still use a seed lot that tested positive for bacterial leaf streak. Currently, it is unclear if prolonged seed storage will be useful in eradicating or reducing the virulence of the bacterial leaf streak pathogen, especially under prairie conditions.

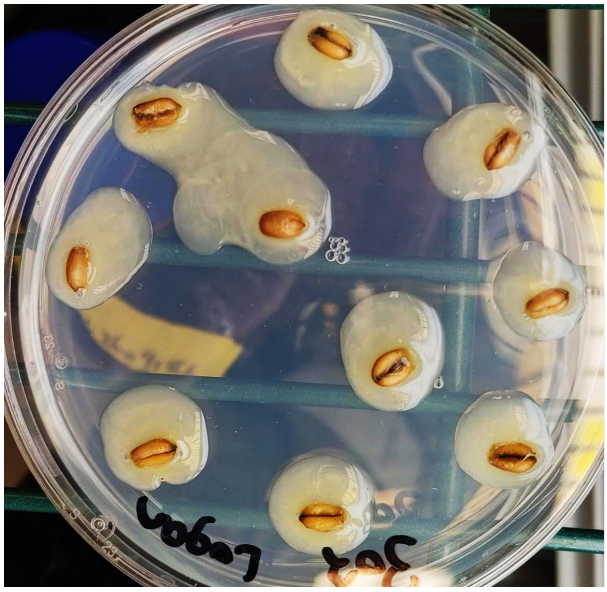

Figure 3.1. Wheat seeds contaminated with the bacterium. Source: Dr. María Constanza Fleitas, University of Saskatchewan

Name of Lab	Address	Contact	Seed Test	Tissue Test
20/20 Seed Labs– Nisku	507 11 Ave, Nisku, AB T9E 7N5	support@2020seedlabs.ca Local: 1-780-955-3435 Toll Free: 1-877-420-2099	✓	✓
SGS Sherwood Park	310, 280 Portage Close Sherwood Park, AB, T8H 2R6	BioVision.SherwoodPark@sgs.com Local: 1-780-702-7254 Toll Free: 1-800-952-5407	✓	✓
Discovery Seed Labs Ltd.	450 Melville Street Saskatoon, SK. S7J 4M2	info@seedtesting.com 1-306-249-4484	✓	✓

Table 3.2. Designated testing labs for bacterial leaf streak.

[7] See note 3

Crop Rotation

An extended crop rotation, with greater than two years between cereals, will help reduce viable inoculum in crop debris as it decomposes. The inoculum can remain viable from season to season, although at present it is a relatively minor source of bacterial leaf streak. Most of the inoculum comes from infected seed[8], especially when adequate crop rotation is part of the management program.

Scouting

Scouting fields for signs of the disease is the best way to identify if bacterial leaf streak is an issue. Scouting can begin during in-crop herbicide application timing through to the start of crop senescence. Special attention should be given to scouting after the occurrence of severe weather events such as strong winds, wind-driven rain, hail, heavy rain and thunderstorms. If bacterial leaf streak is suspected, avoid scouting in wet conditions as walking through a wet crop will spread the disease. Bacterial leaf streak has been reported in seven provinces including British Columbia (1959), Alberta (1927), Saskatchewan (1927) and Manitoba (1920), and its prevalence has been increasing across the prairies in recent years.

Variety Selection

Historically, bacterial diseases have not typically contributed to significant yield loss in Western Canada, so no breeding efforts have been made nationally for bacterial leaf streak resistance. For the same reason, varieties have not been screened for resistance to bacterial leaf streak of black chaff, it remains unknown if any varieties are resistant. In areas where bacterial leaf streak has been more common, resistance screening has taken place over the past 30 years[3], and most recently in the Northern Great Plains of the USA. [9] [10] [11]

Some of the varieties that possess some resistance are grown in Western Canada, such as Glenn, Faller, Prosper and Bolles wheat and AAC Connect and AAC Synergy barley. In Western Canada, it is anticipated that future research will establish resistance screening in variety trials and make bacterial leaf streak resistance information available to growers.

Irrigation Management

Since moisture in the form of water splash and high humidity can accelerate the growth and spread of *X. translucens*, it is important to avoid creating wet, humid conditions in the crop canopy of irrigated fields when it is not necessary. While producers must irrigate to the water demands of the crop, it may be possible to reduce the amount of time that the crop canopy is wet by:

- Irrigating in the evening when the canopy is already wet with dew
- Allowing the canopy to dry out between irrigation events
- Avoiding irrigating when it is not essential

Figure 3.3. Patchy distribution of bacterial leaf streak, shown under irrigation emitters. Source: Dr. Michael Harding, Alberta Agriculture and Irrigation

Acknowledgement

This factsheet is developed with the knowledge support from plant pathologists: Dr. Michael Harding, Dr. Kelly Turkington, Dr. Maria Constanza Fleitas, Dr. Randy Kutcher, Dr. Jie Feng, Dr. James Tambong and Dr. Sean Walkowiak.

[8] See note 2

[9] See note 1

[10] University of Minnesota. 2022a. Spring Wheat Field Crop Variety Trials. College of Food, Agricultural and Natural Resource Sciences, University of Minnesota. Online: https://varietytrials.umn.edu/spring-wheat

[11] University of Minnesota. 2022b. Barley Field Crop Variety Trials. College of Food, Agricultural and Natural Resource Sciences, University of Minnesota. Online: https://varietytrials.umn.edu/barley

[12] FAO. Bacterial leaf streak and black chaff. Online: https://www.fao.org/3/y4011e/y4011e0n.htm

[13] Duveiller, E. (1997). *The bacterial diseases of wheat: concepts and methods of disease management.* CIMMYT. Retrieved May 3, 2023, from https://repository.cimmyt.org/xmlui/bitstream/handle/10883/1227/64767.pdf?sequence=1

[14] NDSU Publication. (2020.11). *Bacterial Leaf Streak and Black Chaff of Wheat.* Online: https://www.ag.ndsu.edu/publications/crops/bacterial-leaf-streak-and-black-chaff-of-wheat