ISSUE2203

FACTSHEET

POTATO BRUISING AND MANAGEMENT

POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

By Dr Jenny Ekman

KEY POINTS

- Bruising is the development of melanin produced after an impact
- Bruises develop over time; it can take hours or even days for the bruise to fully develop
- Variety, drop height, temperature, and irrigation prior to harvest all influence bruising
- The two main ways to reduce bruising are to improve resistance to bruising and avoid mechanical injury

WHAT IS A BRUISE?

Bruises develop due to impacts that either break the cells apart (shatter bruise) or rupture the cell membranes (blackspot). Shatter bruises appear as cracks on the tuber skin, which can extend into the core of the tuber, making it an easy entry point for fungi and bacteria.

Internal cell membranes normally keep phenolic compounds separate from reactive enzymes. Blackspot occurs when the internal cell membranes are ruptured, and the phenolic compounds and enzymes mix and oxidise (Figure 1). This oxidation of the mixture (ortho-quinones) results in the formation of the pigment melanin.

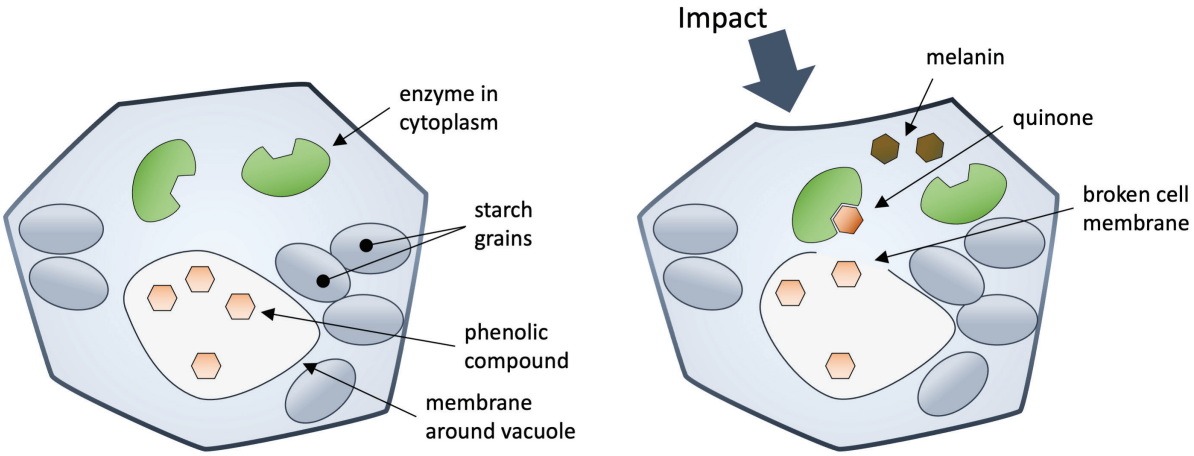

Figure 1. Intact potato flesh cells (left) contain phenolic compounds and oxidising enzymes, kept separate by internal cell membranes. An impact (right) can rupture this internal membrane, allowing mixing. Through oxidation, this eventually gives rise to the dark compound melanin, typical of blackspot.

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HOW BRUISES DEVELOP OVER TIME

Potato skin is made up of small, corky cells that resist damage and protect the pulp. However, the swollen, starch-laden cells that make up the pulp are more fragile. It is the membranes of these cells that fracture most easily.

The oxidisation reaction that produces melanin is not instantaneous. Bruises continue to darken over hours or even days (Figure 2). Initially, the damaged area develops a pinkish colour – possibly due to the formation of ortho-quinones from the oxidised phenolics. This gradually oxidises into melanin (Figure 3).

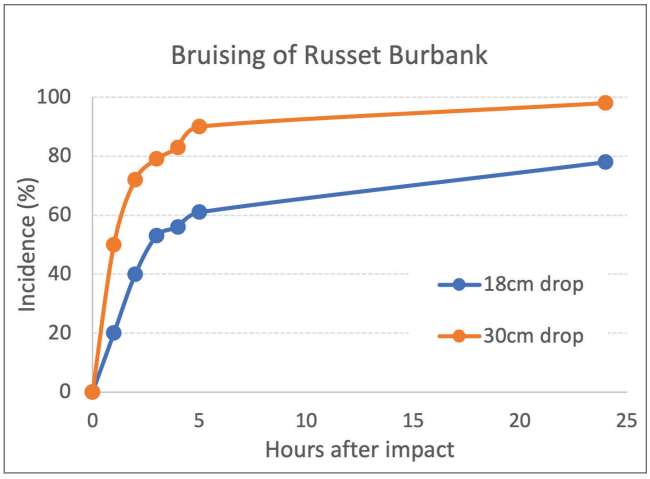

Figure 2. Blackspot development in Russet Burbank potatoes. Data extracted from Olsen and Thornton

INFLUENCING FACTORS

Just as phenolic content varies between cultivars, so does the speed at which the bruise expands and darkens. Temperature and force of impact also play a role. However, regardless of these external factors, most internal bruising becomes obvious within 3-5 hours of impact (Figure 3).

