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Optimising GA_3 to improve fruit firmness in sweet cherries

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Improving sweet cherry firmness under netting and rain covers

Tasmanian sweet cherries are recognised internationally for their large size, firmness and eating quality. Firm fruit are particularly important for export markets, where cherries must maintain quality during storage and transport. Gibberellic acid (GA_3) is commonly applied in commercial orchards to improve firmness and fruit quality. However, there is still uncertainty around the optimal timing and application rate needed to consistently achieve the best outcomes under different growing conditions and protected cropping systems. This project, led by the Tasmanian Institute of Agriculture (TIA) in partnership with the cherry industry, and supported by Hort Innovation Frontiers with contributions from the Australian Government, is undertaking research to better understand how GA_3 affects fruit development and ripening in sweet cherry in both netting and rain cover systems.

Research questions: How high is too high?

The questions being asked for industry are:

- How does GA_3 improve fruit firmness in Lapins?
- Are different GA_3 programs required under rain covers to netting?
- How do high rates of GA_3 application at shuck fall or at green translucent stage influence firmness in Lapins.?
- What are the risks of using high rates of GA_3?
- Do higher rates increase susceptibility to cracking; and/or reduce return bud number or bud set (the following season)?

To understand the mechanistic level that may inform future industry decisions, the questions are:

- Does GA_3 delay changes in cell wall components including cellulose, hemicellulose and pectin?
- Does GA_3 alter hormone levels involved in fruit ripening?

KEY POINTS

- This project is investigating how GA_3 application timing and rate influence sweet cherry fruit quality under netting and rain covers.
- Meta-analysis of three years of field trials suggested an overall improvement of 20% in firmness relative to control with GA_3 application, and responses appear stronger in rain cover than netting system.
- However, return bloom can be reduced by up to 26% by high GA_3 applications (>100 ppm) especially if applied at shuckfall stage though yield was not assessed in this study.
- GA_3 applications can delay maturity: from 3 days for low rates (<50 ppm) and up to 14 days for higher rates (>100 ppm).
- Cracking incidence did not appear to increase with GA_3 application.

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What have we learnt after 3 years of field trials?

Over the past three years (2023 to 2026), we have tested a range of GA_3 programs in commercial sweet cherry orchards. Each season has varied in weather conditions, orchard systems and trial designs. For example, Table 3. is the 2025/2026 trial design.

By combining the results across all trials, we can now identify some clearer trends in how GA_3 affects fruit firmness, maturity and other quality traits (Table 1).

Table 1. Effect of GA_3 treatments on mean firmness relative to control (no GA_3) based on three years of field trials

	Mean firmness increase relative to control*
Overall GA3 effect across all three seasons	**20%**
Training system:	
KGB	16.7%
V-trellis	27%
Timing:	
Shuckfall only	9%
Translucent green only	22%
Shuckfall and translucent green	24%
Cover system:	
Netting	18%
Rain cover	23%
GA3 category	
Low (<50 ppm)	18%
Medium (51–100 ppm)	15%
High (101–160 ppm)	25%

*Firmness measured by Firmtech. Values based on meta-analysis of three years of data and are % increase relative to control and averaged across all GA_3 treatments

For fruit quality, the meta-analysis indicated GA_3 improved firmness, fruit size, dry matter and stem pull, but effects on TSS, colour and cracking were weaker or more variable (Table 2).

Table 2. Effect of GA_3 treatments on fruit quality relative to control treatments (no GA_3) based on three years of field trials

Fruit quality	Approx. GA_3 effect relative to control
TSS	10%
Dry matter	18%
Fresh weight	10%
Diameter	3-4%
Colour	0-1.9%

*Values based on meta-analysis of three years of data and are % increase relative to control and averaged across all GA_3 treatments

These trials confirmed that high applications of GA_3 can delay maturity by up to 14 days.

Table 3. Summary of GA_3 treatments for the 2025/2026 field trial*

Treatment	Timing of application	GA3 rate (ppm or g/ha)
Low applied at translucent stage	1st: Translucent green	22 ppm or 50 g/ha
	2nd: Translucent green (7-10 days later)	22 ppm or 50 g/ha
	2 applications	**44 ppm or 100 g/ha**
Medium applied at translucent stage	1st: Translucent green	44 ppm or 100 g/ha
	2nd: Translucent green (7-10 days later)	44 ppm or 100 g/ha
	2 applications	**88 ppm or 200 g/ha**
High applied at translucent stage	1st: Translucent green	66 ppm or 150 g/ha
	2nd: Translucent green (7-10 days later)	66 ppm or 150 g/ha
	2 applications	**132 ppm or 300 g/ha**
Medium applied at shuckfall	**1st: Applied at shuck-fall**	44 ppm or 100 g/ha
	2nd: Applied at Translucent green	44 ppm or 100 g/ha
		88 ppm or 200 g/ha
Control	**2 applications of water**	**0 ppm or 0 g/ha**

*Disclaimer: Please note the GA_3 concentrations tested in the field trials are not recommendations.

Any side effects of high GA_3 applications?

- The effect of high rates of GA_3 on cracking was variable but across the three seasons, cracking incidence was similar to the untreated controls.
- Analysis of two seasons of data suggest that return bloom can be significantly reduced (26%) when high rates of GA_3 (> 80 ppm) are applied at shuckfall stage, while there is a moderate reduction of up to 12% for low rates of GA_3 (30-44 ppm) applied at translucent stage..

Future work

- A PhD and Honours projects have commenced investigating how GA_3 influences fruit ripening, cell wall structure and hormone activity during fruit development. This will help explain why some GA_3 programs improve firmness more consistently than others.
- We will assess return bloom for the 2025/2026 season in September 2026.

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