Nutrition and Irrigation Interactions for a practical solution

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Fruit cracking in sweet cherries is an economically significant problem for growers world-wide, and is associated with late season rainfall. Building resilience into fruit from an early stage in order to withstand rapid excess water entry without cracking is important. Recent findings from a Tasmanian Institute of Agriculture project have broadened the understanding of the fruit cracking phenomenon (Measham *et al*. 2010). Economically significant large cracks in the flesh of cherry fruit increased with vascular uptake of water, positing a role of irrigation in the development of cracks. Given the structural role of calcium in plant cells, and that calcium is xylem mobile, higher volumes of irrigation may favour the uptake and incorporation of calcium into fruit cells, and thus enable fruit to better withstand rapid uptake of water through the vascular system.

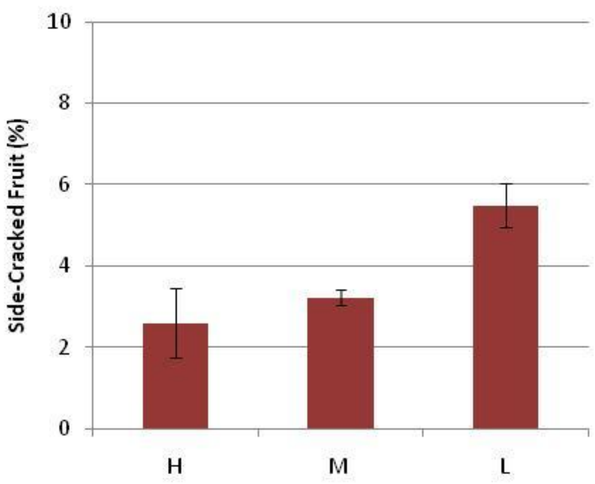

Figure 1. Percentage of side-cracked fruit from trees under High (H), Medium (M) and Low (L) Irrigation volumes. Error bars represent SEM (n=5) . A significant (P<0.05) difference was found between low and both medium and high treatments.

Table 1. Cracking index values of fruit from trees under High (H), Medium (M) and Low (L) Irrigation volumes in two consecutive seasons.

	2010/2011	2011/2012
High	7	15
Medium	7	14
Low	16	31

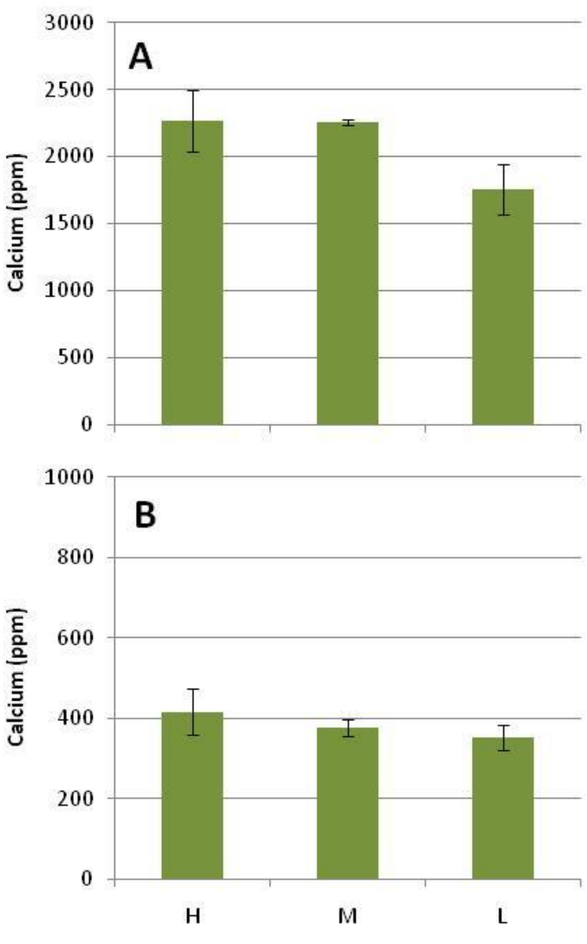

Figure 2. Whole fruit Calcium levels (ppm) from trees under High (H), Medium (M) and Low (L) Irrigation volumes at (A) Stage II of growth (28 DAFB) and (B) harvest (86DAFB). Error bars represent SEM (n=5)

Table 2. Firmness and skin puncture force of fruit from trees under High (H), Medium (M) and Low (L) Irrigation volumes . Values followed by the same letter are not significantly (P<0.05) different.

	Firmness (g/mm)	Skin puncture force (g)
High	279.14 a	423.33 a
Medium	265.16 b	396.67 b
Low	273.13 a	430.00 a

Calcium and irrigation treatments were applied to Variety 'Sylvia' in a commercial orchard in Tasmania, Australia in season 2011/12. Calcium was applied through fertigation on four occasions (total 11kg/Ha) during early fruit development. In addition irrigation treatments (high, medium and low volumes) were applied throughout the growing season in a randomised complete block design (three tree plots). Soil moisture was monitored at 15cm and 30 cm soil depths and fruit samples taken from each plot at Stage II of growth (28 days after full bloom) and at harvest (86 days after full bloom). *In situ* Cracking levels were assessed at harvest as per Measham *et al*. 2009, and cracking indices determined through the immersion method (Christensen 1972). Calcium levels of fruit were determined using ICP-MS, and fruit and skin properties determined using a GUSS texture analyser and a Firm Tech 2. Climate data was obtained from the Bureau of Meteorology, Australia.

There was a significant (P<0.05) difference in soil moisture levels between the different irrigation treatments at both depths (data not presented). Fruit from the low irrigation treatment exhibited significantly more side cracks; irrigation volume had a significant (P<0.05) effect on the percentage of side-cracked fruit (See Figure 1). The trial site received 33.4mm of rainfall in the three weeks, prior to harvest. Furthermore, over two consecutive years, this treatment resulted in fruit with a higher cracking index value (See Table 1)

Although the high irrigation treatment showed higher calcium levels in fruit at both Stage II and at harvest, the difference was not significant (See Figure 2). Fruit from both the high and low irrigation treatments showed significantly (P<0.05) higher firmness and skin puncture force properties (See table 2). There was no correlation between calcium levels and fruit properties (data not presented).

The finding that lower volumes of irrigation result in increased vascular induced fruit cracking in cherries highlights the complex nature of this phenomenon. Following a rainfall event, it may be that fruit from water deficient trees have lowered cuticular integrity and elasticity. Fruit under higher volumes were better able to withstand vascular influx of water, however calcium levels were not significantly different. There was a definite trend of increasing calcium with irrigation volume. This trend was apparent by Stage II of fruit growth, and continued over fruit development even though total concentration decreased with fruit growth. This highlights the importance of early calcium uptake. Fruit and skin properties were similar under both low and high irrigation volumes. The additional calcium may be contributing to increased firmness under high volumes of irrigation. Thus, increasing irrigation to increase size of fruit may not negatively impact on fruit quality when calcium is sufficient, while reducing the risk of cracking. These findings will be important for the development of future cherry fruit cracking management strategies, which may need to be considered early in fruit growth, rather than later in the season when cracking occurs.

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