BC FoodWeb

Peer-reviewed research

Improving red colouration in Honeycrisp apples under protective netting

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KEY TAKEAWAYS

We found 2 strategies to improve fruit colouration in Honeycrisp apples that are under protective netting:

- **1. Timing of net retraction improves red colour:** Retracting protective nets 10 days before harvest increased the proportion of Honeycrisp apples meeting the "Washington Extra Fancy" standard (>33% red coverage) compared to leaving nets on until harvest.
  - **Sunburn risk with early exposure:** While early net retraction improves colour, apples can be susceptible to sunburn if temperatures exceed 40 °C prior to harvest.
- **2. Reflective groundcovers enhance colour under netting:** Installing reflective groundcover (woven plastic "Extenday" or reflective film "Mylar") under protective nets increased the proportion of fruit with >25% red colour by improving light exposure.
- **No negative impact on yield or fruit size:** Since they were applied during final fruit maturation, both net retraction and reflective groundcover did not affect fruit weight or yield.
- These studies highlight the benefits of investing in additional materials for high-value apple varieties that rely on sun exposure for colour development.

How can this research be used?

- Growers using protective netting in apple orchards can adopt either of these strategies to minimize sunburn and improve red colour development in bi-coloured apples.

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Production Type
- Tree fruit

Practice Benefit(s)
- Improved fruit colouration

Research Location
- Washington, USA

Key Terms
- *Protective netting:* A mesh covering used to shield crops from pests, birds, excessive sun, and hail while allowing adequate sunlight and airflow.
- *Netting retraction/retractive netting:* The practice of placing and removing nets as needed, allowing control over when to protect or expose crops to environmental conditions.
- *Reflective groundcover:* material placed on the ground below trees to redirect light back to the canopy to improve fruit colour development.

- Having multiple strategies available to growers offers **flexibility** in choosing the most suitable option for high-value apple varieties based on cost, labour, farm size, and other operational factors or preferences.
- Neither of these strategies negatively affected fruit quality or yield on farms that use protective netting.

Why was this research done?

Apples grown in semi-arid regions (relatively dry regions with 25-50 cm of rainfall per year) are vulnerable to sunburn from intense sunlight and high temperatures, often resulting in fruit loss. Growers in Washington, USA have been adopting protective netting to reduce sun exposure and damage from hail, insects, birds, and other environmental factors. Nets block some of the sunlight, preventing the surface of fruits from getting too hot. However, reduced light exposure also limits red colour development in bi-coloured apples like Honeycrisp, Gala, and Ambrosia. This tradeoff presents a challenge for growers since red colouration is a key quality standard that determines grade and marketability. We conducted these two studies to identify strategies to maintain good red colour development in Honeycrisp apples grown under netting.

These strategies include:

- **Netting retraction**
  - Protective netting was removed 10 days before harvest to allow full light exposure
- **Reflective groundcover**
  - Two types of materials were tested, a woven plastic fabric (Extenday) and reflective film (Mylar)

Figure 2. Reflective ground cover Extenday (left) and Mylar (right) between orchard rows. Photos by Lee Kalcsits.

What was the outcome?

Benefits of protective netting

Protective netting effectively reduced severe sunburn damage. In 2021, both partial and full netting **reduced sunburn incidence by ~9%** compared to unnetted trees, with similar trends observed in 2022. Netting lowered the maximum fruit surface temperature by 2.5 °C compared to unnetted trees. Also, **unnetted trees had more than twice the amount of severely sunburned fruit** (7%) compared to netted trees (3%).

Figure 3. Sunburned Honeycrisp apple. Photo by Lee Kalcsits.

