Better blueberries

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Who doesn't love blueberries? This is the fruit with everything – tastes great, superfood nutrition, useful in dishes from cakes to salads and all in a convenient, non-messy package that children adore. Bigger and better tasting varieties have seen the category explode in the last few years. As a result, both production and consumption have risen dramatically.

According to the Australian Horticultural Statistics Handbook [1], we are each now consuming nearly 3/4 kg annually, more than double the consumption of only 4 years ago. Despite this surge in demand, prices have tended to decline. While the graph below indicates an average price of $18/kg, during peak production prices can be much lower than this.

As more large plantings come online, it seems probable this trend will continue. Good news for those who love eating blueberries, but not so good for growers. In contrast, prices can rise to $8.00 per punnet during short supply periods, at which point many people (me included) simply stop buying.

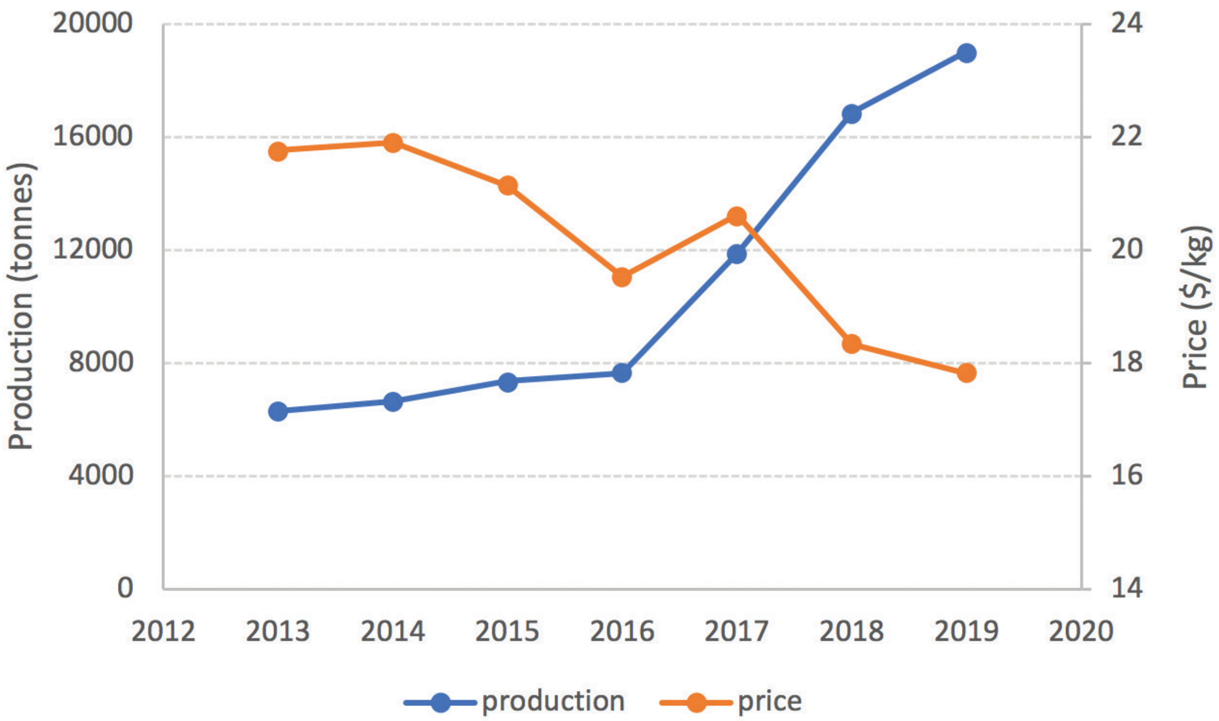

Figure 1. Changes in production volume (tonnes) and average price ($/kg) of blueberries since 2013. Data from the Australian Horticulture Statistics Handbook 2018/19.

Finding new markets is the best way to stabilise prices. New markets could be either in time (storing at peak times to flatten the supply curve) or in place (export destinations). Certainly, exports have increased, rising from 62 tonnes in 2013 to a high point of 356 tonnes in 2017, followed by a slight decline to 201 tonnes last year.

Getting blueberries to new markets in good condition means finding ways to optimise storage life. One option to achieve this is through the use of sulphur dioxide (SO_2) release sheets. These are commonly used to control grey mould (*Botrytis cinerea*) on stored table grapes. As it happens, *Botrytis* is also the key disease affecting blueberries.

The technique is not particularly new – researchers from California [2] first promoted the benefits of SO_2 fumigation on blueberries in 2012. Combinations of SO_2 with modified atmosphere packaging [3] have proven particularly effective. More recently, USDA researchers investigated the use of lightly vented (0.1% to 0.9% surface area) SO_2 release liners on blueberry storage life. The best results were gained when SO_2 was combined with a modified atmosphere bag accumulating approximately 5% CO_2 inside the package. In this trial, an SO_2 sheet with no liner was ineffective [4].

