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Societies

Wildfire smoke and crop development—it's complicated

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Wildfire smoke is becoming a regular feature of Prairie growing seasons, but what does that mean for crops? Turns out that the answer is more complicated than you might think. Photo by Dan Quinn.



Wildfire smoke is becoming a regular feature of growing seasons in the Canadian Prairies—but its effects on crops are far from straightforward. This article explores how smoke can both help and hinder crop development, from altering light and temperature to

interacting with key growth stages. Discover why some smoky seasons still produce strong yields—and what that means for future farm management decisions.

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Public Safety Canada reported that 2025 was the [second](#) worst wildfire season in the country's history. Summer 2025 was Winnipeg's [smokiest](#) since 1961, with 306 smoke hours as of August 4. [Regina](#) and Saskatoon, Saskatchewan, both logged record numbers of smoke hours between March and July 2025. Environment and Climate Change Canada defines a [smoke hour](#) as "when visibility is reduced to 9.7 km (6 miles) or less due to smoke."

Wildfire smoke is becoming a more regular feature of growing seasons in the [Canadian Prairies](#). For example, the total smoke hours in Winnipeg in 2025 far surpassed the 1981 to 2010 yearly average in 5 of the 10 years since 2015 (Figure 1). Understanding the effects of this haze on crop development and yield is becoming increasingly important.

Number of smoke hours in Winnipeg: 1953 to 2025

As measured from May to September each year

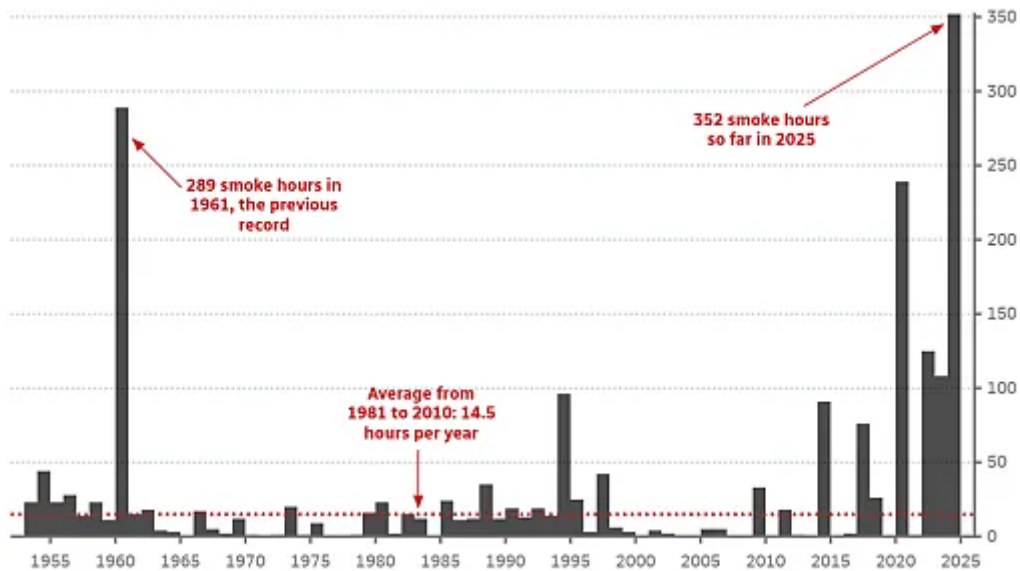


Figure 1. Number of smoke hours in Winnipeg: 1953 to 2025 (as measured from May to September each year). Environment and Climate Change Canada defines a smoke hour as when the visibility was reduced to 9.7 km (6 statute miles) or less due to smoke. Figure courtesy of Robson Fletcher/CBC Archive Sales.

For the past few years, farmers have been asking if smoky haze would affect crop development or influence yields. They wonder if they should change their management strategies in response, and what the research says. The answers are not clear-cut.

Yields for 2025

In many areas of the Canadian Prairies, yields were above average for the major crops of wheat and canola (Table 1), which surprised many growers.

Table 1. Crop yields of principal field crops in Canadian Prairie provinces, 2025.

Province	Crop	Yield in 2025 (bu/ac)	2025 yield change from 2024 (%)
Saskatchewan	Total wheat ^a	49.7	10.9
	Canola	44.4	15.9
	Corn for grain	NA ^b	NA
	Soybean	NA	NA
Alberta	Total wheat	57	18.8
	Canola	45.4	16.1
	Corn for grain	NA	NA
	Soybean	NA	NA
Manitoba	Total wheat	65.5	0.3
	Canola	44.8	11.4
	Corn for grain	147.0	5.5
	Soybean	42.6	-3.2

^a Sum of winter, spring, and durum wheat.

^b NA, not available.

Source: Statistics Canada. [Production of principal field crops, November 2025](#).

Statistics Canada said, “In general, yields were [higher](#) than 2024, particularly in Western Canada, where favourable weather conditions later in the growing season

helped crop development.”

