

FORELLE PEARS: POST HARVEST MANIPULATIONS TO ENABLE VERSATILE MARKETING OF GOOD QUALITY FRUIT

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Forelle, an attractive bi-colour pear, has been grown in Germany since 1670. With such a long history of cultivation, one wonders why the harvesting and storage of this cultivar is still so challenging. Forelle pears grown in South Africa are prone to mealiness and astringency if not stored for at least 12 weeks at -0.5°C . This mandatory storage period can result in a gap between the last bicolour pears, such as Rosemarie and Flamingo, and the onset of Forelle in the market place. Loss of South African bicolour pear continuity may result in buyers switching to fruit from other offshore competitors, a move that often remains permanent, even when Forelle pears resume the bicolour supply in the market. This problem has been exacerbated by fruit arriving in Europe from South America which are available several weeks earlier than the first South African Forelle, mainly because fruit from these countries are packed and shipped immediately after harvest. Chilean export volumes of Forelle have seen a sharp year on year increase in volumes.

This communication provides an update on research conducted by [ExperiCo](#), on behalf of the South African Apple and Pear Producers Association. It is important to note that this laboratory research must be followed by semi-commercial trialling, prior to a phased in industry commercialization initiative.

Early Market Access

Over the years, many technologies have been tested in South Africa to try and reduce the mandatory 12 week cold storage period stipulated for Forelle. These have included ethylene and CO_2 treatments, and temperature manipulations at a range of different harvest maturities. While there have been various degrees of success in these trials, seasonal variations often resulted in inconclusive results that could not be risked on a commercial scale with such a high income earning cultivar. A technology that cannot guarantee a good eating quality fruit could also potentially damage later shipments of South African Forelle to the market.

In reality, there are only two ways to maintain the continuity of bicolour pear supply to the offshore market: first, to extend the storage duration of Rosemarie and Flamingo until Forelle is available or, second, to shorten the mandatory 12 week storage period of Forelle. SmartFreshSM, a powerful ethylene inhibitor, applied commercially to many deciduous crops to extend storage duration and improve shelf-life quality, has been shown to effectively extend the storage period of Rosemarie and Flamingo pears. SmartFreshSM, the trade name for the ethylene inhibitor, 1-methylcyclopropene (1-MCP), retards ripening by blocking ethylene receptor sites and reducing the action of the ripening hormone ethylene. After registration was granted for pears in 2006, SmartFreshSM has been successfully applied to Williams Bon Chretien, Comice, Rosemary, Abate Fatel, Packham's Triumph, and Forelle pears.

The biggest challenge with extending the cold storage duration of Rosemarie and Flamingo pears has become fruit availability. In recent years, many Flamingo orchards have been re-grafted because of inherent internal quality problems with the cultivar, and many Rosemary orchards have been reworked to make way for more successful cultivars, including Forelle.

Current research has therefore concentrated on ways to shorten the initial cold storage requirement of Forelle, and still maintain fruit of exceptional shelf life and eating quality. To this end, [ExperiCo](#) (Fruit Technology Solutions) have conducted trials over several seasons, aimed at developing a method to provide an acceptable eating quality Forelle pear that can be sold within 4 weeks of harvest.

Essentially, the proposed solution entails delaying harvest for 2 to 3 weeks after the normal commercial harvest, therefore allowing the fruit to approach an acceptable eating quality on the tree, with sugar levels in the region of 14%, and flesh firmness near 5.5 kg (Table 1). Fruit are then subjected to a SmartFreshSM application to delay fruit ripening, packed immediately, and cold stored for a minimum of 4 weeks at -0.5°C .

