



(SPF) Sun's Pretty Fierce: Understanding and Preventing Light and Heat Stress

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This article focuses on light and heat damage in apple fruit, outlining the causes, defining key sun damage terms, providing visual examples, and discussing approaches to reduce and prevent injury.

While sunlight is essential for life and fruit production, changing climate conditions and evolving orchard management practices in Ontario have increased the occurrence and visibility of light- and sun-related disorders in apples. Temperatures follow a similar story, where apples require dormant periods and warm periods for successful fruit to grow, but lately climate conditions have shifted, challenging growers in a multitude of ways.

Exposure to ultraviolet (UV) radiation can cause sunburn on fruit and sub-lethal injury on leaves. Leaves are typically more resilient in comparison to fruit as leaves utilize light energy (photosynthesis) and can dissipate light energy (transpiration), while excess light energy in fruit is converted into heat injury.

Burn Factors

Sunburn in apple fruit are caused by two direct factors, temperature and sunlight. It is debated which is more important when contributing to sun damage on the fruit, where it should be noted that findings change based on location of the research.

Temperature

When discussing temperature, we often think of air temperature; however, in this case, **fruit surface temperature** (FST) is the key consideration.

- FST is more related to sun damage risk than air temperature. This is due to (i) direct heat from the sun and (ii) heat from hot air moving into the orchard.
- High FSTs are common daily and not necessarily affiliated with an extreme event to cause sunburn necrosis or sunburn browning.

Fruit surface temperatures can exceed air temperatures by 5 to 15°C.

Sunlight

Sunlight, scientifically referred to as solar radiation has a direct cause in sun damage to fruit.

- There are 3 types of radiation in the field that affect fruit (i) high energy UV spectrum, (ii) visible light and (iii) near infrared radiation.
- UV-B radiation is the most damaging to fruit and is required for sunburn browning.

Indirect Factors

Some contributing factors that could lead to sun damage include:

- **Humidity:** low humidity can increase stress on the tree, potentially making fruit more susceptible to sun damage.
- **Air movement:** poor air circulation can result in elevated FSTs, while increased airflow around fruit has been shown to reduce FST by as much as 5°C.
- **Acclimation (fruit position):** without prior exposure to higher temperatures and sunlight, fruit is less able to tolerate these conditions and is therefore more prone to sun damage.
- **Cultivar susceptibility:** sun damage differs among cultivars, and early ripening cultivars may suffer substantial injury in one season yet avoid damage in another.
- **Geographic location:** tropical regions have shown to have higher sun damaged fruit in comparison to temperate regions of the world. For example, Washington State has noted that roughly 10% and up to 40% could be culled due to sun/heat stress.
- **Cultural management practices:** training system and tree architecture, row orientation, rootstock and cultivar vigour, water and nutrient management, pruning and leaf removal, all factor into sun damage risk.

Environmental conditions may be beyond your control, but the practices described in the ["Dry Spell? Play It Cool"](#) section can help protect fruit from sun damage.



Types of Sunburn

Several types of sun damage can occur on apple fruit, with the prevalence and severity varying by region. In Ontario, certain forms of sun damage are more common, and overall incidence is often greater in high density orchard systems due to increased fruit exposure to sunlight when compared to low density orchard systems.

It is important to note that these definitions reflect **fruit temperature**, not **air temperature**, as noted on the previous page.

I want to preface that the section below is highly based on information from Washington State.

Consideration of the climate differences, specifically our **temperature and humidity levels**, may change how and when certain sunburn damages show up in Ontario.

Sunburn Necrosis

Caused by heat alone.

- **Occurs when:** the fruit surface temperature exceeds 50°C for as little as 10 minutes (under Washington conditions), causing cell death.
- **How it happens:** Caused by excessive heat and is exacerbated by low humidity.
- **Symptoms:** Cell death occurs, causing brown or black lesions.
- **Prevalence in Ontario:** Not common. Extremely high temperatures are necessary for this to occur.
- **Reference photo:** [Figure 1](#)

Sunburn Browning (Sunscauld)

Caused by high fruit surface temperatures and damaging UV radiation.