IMPACT

Resistance to both shatter-bruises and blackspot varies considerably between cultivars (Figure 4). Other variables include soil moisture, temperature, and specific gravity. Depending on their structural qualities, a variety may be relatively resistant to blackspot but susceptible to shatter, or vice-versa.

TEMPERATURE

Temperatures between 12 and 18°C are often considered best for harvesting potatoes. Potatoes are less susceptible to bruising at moderate temperatures rather than temperatures over 25°C or below 12°C. This is also reflected in the drop heights that can be tolerated.

Temperatures of dry soils usually approach air temperatures; under warm conditions, soil (and the tubers it contains) can be cooled through more frequent irrigation.

Figure 3. Bruise development over time

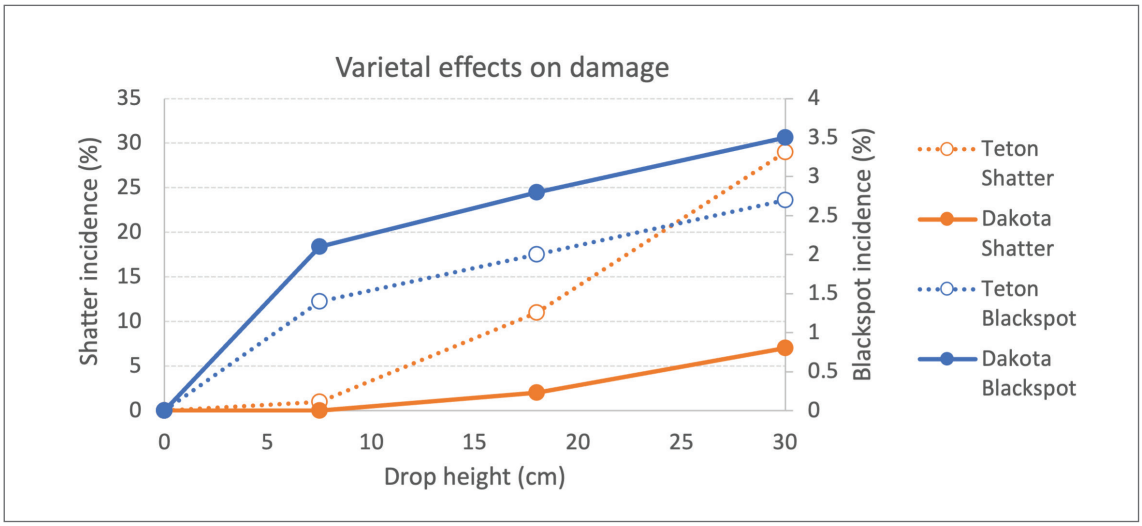

Figure 4. Dakota is more resistant to shatter but has greater susceptibility to blackspot than Teton. Data from Olsen and Thornton.

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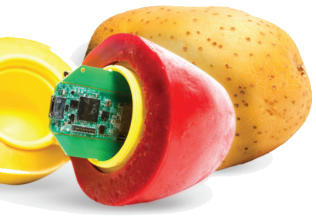
IRRIGATION

Irrigating a few days before harvest also ensures tubers are well hydrated, another factor that reduces susceptibility to bruising. However, very high levels of soil moisture can make potatoes more susceptible to shatter bruising. The general recommendation is that soils should contain 60–80% available soil water at harvest.

DROP HEIGHT AND TEMPERATURE

The drop height required to cause bruising changes with temperature. For example, Mathew and Hyde estimated that the drop heights (onto steel) likely to cause a blackspot bruise in 10% of Russet Burbank tubers were 25 mm at a tuber temperature of 10 °C, 30 mm at 15.5 °C and 50 mm at 21°C. While this suggests that 21°C is optimal for harvest, the risk of increased disease at this temperature (and higher) likely outweighs any possible benefits from reduced blackspot.



Western Australian researchers conducted similar tests on Ruby Lou and Nadine potatoes, linking bruise damage at 10 and 15°C to impact forces and recorded using a "SmartSpud" (Sensor Wireless Inc.) datalogger.

In this WA study, Nadine proved to be more easily bruised than Ruby Lou, with most damage at 10°C compared to 15°C (Figure 5). Also clear from these results is the increased bruising of both types, regardless of temperature, once heights exceeded 50 cm.