Table 1: Harvest maturity of Forelle pears harvested two to three weeks after the commercial harvest in the 2008 and 2009 growing seasons

Maturity Parameter	YEAR 1 02 April 2008	YEAR 2 08 April 2009
Starch Breakdown (%)	12.1	11.4
Flesh Firmness (kg)	5.5	5.5
Skin Ground Colour ¹	3.8	2.5
Red Skin Colour ¹	7.7	7.5
Total Soluble Sugars (%)	14.4	13.1
Acidity (%)	0.15	0.19

The 2009 season results, which verified the 2008 findings, indicated that even after only 4 (Figure 1) or 6 weeks cold storage (Figure 2), control fruit not subjected to SmartFreshSM, ripened during the shelf life period. The ripening of control fruit, however, resulted in unacceptable levels of mealiness (20%), compared to 5.6% in single strength SmartFreshSM treated fruit and only 2.5% in fruit from the double rate SmartFreshSM application (Figure 3). SmartFreshSM applied at a double rate, resulted in fruit that did not soften below 4 kg (Figures 1 and 2). Despite this, a taste panel rated the SmartFreshSM fruit as of exceptional eating quality, mainly because of the sweet, juicy and crisp nature of the pear. An extended shelf life of 14 days at 20°C indicated that SmartFreshSM treated fruit ripened further during this time period (Figure 2).

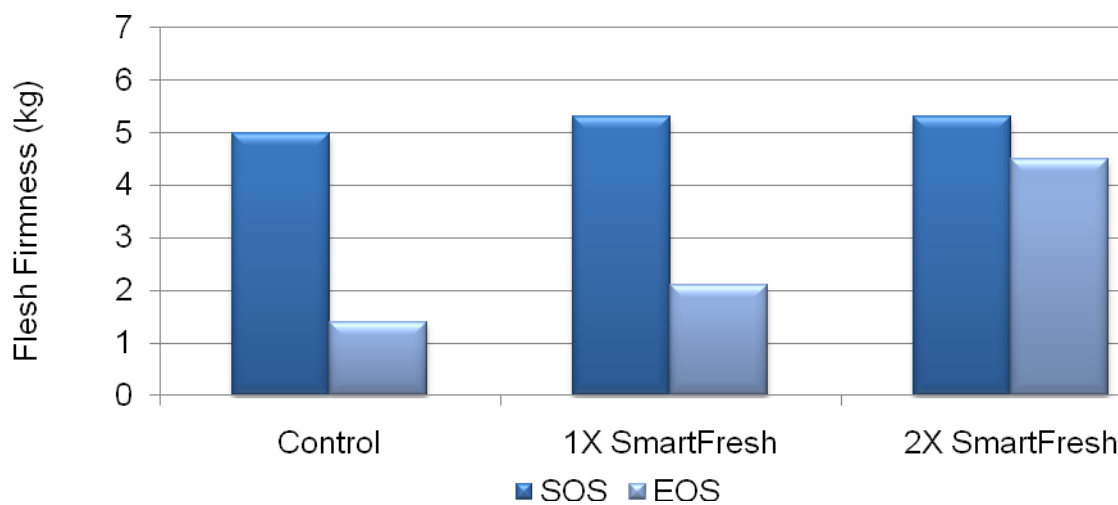


Figure 1: 2008 season Forelle pears stored under RA for 4 weeks at -0.5°C. Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated (Control), and examined at the end of cold storage (SOS) and again after a shelf life period 7 days at 20°C (EOS)