Netting retraction

Net retraction **significantly improved red colour development without compromising sunburn protection**. Average red colour coverage was not different between trees with retracted netting and unnetted trees, but trees with **retracted netting had a higher percentage of fruit qualifying for Washington Extra Fancy grade** (>33% red skin) (Figure 4). Apple trees with nets left until harvest had the **lowest** red colour coverage. The number of sunburned apples was about the same whether nets were retracted (3%) or left until harvest (2.3%) (Figure 5)

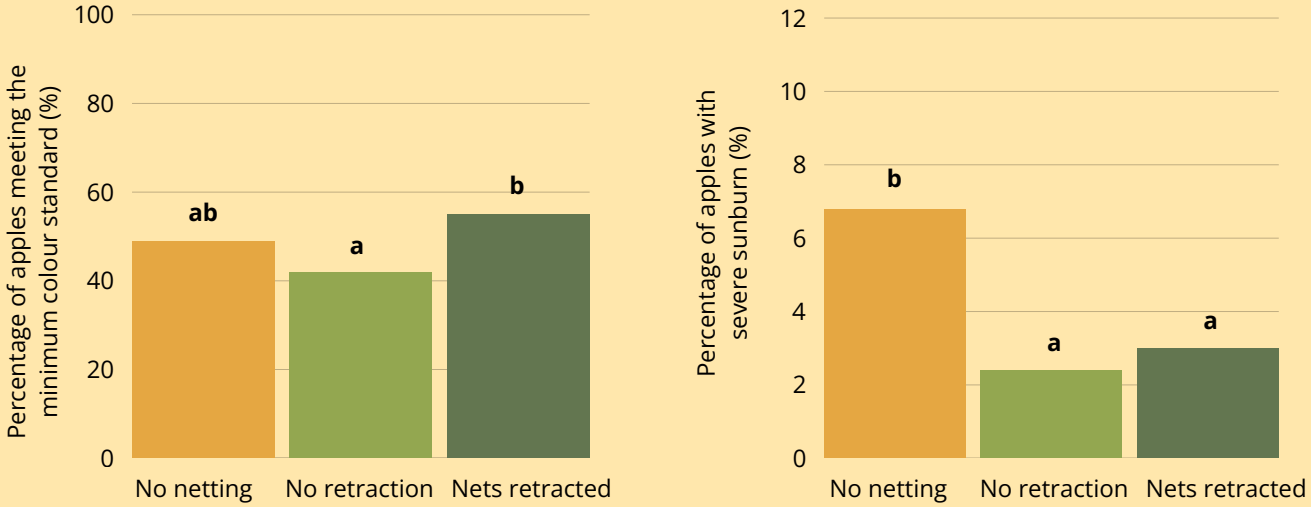

Figure 4. Average percentage of Honeycrisp apples meeting Washington Extra Fancy standards for red colour coverage in 2022 **(left)** and average percentage of apples with severe sunburn in 2022 **(right)** with no netting, netting deployed until harvest, or nets retracted 10 days before harvest. Bars that are marked with different letters (a or b) are statistically different.

Reflective groundcover

Reflective ground cover placed under protective netting improved red colour development by redirecting light back into the canopy. **Both** the woven plastic (Extenday) and reflective film (Mylar) **increased red colour coverage compared to having no cover (grass)** (Figure 5).

Because both reflective materials were installed later in the season during fruit maturation, they did **not negatively affect yield or fruit weight over the two-year study**. However, sunburn incidence was **higher** in trees with reflective film (Mylar) than in those with woven plastic or grass, likely because it's more reflective.

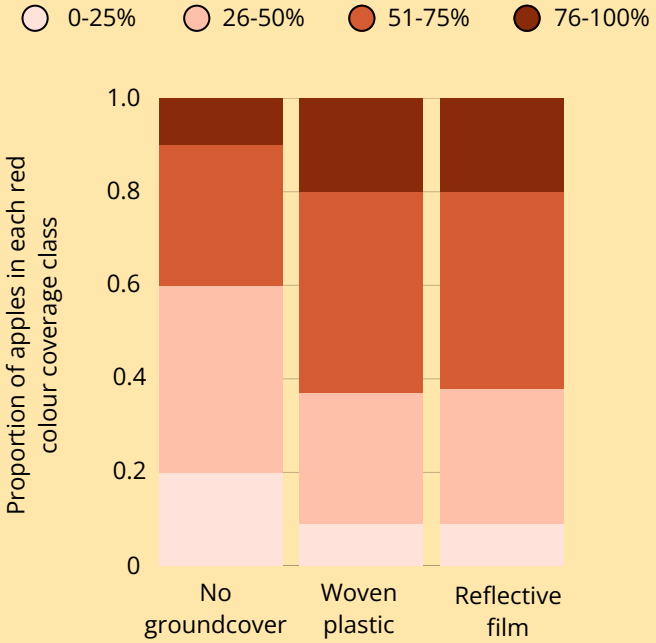

Figure 5. Proportion of Honeycrisp apples in each red colour coverage class at harvest for trees grown under protective netting with two types of reflective groundcovers compared to no groundcover (grass)

What's next?