So how did the weather leading up to the growing season affect crop development?

The 2025 growing season in the Canadian Prairies

In 2025, much of the Prairies entered the season with dry spring conditions, followed by improved moisture in August. As expected, smoke exposure and severity were changeable and uneven. Some areas had smoke during vegetative growth; others saw smoky conditions closer to flowering or early grain fill.

Craig Riese, who grows 6,000 acres of wheat, canola, soybeans, and corn about 10 miles north of Winnipeg, says that this past summer brought “the most smoke we’ve ever had.” He described June and July as overall very warm and dry.

Riese was surprised that his canola yields were up this year. It flowered and flourished in the cooler temperatures under the haze. “The smoke cover kept the baking hot sun off it,” he says. He estimates that they had smoke for at least half of the canola flowering period.

Carl Bangert farms 2,800 acres with his brother. They grow grain corn, soybean, canola, red spring wheat, barley, and sunflower about 45 miles northeast of Winnipeg. They experienced the same effect as Riese did with canola. Bangert says their soybean yields were up by at least 10 bushels per acre over the average of the last eight years.

Smoke caught U.S. scientists’ attention in 2023

The current wave of interest in wildfire smoke and crops began in earnest during the summer of 2023, when heavy smoke from Ontario wildfires blanketed much of the U.S.

Midwest and Northeast. Many farmers contacted their state extension offices or their crop advisers with questions about risks to crops.

The 2023 U.S. scenario mirrored the conditions in the Canadian Prairies in 2025: a hot, dry early season followed by increased moisture in August, combined with periods of significant haze.

Researchers including Alexander Lindsey, crop ecophysiology at the Ohio State University, and Daniel Quinn, extension corn specialist at Purdue University, responded by analyzing weather data, satellite radiation measurements, and final yields. The results were unexpected. Despite measurable reductions in sunlight—by 3% to 9%—Ohio saw record corn, soybean, and wheat yields in 2023.

Whereas many growers expected detrimental effects from the smoke, the reverse mainly seems to have occurred. How to explain this? The effects of smoke and drought can be difficult to untangle.

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How smoke affects crops

Because wildfires are unplanned events, researchers can rarely design controlled field experiments. As a result, much of our current understanding comes from weather data analysis, yield comparisons, modeling, and literature reviews, rather than controlled experiments.

Smoke affects crops in several ways:

- It changes light quantity and quality.
- It can reduce air and crop canopy temperatures.
- It interacts with drought, heat, and rainfall patterns.

Wildfire smoke can produce variable outcomes for crops. Its effects depend on timing, crop type, weather before smoke exposure, and smoke intensity and duration.

Smoke triggers several changes affecting plants

The role of diffuse light

Wildfire smoke reduces direct sunlight but increases diffuse light, which is scattered by smoke [particles](#) in the air. [Particles in the atmosphere also increase the amount of diffuse light reaching the ground and reduce the overall light intensity. Smoke particles also reduce total photosynthetically active radiation \(PAR\), which influences ecosystem productivity.](#)

Photosynthesis is optimized well below full sunlight (often around half full sun), and efficiency declines at higher light levels.

Lindsey explains that diffuse light penetrates deeper into a crop canopy and leads to more even distribution, allowing more leaves to photosynthesize efficiently. This helps explain why modest haze events did not automatically translate into yield losses, and may even support productivity under hot, dry conditions. This mechanism appears

especially relevant in dense canopies, although C3 crops such as wheat and canola likely respond differently than C4 crops such as corn.

Jeremy Boychyn, director of research, agronomy, and extension for Alberta Grains, advises, however, that benefits from diffuse light do not occur in isolation. Unlike cloud cover, smoke introduces fine particulate matter that can interfere with the opening and closing of plants' stomata—the tiny pores in leaves that take in carbon dioxide, release oxygen, and control water flow through the plant. If stomata remain closed because of poor air quality, carbon dioxide exchange and water movement through the plant are limited. This limits photosynthesis, so any gains from improved light distribution in the canopy may be partially or fully offset, depending on smoke intensity and duration. These effects may be most profound in flowering and grain-fill stages.

Timing of smoke exposure is critical

Experts agree that the growth stage of the crop when it is exposed to smoke is likely the most critical factor in determining whether smoke helps or harms crop yield.

Research shows that:

- In the early vegetative stages, crops often [tolerate smoke well](#). Slight cooling and reduced heat stress [can be beneficial](#), particularly during drought. In 2025, much of the Canadian Prairie smoke exposure happened during the vegetative stages.
- During flowering and pollination, cooler conditions may protect yield if haze reduces extreme heat, especially for wheat and canola.

- Grain fill may be the **highest-risk period** for smoke exposure, assuming that smoke exposure causes similar plant responses as does shading. Significant light reduction during grain fill **increases** the likelihood of yield loss, according to modeling studies. During this time, crops rely heavily on transpiration-driven movement of water and nutrients, Boychyn says. Even when soil moisture is adequate, smoke-related reductions in transpiration can restrict grain filling and final yield.