One negative of SO_2 treatment is that it can cause berry bleaching (Figure 2). As with grapes, this develops as a pale, sunken or flattened area around the detachment scar. Finding the right treatment is therefore a balance between mould and bleaching.

Figure 2. Slight (top) and severe (bottom) bleaching of blueberries.

Chile, which exports over 110,000 tonnes of blueberries annually, already uses SO_2 release sheets extensively, as does Peru. There is clearly potential for Australia to increase exports and extend current domestic supply using these same techniques.

But, how many sheets, and how do we make this work?

Our trials

We have conducted preliminary trials examining the effect of Berrisys® SO_2 sheets (*Berrisys is a registered trademark of Tessara Pty Ltd*) on storage and shelf life of packed blueberries. Sheets were added to the top layer of punnets or both the top and bottom layers. In the first trial, sheets were added immediately after harvest at the farm, while in trial 2 berries were simply sourced from wholesale for treatment.

Trial 1: Sheets added at the farm

Method

Berrisys sheets were added to either the top layer or both layers of punnets inside each tray as they arrived at the packhouse. The trays were forced air cooled and stacked, then cling-wrapped. The cling wrap was designed to replicate a wrapped pallet; wrapping treated pallets has been demonstrated to be an effective way to improve SO_2 effectiveness during extended storage.

The blueberries were transported and stored at 1-2°C for either 4 or 7 weeks. At each removal time the Berrisys sheets and wrapping were removed, and half of the punnets were assessed. The remainder were transferred to domestic refrigerators set at 4°C; to replicate how consumers would store them after purchase. These punnets were then assessed after 7 days (first removal) or 3 days (second removal).

To evaluate quality, berries were examined individually for mould, bleaching or softening. The weight of affected berries was used to calculate percentage defects per punnet.

Results

The blueberries used were excellent quality to start with and stored in a well-managed supply chain. As a result, the fruit still had no rots and minimal softening even after 4 weeks of storage at 1°C plus 7 days in the domestic fridge.

However, extending the storage time to 7 weeks exposed differences between the treatments. At this time, up to half of the berries in untreated (control) punnets were already rotten on removal. Similar levels of decay were observed after an additional 3 days in a refrigerator.

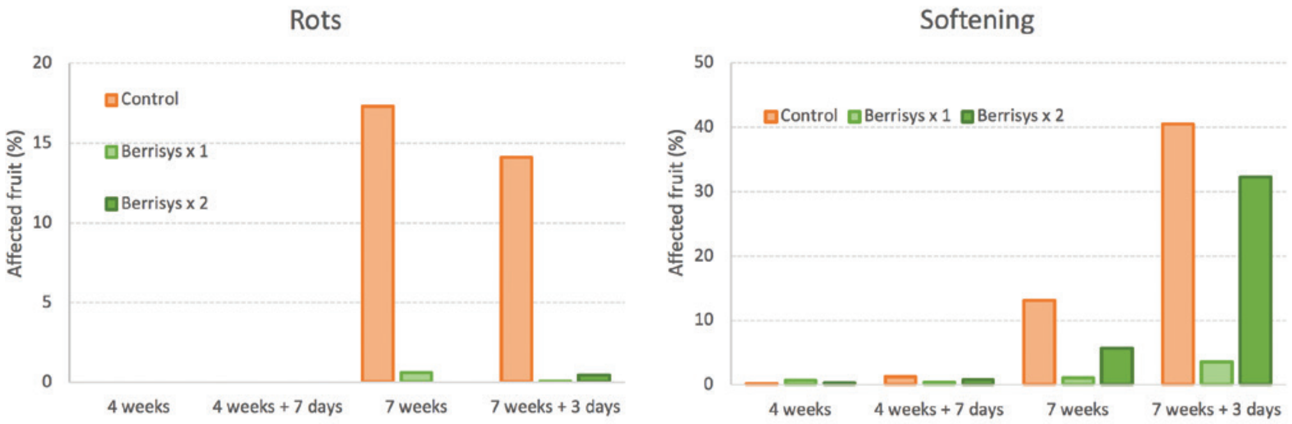

Figure 3. Development of rots (left) and softening (right) in wrapped trays of blueberries left untreated (control) or stored with 1 or 2 Berrisys SO_2 release sheets. Berries were assessed after either 4 or 7 weeks commercial storage followed by 7 days or 3 days in a domestic refrigerator respectively.

Figure 4. Condition of blueberries after 7 weeks commercial storage. Berries were left untreated (left) or a Berrisys SO_2 release sheet was added to the top layer only (centre) or to both layers of punnets inside the tray (right)

In contrast, both of the SO_2 treatments virtually eliminated rots. However, an increase in soft fruit was observed where SO_2 sheets had been placed on both layers of punnets, particularly after 3 days in the domestic fridge. This was due to an increased percentage of bleached berries in both layers; on average, 37% of berries had some evidence of bleaching.