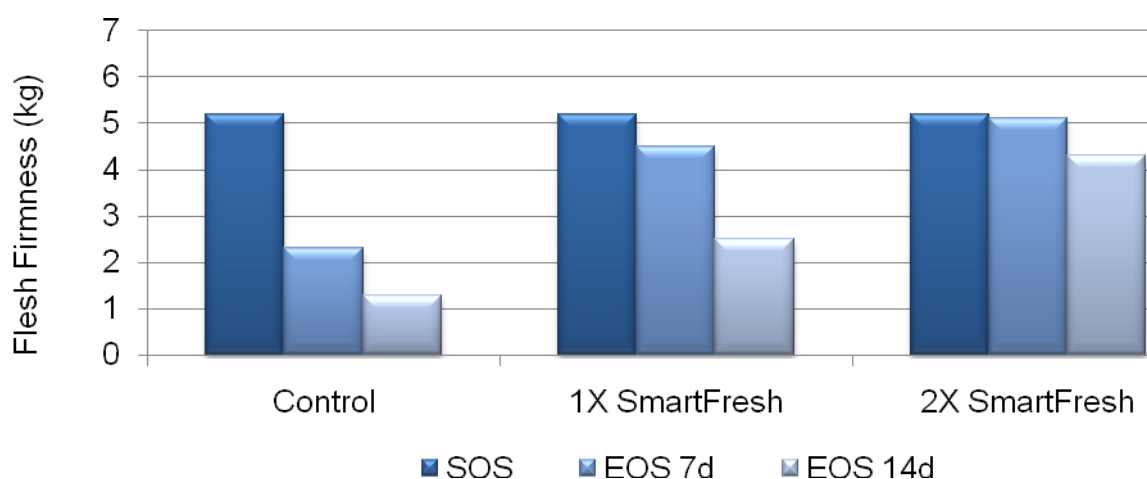


Figure 2: 2009 Season Forelle pears stored under RA for 6 weeks at -0.5°C. Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated (Control), and examined at the end of cold storage (SOS) and again after shelf life periods of 7 and 14 days at 20°C (EOS)

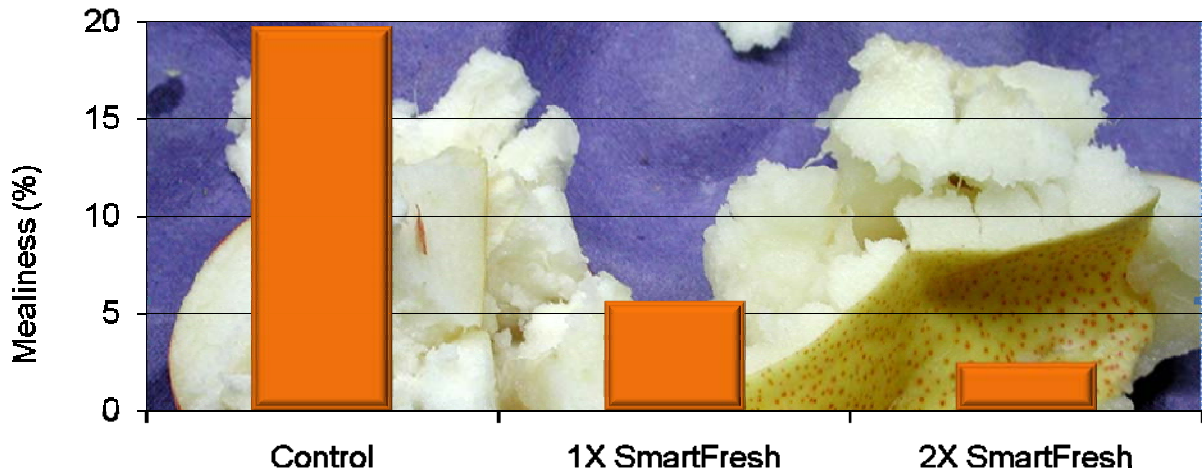


Figure 3: Mealiness levels in 2009 season Forelle pears stored under RA for 6 weeks at -0.5°C . Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated (Control), and examined at the end of cold storage and a shelf life period of 7 days at 20°C

Extended RA Storage

South Africa has experienced an increase in the plantings of Forelle in recent years. This has coincided with a decline in planted hectareage of several other cultivars including Bon Chretien, Packham's Triumph and Rosemarie (Figure 4). Forelle is now the second highest exported pear cultivar from South Africa, second only to Packham's Triumph. The larger volumes have resulted in a requirement for longer storage periods to alleviate distribution peaks in the offshore market. Since the Forelle harvesting window coincides with that of other pome fruit cultivars such as Golden Delicious and several red varieties of apples, space in controlled atmosphere (CA) storage may at times be limited or unavailable. Several studies to extend the duration of regular atmosphere (RA) cold storage using SmartFreshSM were therefore initiated – with very promising results.