A 50 cm drop corresponded with a value of 218 G recorded with the SmartSpud. Royal Blue tubers were more susceptible to bruising than both Ruby Lou and Nadine, with 10% of tubers damaged by a mere 30 cm drop.

REDUCING THE RISK OF BRUISING

There are two broad strategies for preventing blackspot, some of which begin even before planting:

1. Improve resistance to damage and
2. Avoid mechanical injury.

Improve resistance to damage

- Choose varieties with low susceptibility to bruising
- Do not over fertilise with nitrogen, especially late in the season: High vine nitrate readings are associated with increased susceptibility to blackspot
- Manage the crop to keep it as uniform as possible
  - Uneven growth will result in under-mature/ overmature tubers, which are more prone to damage

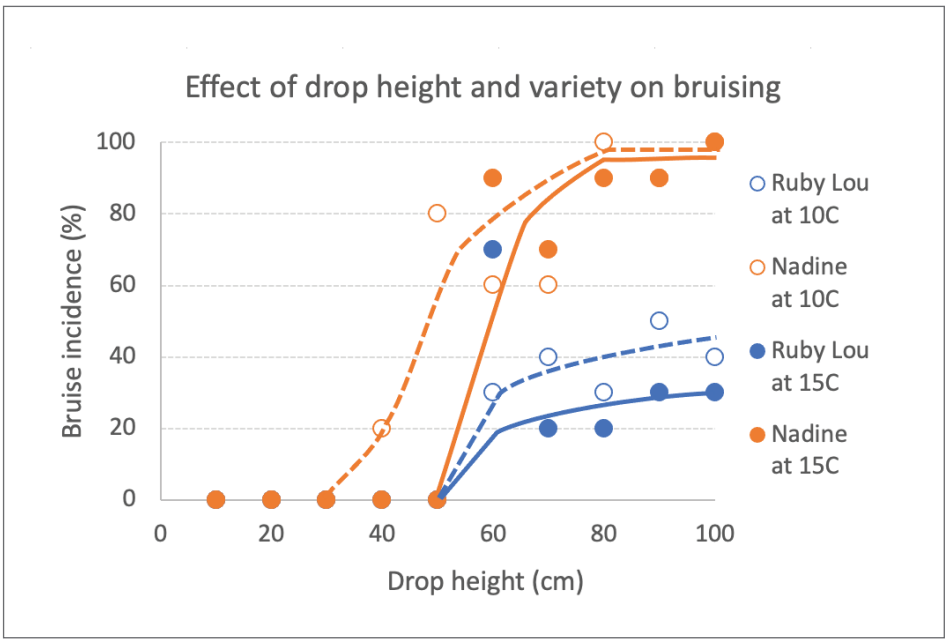


Figure 5. Incidence of bruising of Nadine and Ruby Lou potatoes dropped 10–100cm at either 10°C or 15°C. Lines indicate approximate best fit to data, with the exception of the outlying value at 60cm for Ruby Lou. Data from Dawson and Johnstone, 2016.

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- Uniform stands also mean uniform flow through the harvester, reducing impacts on hard surfaces
- Control diseases that can cause premature vine death

- Kill tops before more than 50% of vines have died and wait at least 14 days before harvesting
- Avoid harvesting during hot conditions
- Ensure soil is moist at harvest, especially if the weather is hot
- If harvest must be carried out at high temperatures, consider how the tubers can be cooled to remove field heat

Avoid mechanical injury

- Use cover crops or rotations that improve soil organic matter and deep rip to break up hard pans, as this will reduce crust formation and creation of damaging clods
- Further reduce clod formation by avoiding ploughing, discing, or cultivating soil while wet
- Remove rocks and stones from the field
- Angle the digger blade at the front of the primary conveyor so that tubers are lifted onto the chain/web, not jammed into it
- Adjust the harvester speed so that the conveyors are kept around 85% full
  - If speeds are too slow, tubers will pile up and be forced against the sides; too fast and tubers can roll around, hitting more hard surfaces
  - Suitable conveyor speed to ground speed ratios are estimated at 1.0 to 1.2 in sandy soil, but 1.2 to 1.5 in heavier soil
- Cover conveyor support bars with padding to reduce impacts
- Use deflectors to divert tubers away from the sides of the de-viner, chain link ends and sorting table
- Minimise use of agitators and conveyor shakers to dislodge soil
- Minimise drops between different conveyors, particularly from the end of the boom conveyor into the truck, trailer, or bins

The easiest way to find out where damage could be occurring is using an impact recorder. Once identified, the drop may be reduced and/or cushioning added. Running the recorder through the line again can show whether the modification has been successful.

Figure 6. Harvesting potatoes at Aaron Haby's farm

FURTHER READING/RESOURCES

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