WASHINGTON STATE UNIVERSITY
EXTENSION

Apple Sunburn

Sunburn damage costs apple growers tens of millions of dollars annually and is often the primary cause of fruit cullage for apples grown in the Pacific Northwest. Growers often lose more than 10% of their apples to sunburn unless they have used some means of protecting their fruit from sunburn damage. There are four types of apple sunburn: (i) Sunburn Necrosis, (ii) Sunburn Browning, (iii) Photo-Oxidative Sunburn, and (iv) Storage Sunburn. Apple fruit are susceptible to sunburn because they have a much higher thermal mass (the ability of a material to absorb and store heat energy) than leaves and are not able to dissipate this heat as effectively as leaves. It is important to remember that fruit temperature can be considerably higher (20 - 30°F) than the ambient air temperature.

Sunburn Necrosis occurs when fruit surface temperature (FST) exceeds 125°F for as little as 10 minutes, causing cell death and brown or black lesions. This type of sunburn can be exacerbated by low humidity.

Sunburn Browning is caused by a combination of UV-B radiation and high fruit surface temperature (115 – 120 °F, depending on variety). Risk parameters for sunburn browning are maximum daily air temperature and mean maximum hourly temperature between 11 am and 5 pm. WSU DAS has a model for sunburn browning available. Sunburn browning is the major type of sunburn in Washington. A yellow, bronze or brown spot develops on the sun-exposed side of the peel, but may not appear for a few days.

Photo-Oxidative Sunburn is caused when the fruit experiences a shock exposure to visible light and the light bleaches the peel. This is temperature independent and can even occur when the air temperature is less than 64°F. Risk factors include hand thinning, selective picking, branch movement, summer pruning, and postharvest transit.

Storage Sunburn symptoms typically develop after harvest, within the first few months of cold storage. Fruit may appear completely normal at harvest, but can develop a brown discoloration during storage, especially on the sun-exposed side of the fruit. Much like other types of sunburn, storage sunburn is associated with exposure to excessive heat and light stress during the growing season.

While sunburn obviously affects the apple's external appearance, recent research has revealed that internal fruit quality is also affected in apples with even slight sunburn. Increased flesh firmness and sugar content have been noted in apples with sunburn browning at harvest and during storage, but titratable acidity (TA) decreased as severity of sunburn browning increased, especially throughout the storage season. TA is not only directly related to tartness in the taste of apples, but also provides the metabolic fuel for the development of most flavor components. Fruit with diminished acid levels are often considered bland and undesirable by consumers.

Effective strategies to mitigate sunburn damage and improve fruit quality are to reduce FST and/or UV-B light exposure to fruit. Growers in Washington have three basic options to achieve this goal: (i). Evaporative cooling (EC) (ii). Protective netting and (iii). Sprayable sunburn protectants. While these strategies have been proven to reduce apple sunburn incidence, none are 100% effective under extreme heat and light conditions. For maximum protection during severe weather periods, growers should consider a combination of strategies.

Evaporative cooling is very effective for lowering FST of apples, but EC alone does not adequately reduce damaging UV rays; thus, sunburn can occur even with EC. Protective netting may be deployed above the orchard canopy or draped directly over apple trees and has proven to be effective at reducing sunburn incidence, as well as conferring other benefits such as protecting against hail damage, reducing wind stress, and potentially excluding some invasive insect pests and birds.

Growers seeking immediate, temporary relief from sunburn pressure at lower up-front costs than installing an EC system or protective nets should consider the application of sprayable sunburn protectants. These products generally fall into one of three categories: (1) Kaolin clay-based particle films (e.g. Surround WP) (2) Calcium carbonate-based particle films (e.g. Eclipse, Diffusion, MicroCal), and (3) UV-blocking wax matrices (e.g. Raynox). When properly applied, most sprayable sunburn protectants can reduce sunburn symptoms by up to 50% in apple fruit. Wax-based products like Raynox may be used in combination with EC to achieve even greater protection from sunburn than either strategy alone. Since sunburn incidence is highest in unshaded fruit that are exposed to direct sun (typically in the tops of trees), good spray coverage to the upper portion of tree canopies is critical.

Some particle films, particularly those comprised of kaolin clay, can be challenging to wash off the fruit surface during packing and growers should consult with their warehouse before using these products aggressively near harvest.

NOTE: Most sunburn protectants have limited compatibility for tank-mixing with other products; carefully consult individual product labels regarding options for tank mixing and best practices for product use.

	Chemical	Rate per Acre	Notes
Apple Sunburn	**calcium carbonate** Diffusion	2 - 4 gal	Apply prior to heat event and repeat every 2-3 weeks as needed. Residue removal on the packing line may be improved by acidifying rinse water to pH 5.5 or below.
	calcium carbonate Diffusion O	2 - 4 gal	Apply prior to heat event and repeat every 2-3 weeks as needed. Residue removal on the packing line may be improved by acidifying rinse water to pH 5.5 or below. **Organic**
	calcium carbonate Eclipse	2.5 - 3 gal	Re-apply as needed to maintain adequate coverage as fruit grows.
	calcium carbonate Mask	2 - 4 gal	Apply prior to heat event. Reapply every 12-21 days as needed to maintain coverage.
	calcium carbonate Mask O	2 - 4 gal	Apply prior to heat event. Reapply every 12-21 days as needed to maintain coverage. **Organic**
	calcium carbonate Microcal	2.5 - 3 gal	Re-apply as needed to maintain adequate coverage as fruit grows.
	calcium carbonate Oasis O	2 - 4 gal	Apply prior to heat event and repeat every 2-3 weeks as needed. Residue removal on the packing line may be improved by acidifying rinse water to pH 5.5 or below. **Organic**
	fruit protectant Parka	1 gal	Do not mix with or spray near applications of Captan, sulfur, lime sulfur, oil, or surfactants. Consult product label for more information.
	calcium carbonate Purshade	2 - 3 gal	Apply 3-10 days before heat event and repeat every 2-4 weeks as needed. Do not spray to runoff.
	fruit protectant Raynox	2.5 gal	Follow manufacturer's label, and apply 2.5 gal. RAYNOX in either 50 or 100 gal. water conditioned with RAYNOX water softener (according to label). To maintain good coverage of fruits as they expand, four applications should be made: first about 7 weeks after full bloom; 2nd 10 days later; third 3 weeks later; and fourth 4 weeks later. Do not apply when air temperature exceeds 85 deg F.
	fruit protectant Raynox Organic Sunburn Protectant	3 gal	Mix 3.0 gal RAYNOX ORGANIC in 47 or 97 gallons of water (no RAYNOX water softener is needed). Four applications should be made as described above for RAYNOX. **Organic**
	fruit protectant Raynox Prime		Follow manufacturer's label, and apply 2.5 gal. Raynox Prime in either 50 or 100 gal. water per acre. To maintain good coverage of fruits as they expand, four applications should be made: first about 7 weeks after full bloom; 2nd 10 days later; third 3 weeks later; and fourth 4 weeks later. Do not apply when air temperature exceeds 85 deg F.
	kaolin clay Surround WP	25 - 50 lb	Follow manufacturer's label. At least three applications are recommended. Do not apply any substance with or on top of particle film sprays that will increase the difficulty of removal. **Organic**

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