Surprisingly, young crops can often tolerate smoke well. Photo by Osler Ortez.

Temperature, development, and maturity

Smoke can slow the accumulation of growing degree days, which delays crop development and maturity. In northern areas, this can push harvest later into the fall, increasing the risk of frost damage.

Extended smoke exposure can also slow crop metabolism by reducing transpiration and overall physiological activity. A few days of smoke may have little visible effect,

similar to short periods of cloud cover. But multiweek smoke events—such as those reported in parts of Manitoba during the 2025 growing season—are more likely to delay growth progression and maturity.

Boychyn notes that improved late-season moisture does not necessarily offset earlier smoke stress. If smoke reduces stomatal opening, plants may be unable to fully use available moisture and nutrients.

What about the chemicals in smoke?

Another common question is whether chemicals in wildfire smoke directly injure crops. Experts agree that compounds such as nitrogen oxides and volatile organic compounds *can* harm plants—but these effects would be seen only close to fires. At the distances typical of Prairie and U.S. Midwest haze events, these compounds are diluted, and visible crop injury has not been reported.

Should growers change management strategies under smoky skies?

Wildfire smoke affects more than crop physiology. Smoky conditions often coincide with stable atmospheric conditions, increasing spray drift risk and complicating herbicide applications.

Tom Wolf, of Agrimetrix Research & Training in Saskatoon, who is known on X (formerly Twitter) as “nozzle_guy,” says that growers may find slower uptake of systemic herbicides because of reduced photosynthesis. He notes that light-dependent products such as glufosinate may have reduced efficacy in smoky conditions. Wolf cautions that there is greater risk of herbicide drift because of

limited air mixing, and more droplet evaporation during hot, dry, smoky periods.

To account for these conditions, Wolf recommends adjustments including attention to water quality, use of ammonium sulfate conditioners where appropriate, coarser droplets, and adherence to label-approved rate ranges under stress conditions.

What do we still need to know?

Despite growing interest in this topic and probably a growing threat, there may be no Canadian Prairie-specific field studies on haze and crop yield. There is more data available for corn than for wheat and canola—crops more commonly grown in Canada than corn. Farmers would benefit from more clarity around smoke intensity thresholds and timing sensitivity, as well as how smoke alters the light spectrum in the plant canopy.

Smoke Is another variable, but not necessarily a negative

The yield results of the 2025 Prairie growing season show that wildfire smoke is a stressor, but it does not necessarily reduce yield. Under some conditions, smoke may reduce heat stress and improve light distribution. Under other conditions—especially during grain fill—it can contribute to yield loss or delayed maturity. The difference lies in timing, weather context, smoke intensity and duration, crop, and crop stage.

Because of the many interacting factors, most experts recommend caution when assigning cause and effect related to crop yields. “It’s so complex that it is hard to get an answer,” Boychyn said in a 2019 [article](#) on this topic. “It’s all hypothetical.”

If wildfire smoke becomes a regular feature of Prairie summers, advisers will increasingly need to interpret hazy skies through a multifaceted lens, weighing risk, opportunity, and uncertainty.

Self-study CEU quiz

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1. How did crop yields in many Prairie regions respond during the 2025 growing season?

- a. Yields declined significantly across most major crops due to smoke exposure.
- b. Yields remained unchanged despite variations in weather and smoke conditions.
- c. Yields were generally above average for wheat and canola in many areas.
- d. Yields decreased early but recovered fully by the end of the growing season.

2. What was one key finding from U.S. research during the 2023 wildfire smoke events?

- a. Crop yields reached record levels despite a measurable decrease in sunlight.
- b. Reduced sunlight consistently resulted in lower yields across all crops.
- c. Smoke exposure caused severe plant injury due to chemical toxicity.
- d. Farmers experienced widespread crop failures due to reduced radiation levels.

3. During which crop growth stage is smoke exposure considered most risky for yield?

- a. Early vegetative growth when plants are establishing their root systems.
- b. Mid-season leaf expansion during periods of rapid canopy development.
- c. Flowering and pollination when crops rely on stable temperature conditions.
- d. Grain fill when crops depend heavily on light and nutrient transport.

4. How does wildfire smoke alter light conditions for crops?

- a. It increases direct sunlight while reducing overall atmospheric scattering.
- b. It decreases both direct and diffuse light equally across the canopy.

- c. It reduces direct light but increases diffuse light reaching plant leaves.
- d. It has no measurable effect on light distribution within plant canopies.

5. Why can diffuse light sometimes benefit crop productivity?

- a. It raises canopy temperatures, accelerating plant metabolic processes.
- b. It penetrates deeper into the canopy, allowing more leaves to photosynthesize.
- c. It increases total radiation beyond what plants normally receive in full sun.
- d. It reduces water demand by limiting all forms of photosynthetic activity.

This quiz was created with AI assistance and reviewed by the editorial team for accuracy and appropriateness.

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