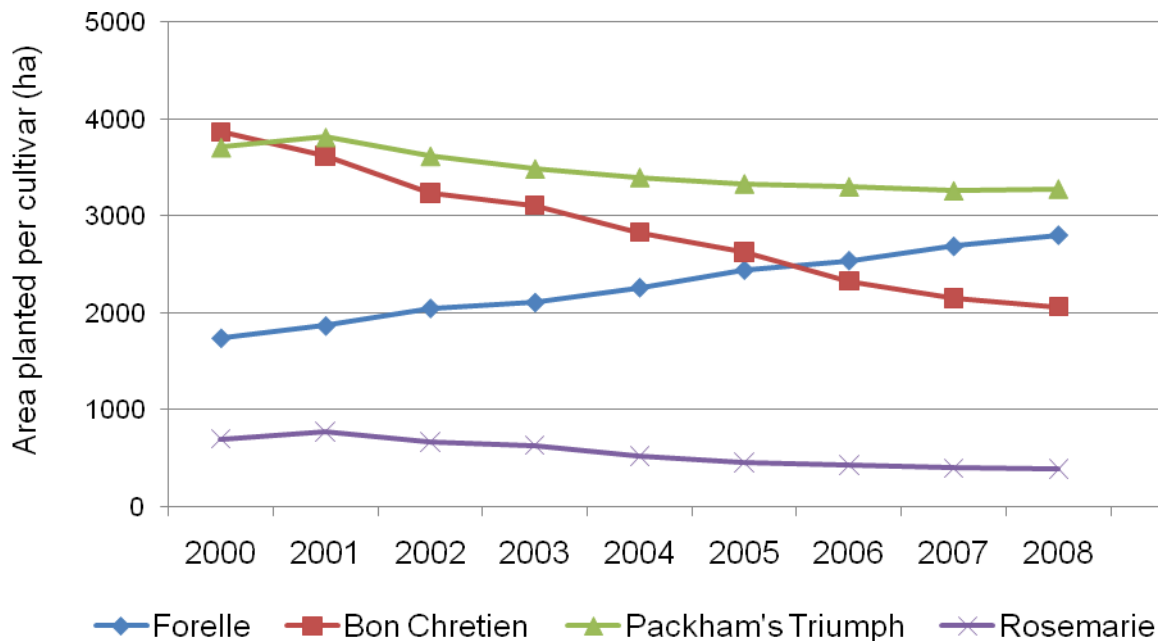


Figure 4: Area of Forelle, Bon Chretien, Packham's Triumph and Rosemarie planted in South Africa indicating trends from 2000 to 2008 (Data from Key Deciduous Fruit Statistics, Compiled by Optimal Agricultural Business Systems for the Deciduous Fruit Producers Trust)

Optimum maturity Forelle were harvested over two seasons, subjected to SmartFreshSM applications, and RA stored at -0.5°C for 25 weeks. The maturity of the fruit at time of harvest was within the recommended range for optimum fruit, with flesh firmness values of 5.9 kg and TSS levels of 13.2%. Skin ground colour was 2.1 according to the industry skin colour chart for green apples and pears and blush colour was 8.7 according to the chart P16 for Forelle pears. Titratable acidity levels were 0.25%.

After 25 weeks RA cold storage, before shelf life, the flesh firmness of all the fruit was higher than 4.5 kg, regardless of whether subjected to SmartFreshSM, or not (Figure 5). SmartFreshSM treated fruit were however firmer by almost 1 kg. After a shelf life period of 7 days at 20°C , control fruit ripened to 2.2 kg, compared to 4.1 kg in the single strength SmartFreshSM application and 4.7 kg in the double strength application. A sensory evaluation found that although the SmartFreshSM resulted in firmer, crisper fruit, they were of a preferred eating quality compared to control fruit – mainly because of high levels of mealiness in the untreated fruit (Figure 6). Extended storage under RA conditions did however result in increased in levels of decay on fruit in the cartons, a problem that was to some extent alleviated by SmartFreshSM (Figure 7). While, the higher SmartFreshSM concentration resulted in a reduction in decay levels from 19% to 6% when compared to control fruit, decay remains a potential threat for long term storage.