While bleaching affected 23% of berries directly under a single sheet, the damage was much less severe. Moreover, less than 5% of fruit in the bottom layers of punnets had any bleaching in this treatment.

Conclusions

In this trial, a single SO_2 sheet placed on top of each tray at packing greatly extended storage life. This treatment almost completely prevented rots without causing unacceptable bleaching. Amazingly, fruit was still in acceptable condition after 7 weeks storage.

This is long enough to allow sea freight to Asian markets, or could be used to improve marketing flexibility for domestic supply.

Trial 2: Sheets added at wholesale

Method

Blueberries which had been packed two days earlier were purchased at Sydney Markets. As previously, the trays were left untreated, a single Berrisys sheet was placed on top of each tray, or Berrisys sheets were placed on top of both layers of punnets inside the tray. Half of the trays were wrapped as previously, the remainder remaining unwrapped.

The trays were then stored at 4°C in a general-purpose cold room. After two weeks, half of the punnets were removed and placed at 20°C for 24 hours before assessment. The remaining punnets were cold stored for an additional 2 weeks, then again assessed after a day at 20°C. Assessments included rots, bleaching and softening as previously described.

Results

Leaving trays unwrapped during the 4 weeks cold storage significantly increased weight loss. The effect was greatest in the untreated trays, as punnets in these had no protection against the relatively dry cold room air.

Despite reducing weight loss, wrapping increased the percentage of soft fruit in untreated control punnets. This was due to an increase in rots. However, the opposite effect was found when trays were topped with a single Berrisys sheet. In these trays, rots were consistently lower in the top layer of punnets, these being closest to the SO_2 sheet. There were more rots in the bottom layer of punnets, but still less than in the untreated controls; after 4 weeks, 5% in wrapped and 8% of fruit in unwrapped trays had visible rots, compared to nearly 15% of fruit in the untreated controls.

On average, both the single and double Berrisys treatments reduced decay compared to the untreated controls, with the best results when trays were wrapped. Unlike the previous trial, bleaching remained relatively low, affecting less than 6% of fruit in all treatments. It is possible that this is because the sheets were added when fruit were already cold, rather than still warm from the field, slowing release of SO_2.

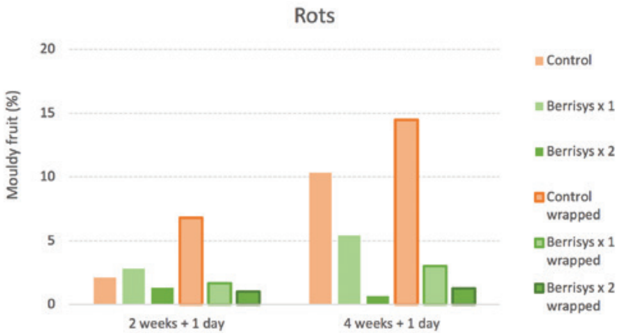

Figure 5. Development of rots in trays of blueberries left untreated (control) or stored with 1 or 2 Berrisys SO_2 release sheets. Trays were left as normal or wrapped with clingfilm to simulate pallet wrapping. Berries were assessed after 2 or 4 weeks cold storage + 1 day at 20°C.

Conclusions

Wrapping trays of blueberries before storage reduced moisture loss, but rots were increased. However, adding either one or two Berrisys sheets before the trays were wrapped reduced rots and extended storage life. If trays were not wrapped, then two Berrisys sheets were needed to extend storage life, as a single sheet did not control rots on the bottom layer of the tray.

Summary

These trials have demonstrated that a single Berrisys SO_2 release sheet on top of trays can reduce rots in blueberries, increasing storage life. The best results were gained when the sheets were added at the farm and trays were wrapped in cling film – simulating pallet wrapping. If the sheets are not added at packing, then one sheet per layer may be needed to provide similar control.

It was interesting to observe that the benefits of SO_2 treatment continued after the sheets were removed – as would occur once the trays are put on retail display. This would help ensure that consumers taking these blueberries home have a positive experience, not the disappointment of grey fluff at breakfast.

On the negative side, application of SO_2 sheets did cause some bleaching. An effective dose is a balance between being high enough to control Botrytis but not so much as to cause obvious damage. While difficult to integrate with normal practices, it may be possible to minimise bleaching by cooling fruit before adding the sheets.

Limited (although happily conducted) taste testing by the project team could not detect any off flavours in the SO_2 treated fruit. In contrast, a rotten berry is very definitely an unpleasant experience!

While SO_2 sheets are registered for application on blueberries, the use patterns tested here are not yet approved. Residue testing and confirmation of efficacy are still required. Nevertheless, these positive results hopefully bring this tool a step closer for Australian blueberry growers.

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applied horticultural research

Jenny is a postharvest physiologist and communicator who works to maximise produce freshness and value while minimising supply chain losses. She is passionate about applying science to improve commercial and consumer outcomes.

References

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