These studies demonstrate effective strategies for protecting apples from sunburn while maintaining desirable red colouration under protective netting. However, adoption can be challenging due to the cost of netting and the limited information available to producers, particularly for British Columbia, where few studies have evaluated these practices. Developing protective netting strategies based on multi-site, multi-year research will be critical for enhancing climate resilience and providing practical guidance for apple production across British Columbia.

How was the research done?

Netting retraction

We conducted this study in 2021 and 2022 at Washington State University on 'Firestorm' Honeycrisp apple orchards. The trees had been regrafted in 2016 onto M9-T337 rootstocks with a 'Granny Smith' interstem. We planted the trees 3 feet apart within rows, with 12 feet between rows.

We tested three netting treatments:

- No netting
- Netting left on until harvest
- Netting removed 10 days before harvest

Each treatment was repeated three times, with one row of 12 trees per treatment. We installed the nets in early June using a custom-built system. The woven plastic nets (Extenday) blocked 20% of sunlight and were draped over single rows using three wires: one above the row and two on either side. Carabiners made it easy for us to remove or adjust the nets from the ground.

In 2021, we pulled the nets back on August 18 and harvested the apples 10 days later on August 28. In 2022, we removed the nets on August 29 and harvested them on September 8. For two weeks after removing the nets, we monitored the surface temperature of four south-facing apples on each tree in every replicate. At harvest, we graded the fruit by hand for sunburn and severity, and then ran the apples through an AWETA sorting line to measure fruit weight and red colour coverage.

Reflective groundcover

We conducted this study in a commercial five-year-old 'Cameron Select' Honeycrisp apple orchard near Quincy, Washington. The trees were grafted onto 'Budagovsky 9' rootstock, spaced 2 feet apart within rows and 12 feet between rows, and trained on a V-trellis system. We followed standard orchard practices throughout the study, including irrigation, bloom, hand thinning, pruning, pest control, and fertilization.

This farm first began using protective netting in May 2015 after bloom and pollination, removing it each October. For this study, we installed 17% white nets 1 metre above the tree canopy in late June 2018 and mid-May 2019. We tested three ground cover treatments: woven plastic (Extenday), reflective film (Mylar), and grass (no cover). We installed the Extenday five weeks before harvest and the Mylar two weeks before harvest. Each treatment covered four adjacent rows, 3 meters wide and 18 meters long, for a total of 40 trees. We harvested apples on September 4, 2018, and September 6, 2019. We then evaluated sunburn incidence and fruit quality traits, including fruit weight, colour, starch, firmness, and bitter pit.

About this brief

This brief was prepared by Nisa Chavez and Juliana Cao from the BC Food Web team, with the help of Lee Kalcsits, and is based on the following scientific journal articles:

- Mupambi, G., Valverdi, N. A., Camargo-Alvarez, H., Reid, M., Kalcsits, L., Schmidt, T., Castillo, F., & Toye, J. (2021). Reflective groundcover improves fruit skin colour in 'Honeycrisp' apples grown under protective netting. *HortTechnology, 31*(5), 607-614. https://doi.org/10.21273/HORTTECH04776-20
- Willsea, N., Blanco, V., Howe, O., Campbell, T., Biasuz, E. C., & Kalcsits, L. (2023). Retractable netting and evaporative cooling for sunburn control and increasing red colour for 'Honeycrisp' apple. *HortScience, 58*(11), 1341-1347. https://doi.org/10.21273/HORTSCI17339-23

Want to learn more?

For any questions regarding this research, contact Lee Kalcsits at lee.kalcsits@wsu.edu

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Funding for this research was provided by Washington Tree Fruit Research Commission (2018-2019 and 2021-2022). This research was conducted by Washington State University and the Washington Tree Fruit Research Commission.

Funding for this research brief is provided by the Government of British Columbia through programs and initiatives delivered by the Investment Agriculture Foundation of BC.