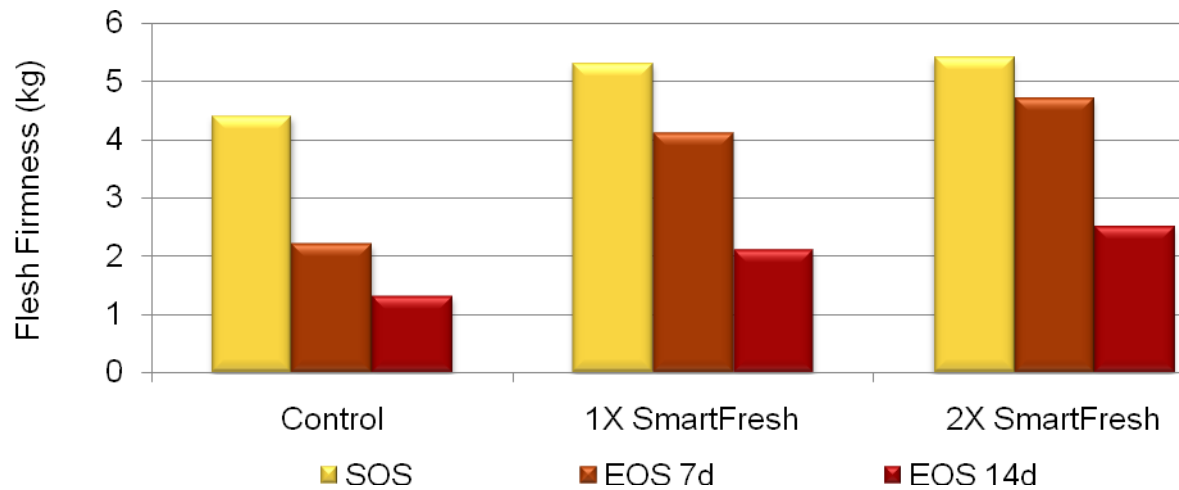


Figure 5: Forelle pears stored under RA for 25 weeks at -0.5°C . Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated (Control), and examined at the end of cold storage (SOS) and again after shelf life periods of 7 and 14 days at 20°C (EOS)

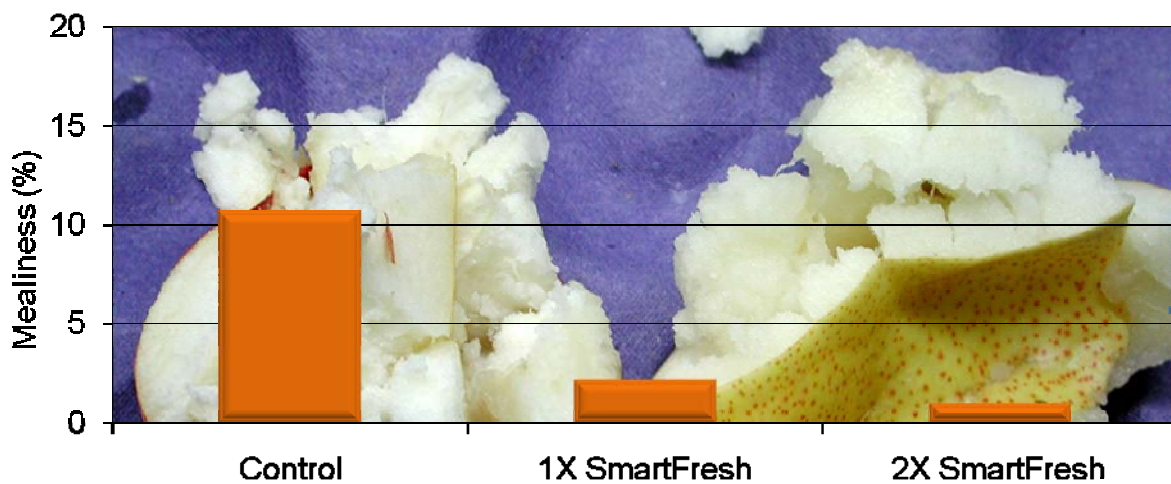


Figure 6: Mealiness levels in Forelle pears stored under RA for 25 weeks at -0.5°C . Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated (Control), and examined at the end of cold storage and a shelf life period of 7 days at 20°C