- **Commonly occurs when:** a combination of UV-B radiation and high fruit surface temperature causing degradation of cell membranes. Sunburn browning can contribute to storage/delayed sunburn.
- **How it happens:** Typically occurs between fruit surface temperatures of 45 – 49°C, although this can change based on the variety (i.e. Honeycrisp is more

sensitive than Red Delicious or Braeburn).

Higher risk occurs between the hours of 11am and 5pm when maximum daily air temperature and mean maximum hourly temperature are high.

- **What happens to the fruit:** Yellow, bronze or brown spot develops on the sun-exposed side of the peel but may not appear for a few days. Sunburn also affects the flesh of the fruit.
- Sunburn browning has **six different classes** based on severity ([Figure 2](#)). As sunburn browning severity increases (i) fruit firmness increases, (ii) soluble solids decreases, (iii) titratable acidity decreases and (iv) starch levels decrease.
- **Prevalence in Ontario:** Common. Can be seen in tops of tree canopies and when waiting for additional colouration before harvest.
- **Reference photo(s):** [Figures 2, 3 & 4](#)

Although you may see apples that exhibit necrosis, it most likely is **not sunburn necrosis**, but a **severe** incidence of **sunburn browning**.

Photo-oxidative Sunburn

Caused by visible light alone.

- **Defined as:** Shock exposure to visible light due to light intensity. Can occur at low temperatures (17°C).
- **How it happens:** Risk factors include hand thinning, tree training, selective picking, summer pruning, branch movement and postharvest transit.
Photo-oxidative sunburn has been seen across the province (particularly in 2026) in areas that have had 'overcast' conditions due to the smoke, with a sudden break and intense sunlight could have led to fruit sunburn.
- **What happens to the fruit:** Bleaching and eventual darkening of the peel.
- **Prevalence in Ontario:** Common. Although it is noted to have occurred after smoky conditions, it is more typically seen after leaf defoliation and summer pruning have been conducted.
- **Reference photo:** [Figure 5](#)



Figure 1. Sunburn necrosis 'Pink Lady'. Source: Racsko, J., & Shrader, L. 2012.



Figure 3. Sunburn browning on Ambrosia, July 14, 2026.



Figure 2. Sunburn browning using the Schrader and McFerson System. Higher values mean greater damage (0 = none, 5 = necrosis). Source: Shrader, 2015.



Figure 4. Severe sunburn browning leading to necrosis of the fruit on Honeycrisp apples.



Figure 5. Photo-oxidative sunburn on Honeycrisp. The lower apple was exposed to light due to recent leaf defoliation.



Sunburn Prevention Techniques

If your orchard is exposed to conditions that could increase sun damage risk, such as high sunlight, extreme weather (drought/heat), or certain management practices, proactive protection is key. Waiting until symptoms are visible often means the damage has already occurred. Keep your orchard chill by using the protective methods listed below.

Evaporative Cooling

Use overhead sprinklers or misters during peak heat hours to reduce canopy and fruit surface temperatures. Especially useful to prevent sunburn on fruit. Overhead irrigation works by reducing the air temperature due to water vapourization.

Evaporative cooling has been scientifically proven to decrease fruit surface temperatures (by up to 8.5°C) and reduce sunburn damage incidence, but it does not reduce UV radiation – meaning that sunburn browning can still occur, along with photo-oxidative sunburn.

Evaporative Cooling	
Pros	• Decreased fruit surface temperatures • Reduced sunburn incidence • Effective during extreme heat events
Cons	• Expensive to install, maintain and operate • Access to water source (high volume requirement) • Water mineral deposits could be left on fruit • Timing is critical in efficacy of sunburn reduction

Protective Netting

Overhead netting reflects/absorbs sunlight and can reduce the impact of sun on exposed fruit. Colour of the net can influence growth, colour and quality of fruit (positivity or negatively), but can also prevent wind and/or hail damage.

Variable amounts of sunlight will be transmitted through the netting, where crystal white netting allows 95% and black netting allows 78%. This can vary significantly depending on the weave, material and colour of the netting.