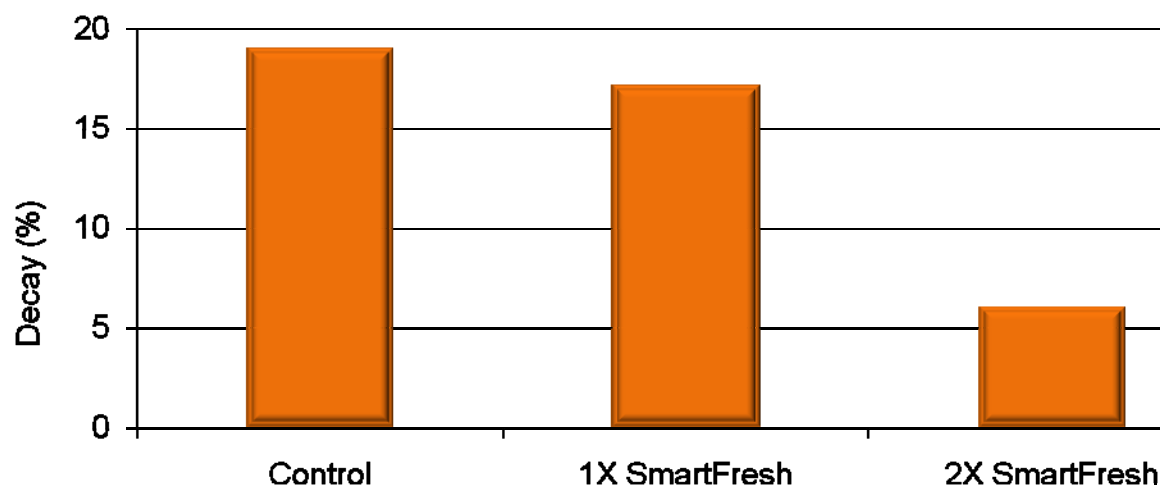


Figure 7: Decay levels in Forelle pears stored under RA for 25 weeks at -0.5°C . Fruit were either subjected to SmartFreshSM within 7 days of harvest, or left untreated, and examined at the end of cold storage and a shelf life period of 7 days at 20°C

The Way Forward

This study has demonstrated the potential use of SmartFreshSM, in combination with fruit maturity, to reduce the mandatory 12 week cold storage period of Forelle pears, and provide early market access for the cultivar. Allowing the fruit to ripen on the trees to an acceptable eating quality, and then halting the ripening with SmartFreshSM shortly after harvest, resulted in sweet, juicy and crispy fruit. No astringency was noted in any fruit in these trials. Delaying harvest for 2 to 3 weeks is not without its risks as fruit may experience a slight loss in red blush colour, and may be more prone to abscission in strong winds. For this reason, the orchards intended for short term storage would need to be selected and monitored carefully. Forelle handled as above could be in the market 5 weeks earlier than those subjected to the mandatory cold storage period, and therefore realise preferential financial returns. Initially markets which prefer a slightly crisper Forelle should be targeted.

The laboratory scale research conducted to date indicates that, subject to successful commercial trialling, which is scheduled to commence in 2011, major competitive benefits can be derived from this programme.

Application of SmartFreshSM to optimum fruit was also shown to effectively maintain fruit quality to up to 25 weeks RA cold storage. This could be very useful when CA facilities are not available. As in the case of any long term storage regime, decay may be an issue and will require careful phytosanitary management.