Fruit surface temperature has been scientifically shown to be lower under protective netting, ranging between a 5°C – 10°C decrease.

Protective Netting	
Pros	• Decreased fruit surface temperatures • Reduced sunburn incidence • Can reduce effects of wind / hail damage • Net can influence growth, colour and quality
Cons	• Reduced red colour development • Expensive to install • Additional cost for deployment of netting • Learning curve for deployment and removal • Net can influence growth, colour and quality

Sprayable Sunburn Protectants*

Sprayable sunburn protectants use the application of material(s) on fruit to create a physical barrier that either block, reflect or scatter sunlight, depending on the product formulation. Kaolin clay, calcium carbonate or talc sprays are commonly used in apples to effectively lower fruit surface temperatures. These often require reapplication but can be utilized for spot treatments.

Kaolin clay products have been scientifically proven to reflect UV-B radiation but have also shown to reduce fruit size and colour. Calcium carbonate products have shown to reflect visible light, but not as effectively as kaolin clay products. Limited research has evaluated the reflectance properties of calcium carbonate and talc sprays across different types of radiation

**Most sunburn protectants have limited compatibility for tank-mixing with other products; consult product labels regarding best practices for product use.*

Sprayable Sunburn Protectants	
Pros	• Spot treatment (flexible and targeted use) • Less expensive than permanent infrastructure • Could be combined with other methods for sunburn prevention
Cons	• Could affect fruit size and colour • Not as effective as other options for fruit sunburn prevention • Reapplication is often required • Coverage is critical and timing can be uncertain • May be a hindrance for packer due to residue

*This article is not intended to be an endorsement or recommendation for a particular product or products but rather a **sharing of information.***



Dry Spell? Play It Cool

As heat stress can increase the occurrence of sun damage, it is important to be mindful of management practices that may either increase or reduce sunburn risk. The grower-controlled factors outlined below can **indirectly support sunburn prevention** either through moisture conservation, tree health and/or moderation of soil temperatures.

Adequate Moisture

Consistent moisture helps maintain cell turgor, supports active photosynthesis, and allows for active vascular system activity, which in turn prevents fruit shrivel and sunburn.

Irrigation: specifically, during dry periods is crucial in high-density apple orchards, where limited root zones and closely spaced trees increase vulnerability to heat stress.

- Drip irrigation: precision management and improved efficiency compared to overhead irrigation. Drip irrigation is preferred due to a reduction in evaporation.
- Pulse Irrigation: requires an automated system where water is applied in short, repeated intervals rather than one long, continuous session. Although not scientifically proven to decrease sunburn incidence, pulse irrigation can aid in maintaining a more consistent soil moisture and tree water status, supporting transpiration cooling to moderate fruit surface temperatures.

For best management practices for irrigation management, practical calculations and drip irrigation information, check out the following links:

- [Irrigation Best Management Practices](#)
- [Drip Irrigation Scheduling](#)
- [Using ET Data to Make Irrigation Decisions](#)
- [Irrigation Scheduling for Fruit Crops](#)
- [Irrigation Timing in Fruit Crops](#)
- [3 Secrets of Irrigation](#)

Under Tree Mulching: organic mulches help retain soil moisture and reduce surface temperature beneath the tree canopy. Examples include:

- Grass clippings: proven to conserve moisture and moderate soil temperatures, although it can decompose quickly and promote certain pests.
- Straw mulch: is excellent at moisture preservation but could introduce weeds and harbour pests.
- Wood chips: moderates soil temperatures and provides good moisture retention but has a higher price and can immobilize nitrogen near soil surface.
- Living mulches/groundcovers: include an array of crops (grasses, legumes and broadleaves), which have been shown to reduce erosion and improve soil infiltration but can compete with trees for moisture. For more details check out [Cover Crops in Apple Orchards: What You Should Know](#) in the 2024 Spring release of ONcore (Vol 28:2).

Field Activity Adjustments

When able, during a heat stress event, delay non-urgent tasks like pruning/leaf defoliation or heavy equipment use until cooler periods occur. Avoid applying stress-inducing sprays during peak heat periods and take note of field activities that could prevent sunburn on fruit:

- **Summer Pruning & Leaf Defoliation:** exposes fruit which can be detrimental during heat waves, further increasing sunburn risk, specifically photo-oxidative sunburn. Delay if possible and only perform on cool days with 3 or 4 days of cool weather following.
- **Summer Hand Thinning:** also exposes fruit to the elements, follow summer pruning and leaf defoliation strategies.
- **Harvest Management:** consider harvest timings and fruit exposure when harvesting to further prevent sunburn incidence.
 - Mature fruit exposure: minimize time that mature fruit are exposed to severe weather, either through prevention methods listed in the previous section or by harvesting.
 - Selective harvest: can expose fruit that were previously shaded, take note of this if hot temperatures and strong light are forecasted.
 - Harvested fruit: move fruit quickly out of the sun, preferably into storage as soon as possible to prevent sunburn in the bin.



Nutrient Support

There is strong evidence suggesting that certain nutrients could aid indirectly in sunburn prevention, either through tree water relations, drought tolerance and/or physiological resilience. The main nutrients to focus on are potassium and calcium, although there is emerging research suggesting that boron, magnesium and zinc could also support fruit sunburn prevention. Ensure there are adequate levels of potassium and calcium available to the tree to help with plant stress tolerance and fruit integrity. Foliar feeding could be used when uptake through the roots is impaired.

Monitoring & Record-Keeping

Use soil moisture sensors, weather stations and scouting to make timely and proactive decisions. Track growing degree days and stress days to refine your response year to year based on yields, culls, economics and quality of fruit.

Sunburn Summary

- Sunburn can occur at various temperatures and is affected by many environmental factors.
- Sunburn damage does not need an extreme event to occur on apple fruit in Ontario (see Figure 6).
 - Consider proactive prevention methods if sunburn is of concern.
 - Sunburn can be more damaging to fruit if there is a week of cool, windy, overcast weather followed by a hot (over 30°C) calm day with full sunshine.
 - Water stressed trees are more prone to sunburn damage.

Resources & References

Ananthakrishnan, S., Sharma, J. C., Sharma, N., Kumar, S., Shankar, S. V., Ranjha, R., Lalkhumliana, F., Sharma, K., & Aravinthkumar, A. 2025. Mulching and irrigation strategies for climate resilient apple cultivation in high-density orchards. *Scientific Reports*, 15:1, Article 17125.

Hannam, K. D., & MacDonald, J. L. 2023. Tools for climate resilience in tree fruit II: a calcium carbonate-based foliar spray showed potential for protecting fruit quality during an unprecedented heat event. *Canadian Journal of Plant Science*, 103:2. 228–232.

Air Temperature	Risk Level	Meaning
 ≥ 40°C	 HIGH RISK OF SUNBURN NECROSIS	Extreme heat can cause sever cell damage and tissue death on the sun-exposed side of the fruit
 ≥ 35°C	 HIGH RISK OF SUNBURN BROWNING	High temperatures can cause browning of the skin and deeper tissue without cell death.
 30 to 35°C	 VARIABLE RISK, DEPENDING ON OTHER RISK FACTORS	Risk is influenced by factors such as sun exposure, fruit orientation, cloud cover, humidity, wind and orchard management
Negligible	 PHOTO- OXIDATIVE RISK, DEPENDING ON LIGHT	Risk is solely determined by sun exposure and fruit acclimation to the environment.

Figure 6. Sunburn damage risk levels of apples in relation to air temperature.

Are you interested in a **sunburn protection model**?
If so, reach out to Erika through email or phone
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Racsko, J., & Shrader, L. 2012. Sunburn of Apple Fruit: Historical Background, Recent Advances and Future Perspectives. *Critical Reviews in Plant Sciences*. 31:6. 455–504.

Shrader, L., Zhang, J., & Sun, J. 2003. Environmental Stresses that Cause Sunburn of Apple. *Acta Horticulturae*, 618. 397–405.